



Paying for the Hydrological Services of Mexico's Forests: analysis, negotiations and results

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Abstract:

Mexico faces both high deforestation rates and severe water scarcity problems. The Payment for Hydrological Environmental Services Program was designed by the federal government to pay participating forest owners for the benefits of watershed protection and aquifer recharge in those areas where commercial forestry is not currently competitive. It seeks to complement an array of forest policies that include development of community forestry firms and prohibitions of land use changes. Funding comes from a fee charged to federal water users, from which nearly \$18 million USD are earmarked for the payment of environmental services. Applicants are selected according to several criteria that include indicators of the value of water scarcity in the region. This paper describes the process of policy design, main actors and rules, and provides a preliminary evaluation. One of the main findings is that the program has paid where deforestation risk is low. The policy recommendation given is that selection criteria need to be modified so benefits to water users are maximized, otherwise the program will just be a partial redistribution of property rights over environmental services, increasing equity, but without bringing a Pareto improvement in overall welfare.

Key words:

Deforestation, payment for environmental services, watershed protection

Introduction

The problems of water scarcity and deforestation are two of the most important environmental challenges of Mexico. According to the National Water Commission (Comisión Nacional de Agua: CNA), two thirds of the 188 most important aquifers in the country suffer from overexploitation (Diario Oficial de la Federación, DOF: 2003).

On them, the average extraction for human uses is nearly twice the level of natural recharge, a straightforward path towards depletion. An additional 28% of them are in equilibrium, a fragile situation especially when consumption is projected to grow and natural recharge is threatened by deforestation. And deforestation in Mexico is certainly an issue by itself. Despite debates concerning methodologies, there is no doubt that even by the conservative estimate of a rate of 1.3% per year during the 1990s (Torres y Flores, 2001), Mexico has been losing its forests at an alarming rate.

According to its National Forest Inventory, Mexico has nearly 63 million hectares of forests, little more than half of them are temperate forests, while the rest are various kinds of tropical forests (Velásquez, et al. 2002). The main driver of deforestation has been land use changes to produce crops and feed cattle. Between 1993 and 2000, 3.1 million hectares of forests were transformed to agricultural uses and 5.1 million hectares had been converted into pasture (Velasquez, et al. 2002), an expansion of these land uses of 2.0% and 4.6% respectively.

The federal government has a policy strategy to deal with water scarcity, which consists mainly in the expansion of physical infrastructure, financed mainly from the general taxes, and complemented with the revenues obtained from industrial and service sector users, which pay the highest fees. For a couple of years now, municipalities have actually started to pay for the water delivered, however they still face timid water pricing schemes. The overexploitation problem resides mostly in the ineffective enforcement on the extraction limits for agricultural and ranching users, the zero pricing of water they face, and the extensive electricity subsidies given to this sector for pumping water out of the aquifers.

On the other hand, the Mexican forest policy consists of a series of programs that subsidize plantations and other commercial forestry, help build capacities among poor forest-owning communities so they can have their own community forestry firms, and directly invest in reforestation. The program for Payment of Hydrological Environmental Services (PSAH for its acronym in Spanish) seeks to complement these policies by becoming an interface between the forestry and water policy. It was designed to complement both policies by providing economic incentives to avoid deforestation in areas where water problems are severe, but where in the short or medium term there is no way in which commercial forestry could cover the opportunity cost of switching to agriculture or cattle ranching.

PSAH consists on direct payments to landowners with primary forest cover (forests in good state of conservation) given at the end of the year, once it has been proven that they were not deforested. Part of its innovative approach is that it is funded through an earmarked percentage of the federal fiscal revenue derived from water fees, creating a direct link between those who benefit from the environmental services and those who provide them.

ACTORS AND NEGOTIATIONS

The PSAH background analysis and design was carried out by a team of researchers from the Instituto Nacional de Ecología (INE), the Universidad Iberoamericana, the Centro de Estudios y Docencia Económica (CIDE), and the University of California at Berkeley, whose work started in mid 2001 and continued

until the program's launch in 2003. The Minister of the Environment accepted the basic idea at the end of 2001, and requested support from the World Bank's Environment Department, which channeled a donation from the government of Japan to finance data gathering and analysis, and whose staff provided advice and feedback throughout the different stages. The client agency was CONAFOR, the National Forestry Commission, which in time would become the one operating the program. Its General Director was a key player, first giving his agency's full support for the development of the idea, and latter providing the political backing it needed to pass through the Congress and the agricultural lobbying groups.

Certainly the main actors are the forest-owning communities and individuals, and the different water users: firms, cities, and citizens, with their respective organizations through which they influence public policy making. But before describing these actors in more detail, we will compare the basic elements of a Payment for Environmental Services program as they were initially proposed for Mexico with the final version that resulted from the process of political negotiation. This analysis will provide useful lessons on how political restrictions shape PES programs, and how these programs can best be sold to political actors in countries with similar conditions to the ones in Mexico.

Starting with a monopsony

The research team recognized that the PSAH could not become a fully competitive market because the ecosystem services provided to the watersheds and aquifers were indeed public goods on a regional scale. Government, either the federal,

state or municipal one, had to act as intermediary between those citizens and firms benefiting from clean, abundant water, with low natural disaster risks, and the owners of the forests. It would be a monopsonistic market, because there would be only one buyer, the government, which would choose which forest plots and types of actions would be rewarded.

At its current stage PSAH is a federal program, but the strategy proposed by INE includes its further development through a series of local markets, at the level of a municipality-microbasin. These would be complementary, allowing municipal governments to target areas of secondary importance to the federal program, but of primary interest for them.

Where to get the money from

The recommendation of the design team was to create a fiscal instrument that would provide financial resources for the program, preferably in the form of an environmental fee that would send the signal that those benefiting from environmental services would be contributing to maintain them. The federal water fee was the ideal candidate. Set every year by Congress, it could be raised and a percentage of it could be earmarked for the payment of environmental services. In this way those that used more water would be making larger contributions.

The piece of legislation that needed to be reformed was the Federal Rights Law (Ley Federal de Derechos, LFD). Because lakes, lagoons, aquifers and rivers in Mexico are considered national property and as such are managed by the federal government,

the LFD allows charging a fee for their use and maintenance as suppliers of water or repositories of wastewater (Cortina, 2002). It is the maintenance part that was the link to the payment of environmental services: these needed to be paid in order to maintain the supply and quality of water in those aquifers and rivers. The proposed modification of article 223 initially earmarked a specific share of water revenues for payments for forest environmental services, set at 2.5% of the annual revenues. Latter negotiations with SHCP left the earmarking in nominal terms: \$200 million Mexican pesos (\$18.2 million USD) per year.

It was certainly difficult to convince the National Water Commission (CNA) to accept the earmarking. They still perceive water scarcity mainly as a problem of investment in infrastructure, dismissing the role played by natural capital. On another front, the Ministry of Finance (SHCP) had to be convinced that the instrument was well designed and that it could be approved by Congress, because it was too different from existing fees; very few of them are earmarked. In general, Mexican fiscal policy opposes the earmarking of taxes. However, this is not longer true for the case for fees. Thanks to the successful negotiations of the Director General in charge of green issues in the Revenue section of SHCP, several environmental fees have been earmarked during the Fox administration, among them most notably the fees collected from the visits to Natural Protected Areas and those obtained from hunting wildlife in federal lands.

That said, staff from CNA and SHCP strongly opposed the earmarking of water fees for PSAH because there was a previous negotiation with municipalities that had promised to give them back 100% of what they paid for water to the federal

government, with the purpose of investing it in water supply infrastructure. Choosing between the two objectives was a difficult political decision to assess from a public policy perspective, because water supply infrastructure deficits are significant in Mexico and the matching-fund style program was delivering fee collection results never seen before in the country, but on the other hand it is was equally clear that there was a gap between this investment and the one on the natural capital that provides this water in the first place.

During the lobbying process with the Mexican Congress, several key members of the Environment, Natural Resources and Taxing Commissions became very supportive of the draft fiscal initiative of PSAH. So much that they even declared to opposing Finance Ministry officials that they would present the initiative as their own if SHCP did not. At the end, a compromise version was presented, which symbolically excluded municipalities from making the contribution, but the expected amount of 18.2 million USD was effectively earmarked from the water fees collected from other users.

It was the interest from different political parties stemming from their diverse agendas (environment, poverty reduction, water supply and forest conservation) which helped to build the necessary consensus to pass the initiative through the Review Commissions and at the end be approved by a large majority in the general session. This support was repeated when the LFD was approved again for 2004, and even more, the environmental commission recommended that the earmarked fee should rise to \$300 million pesos (27.3 million USD).

Where to keep the money

The PSAH was designed to send a medium term signal for the protection of forests, in this case 5 years, after which either a) the forest owners are expected to be able to undertake commercial forestry, b) the local government picks up the tab, or c) there is a renewal of the participation in the federal program. For that objective, the earmarking of the water fees was not enough; the legislation could be pulled out in any given year. The solution was to create a trust fund, the Fondo Forestal Mexicano, which would act as a commitment device to ensure participants that the resources that would pay them for the following 5 years were already set aside. Each year the earmarked fiscal revenues would be deposited into the fund. And each year the program would sign on only one fifth of the total hectares it could pay with that year's budget, keeping the other four fifths in the trust fund as a signal to participants that their money for the next four years was already there, waiting for them to fulfill their obligations.

Information about the Hidrological Environmental Services of Forests in Mexico

The relationship between forests and water flows is complex and requires rigorous studies to obtain credible measurements. Despite the little information available for Mexico, among the public, civil society organizations and government officials, there is a strong perception that forests do indeed play an important role in protecting water resources. Among the scientific work done in the country, Garcia Coll (2002) highlights the role that cloud mountain forests play in providing superficial water flows during the dry season in Veracruz's watersheds. Ana Burgos (1999) also finds evidence of an environmental service provided in this case by dry tropical forests:

that of reducing the risk of floods during storms in western Jalisco. Finally, the work of Carrillo (2002) shows that the Sierra Gorda's forests are fundamental for water recharge in the aquifers supplying the cities of Queretaro and San Juan del Rio. Although information regarding the relationship between forests and water in Mexico is still incomplete, the adoption of a precautionary principle approach (OECD: 2001) was motivation enough to start with the program. The payments of PSAH are linked to maintaining forest cover, as if buying the option of keeping whatever environmental service related to water they are providing.

WHOSE FORESTS RECEIVE THE PAYMENT, AND FOR WHAT

Passing the fiscal reform was only a first step, attending the demand side of the environmental services. The actual incentives given to forest producers, the supply side, are defined in the Operating Rules of the program (Reglas de Operación, or RdOp). These are detailed in the second part of this paper before looking into the results of the first two years of operation.

It is important to note that, while the original design of the Operating Rules had been prepared and discussed with CONAFOR, and included consultation with NGOs and communities, at this point new actors enter the process. Successful negotiations by the agricultural lobby at the beginning of the Fox administration make it obligatory that all federal subsidy programs in Mexico are reviewed and approved by the agricultural lobby representatives. Their influence is not absolute, the federal agencies' objectives still have the strongest say, but they do shape the final rules, as will be seen in each of the items that follow.

Paying to individuals or communities?

A particular feature of forests in Mexico is that almost four fifths of them are owned as common property by Ejidos and Comunidades, a particular Mexican institution where groups of peasants own land in a combination of private and common property. This ownership structure has a positive influence because community interests are taken into account for decisions of use of resources, but it also has the potential problem of collective action. Several empirical studies in Mexico (McCarthy, et al.: 2001; Muñoz, et al.: 2003; Alix, et al.:2004) have pointed out that high cooperation costs increase the probability that a particular ejido or comunidad will choose individual activities or individual tenure over collective ones. This is a problem for forests, whose sustainable use is generally done as common property, while the land uses that compete with it, cattle ranching and agriculture, can more easily be done in individual terms.

The individual-collective decision framework made us consider two options for the types of payments that PSAH would give in Ejidos. In the first one, payments were to be given directly to individual owners in proportion to the percentage of rights over the benefits from the commons stated in their land title. This would have the advantage of directly compensating households for bearing the costs of limiting timber and firewood extraction, as well as their restraint in expanding the agricultural frontier over the forests. In the second option, payments would to be given to the entire collective through their representative and executive body called the Comisariado Ejidal or Comisariado de Bienes Comunales. In this case, the entire Ejido Assembly would

decide what to do with the resources, either directly or through the guidelines given to their Comisariado. The second option was chosen by CONAFOR under the argument that it had more legal support the idea that the owner of the forest is the Ejido, not the individuals.

Paying those that comply with regulation...

The Mexican government pursues a strategy to reduce deforestation that combines two elements: direct regulation that prohibits land use changes, and strategic support for sustainable forestry activities. The three main direct regulation instruments are: 1) the need to present an Environmental Impact Assessment to obtain an authorization for land use changes, 2) the need present a sustainable forestry management plan that includes extraction limits and fragile areas conservation before initiating any timber extraction operations, and 3) the tougher requirements and additional restrictions imposed on landowners if the forest is within a Natural Protected Area (ANP). That said, the vast majority of deforestation has occurred without authorization, so in a sense the PSAH is paying to give incentives to forest owners to avoid doing something that is considered illegal.

...because for some complying means increasing poverty.

The reason for this apparently surrealistic policy objective is that without the option of having a payment for environmental services program Mexico faces a public policy dilemma. When regulations that prohibit land use change are effectively applied, deforestation rates decreases. But that means that in forests of low commercial value,

such enforcement is actually eliminating income generation opportunities for its owners. If forest owners are poor then we have protected the environment but at the cost of increasing poverty. The trade-off is between poverty reduction and environmental protection, between local and global benefits, and between present and future generations.

In Mexico EIA assessments are in real terms limited to the more formal and large-scale projects associated with tourism development, infrastructure, industrial projects, high value agriculture and livestock, and some urban development. Small scale land use changes are outside the government's enforcement capacity. In this context, programs for the payment of environmental services are the necessary complement to existing land use change prohibition policies and sustainable forestry management incentive programs.

The Prodigal Son dilemma

One of the most controversial policy objectives was the exclusion from PSAH of those forest owners who had already a sustainable timber operation. The logic behind it was that they already had income flowing in from the forests and were less likely to deforest. Money would be better spent on those communities that still were generating little or no income from their forests, and thus more tempted to change their land use. This objective was strongly challenged by the agricultural lobbying groups discussing the PSAH rules, composed mainly of forest owners represent timber or coffee **producers**. As expected, their lobbying efforts were aimed at focusing payments to communities that had already timber operations or shade-grown coffee plantations,

arguing that who else deserved the payments more than them, who had for years been more responsible and responsive to government calls to keep their forests and use them in a sustainable way. They resented that the privilege of payments was to be directed to those who had failed to do what they had labored so much to obtain.

INE and CONAFOR strongly resisted these pressures; it was a core objective of the program to benefit those who were more at risk from land use changes, who are the ones not obtaining income from their forests. It was clear for these agencies that non-commercial forest owners' interests were not being represented by the lobby representatives reviewing the forest programs. Non-forestry communities represent more than 70% of all forests, and are not as well organized as timber producers, thus lacking the lobbying power to countervail the producers' groups. The Mexican government took a firm position on their behalf at the beginning of the negotiations. But in the end it had to compromise and allow some restricted PSAH payments in timber production areas. These can be done only on conservation areas or those under lengthy rotation cycles, and up to a maximum of 400 hectares, instead of the 2,000 hectares limit reserved for the rest of the communities.

Commercial forests are not left without support. They are eligible to receive several times the PSAH budget in direct subsidies from the technical support program PRODEFOR, the plantations program PRODEPLAN, and the capacity building program PROCYMAF, and over a much smaller area. Over the past two decades, both environmental and community organizations have focused on communities that could actually start their own forestry firms, which is a clear and valuable objective, but while the message to the public has been that all forests should have sustainable and profitable

timber operations in due time, this goal is not realistic. PSAH was designed to cover the gap for those forests not able to have profitable forestry in the short and medium term, but where hydrological services are important.

ELEGIBILITY

One of the public policy criteria used in designing the PSAH program was to give taxpayers the highest value of environmental services for their contributions. This meant for us that initial payments should target forests which are at higher risk of deforestation, are more important for water, and which have the lowest but positive opportunity cost. The target is then well preserved forests, not denying that other ecosystems and agricultural lands also provide environmental services, but focusing on the former. This still leaves a very large area under forests in Mexico, with the restriction of limited funds. Pass/fail criteria were incorporated into the rules of operation of the program to narrow down even more the target areas. These are shown on Figure 1, and explained in detail below.

Paying forests that are important for water

The PSAH program's operating rules state that eligible areas needed to be located either in the recharge area of an overexploited aquifer, in a watershed with high water scarcity, or where hydrological natural disasters are more frequent. It was relatively simple to provide an indicator about overexploited aquifers. The National Water Commission had just published in the Federation's Official Gazette (Diario Oficial de la Federación, DOF: 2003) a note specifying geographical coordinates for

188 aquifers and their degree of overexploitation. This indicator was used in the 2004 map of eligibility that CONAFOR used as a general criterion to accept or reject proposals, and was perceived as objective and fair.

We had more problems with the indicators of general water scarcity and vulnerability to natural disasters. On the one hand CONAFOR in 2003 was reluctant to introduce very specific definitions of eligibility because they had doubts about how much participation there was going to be. On the other hand the agency was worried that the official indicator for water scarcity, the zonas de disponibilidad from LFD, had its highest scarcity zones concentrated in just a few States. Putting as a prerequisite that participating forests be located in them would limit the scope of the program failing to send the signal that it truly was a national program. Additionally, the National Disaster Prevention Center (CENAPRED) had not yet produced a map of natural disaster risk that could be used to clearly define priorities¹.

As a result, both of these policy priorities: water scarcity and natural disaster areas were left without clear indicators. In retrospect it was a bad decision. In 2003 it meant receiving many applications supported by local documents of more or less scientific value, claiming that a particular forest tract was linked to scarcity or disaster areas. In 2004, when this documentation was considered invalid, it meant that the scarcity and risk criteria were not integrated into the eligible areas defined by CONAFOR. To correct the mistake, INE has suggested the incorporation of the specific indicators mentioned into the 2005 or 2006 Rules of Operation, not as prerequisites, but as components of a grading system to evaluate the applications.

¹ Such map is now available at: CENAPRED (2004)

A final issue regarding hydrological priorities was the difference between types of forests. A Blue Ribbon Committee was assembled with scientists from Mexico and abroad to help us in classifying forests according to their importance for aquifers and watersheds. Their recommendation put cloudforests in first place for their role in capturing water from fog in the dry season. Dry tropical forests were a potential second place for their role in reducing flood damage in the lower watershed, but there was not enough consensus, so they were placed together with the rest of the forests in a second group, pending more research. Because all types of forests could provide hydrological services, we decided that the privileged place of cloudforests should be reflected in the price paid, not in the eligibility rules, as is discussed later in this section.

Paying forests which are more likely to have future clients

A key policy objective is to link the federal PSAH program with future local systems. The Rules of Operation capture this intention by establishing that the participating forests are in a location that satisfies at least one of these three criteria: a) in the area of influence of a population center of more than 5 thousand inhabitants, b) inside a Natural Protected Area, or c) in a mountain belonging to the National Priority Mountain Program.

The sufficiently large population center option was opened because of our assessment of the capacity of a local government to generate enough revenue to make an environmental fee collection worthwhile and develop their own PSAH program. We will be including smaller towns in the 2005 and 2006 effort of developing local PSAH

programs. If there is evidence that indeed they are capable of launching their own systems, we will recommend this bar to be lowered in the federal program.

The “priority list” mountains and Natural Protected Areas criteria were the result of internal lobbying by the officials holding these agendas. The mountains were incorporated because 2002 had been declared the International Year of the Mountains by the UN, and Mexico had done the task of selecting a list of 60 priority ones through a multicriteria analysis. However in 2003 the strategic support promised for these mountains was still an unfunded mandate, so their inclusion into the PSAH program provided CONAFOR with a way to fund them. It is not necessarily a miss for hydrological services; in the correct interpretation of the rules they still have to comply with the criterion of facing water problems, and many of these mountains are indeed facing problems in their lower watershed.

The Natural Protected Areas criterion on the other hand was not included until the 2004 Rules of Operation. The success of the program the previous year had attracted the attention of the agency in charge, which saw these payments as a way to ease the pain of strongly enforcing their regulations over poor communities. Their inclusion was justified for the watershed protection reason, despite not all of them having real possibilities of a local government joining in the near future. In meetings with NGOs, some of them praise that the PSAH is protecting two types of environmental service for the price of one. And in terms of implementation, the staff from the Natural Protected Areas Commission has been very active and effective in promoting and implementing the program.

Paying for forests in good state of conservation

It was and still is intensely discussed if the program should also invest in degraded forests located in important areas of the watershed, to recuperate their environmental services. The recommendation of the research team was that it should not, because degraded areas can be attended by the existing reforestation program, with abundant funding, while it would weaken the statement that the earmarked water fee was used to pay for actual environmental services delivered.

CHOOSING THE AMOUNT TO PAY

A Walrasian auctioneer for Environmental Services

There are two approaches on how much to pay for environmental services. One of them is to pay the value for the consumer of those services. The other one is to pay for the opportunity cost of providing them. Because there was so little information about the value of the environmental service, the design team recommendation was to pay for the opportunity cost of not deforesting on the areas considered to be of highest hydrological value.

The research team recommended an inverse auction system as the first best option to obtain information about the opportunity cost. This would maximize the area protected given a budget, either paying a single price or using the government's discriminating monopsonist power. However, the mechanism was too innovative for the Mexican officials and regulation. Either because of uncertainty, risk aversion, higher administrative costs, or true regulatory requirements, the program was required instead to define a small set of prices beforehand. A two tiered payment scheme was chosen, differentiating by type of forest only, with cloud forests the upper tier and the rest of the forests in the second one.

The voluntary nature of the program constitutes a self-selection mechanism that would provide additional information on the true opportunity costs, information that could be used in different rounds of the program. Some of this information will be presented in the next section, when the 2003 and 2004 outcomes are analyzed.

After choosing a fixed payment, two circumstances can arise; the first one is that on priority areas some of the opportunity costs of keeping the forest might be zero; the second one is that some of the opportunity costs in these areas might be higher than the amount paid. Both circumstances deserve some attention.

An opportunity cost of zero means that forests would be preserved independently of governmental intervention, mainly because agriculture and grazing are not profitable at all, or less profitable than forest activities. Their owners would clearly be interested in participating in PSAH, since environmental services payments are received without actually sacrificing anything. It would be fair situation, in a sense establishing property rights over environmental services in favor of the owner of the forest. However, from the government and society's point of view, it would not be the best deal, wasting the opportunity to take full advantage of the available funds and the monopsonistic position. When the opportunity cost is zero, no conduct is being modified by the incentives; environmental services would have been provided for free. There is a need to find an instrument that would help sorting out cases like this.

On the other side of the spectrum, the self-selection process implies that forests that would yield a higher income as agriculture, livestock, industrial or urban projects than the amount paid will choose not to participate in the program. If the amount paid is equal or less than the environmental benefits, then society is better off by having those forests not joining the program and instead asking for a formal authorization of changing land use. This situation presents no problem. If on the other hand, the true environmental benefits are higher than both the opportunity costs and the amount paid,

then having a single price is limiting a welfare improving transaction. The tradeoff would be to increase the price, get that forest plot to join the program, but having to pay more to the rest of the plots with lower opportunity costs.

Empirical Estimation of Opportunity Costs, proposed price, and negotiations

A team from INE studied the profits obtained from agriculture and livestock operations near forested areas as an input to the design of the program (Jaramillo: 2002). The objective was to estimate the distribution of the opportunity costs of keeping a forest. The data was obtained from the main commercial agricultural credit organization of the government, the Fideicomisos Instituidos en Relación a la Agricultura (FIRA). These profits most certainly overestimate those in the candidate areas of PSAH, because FIRA's clients tend to be the high end of agricultural production, but they were useful as an upper-limit reference for policy analysis.

The results obtained show average profits of \$37 USD per hectare per year from growing corn. Livestock production yielded \$66 USD per hectare annually on average. The estimated distribution showed that with a payment a \$200 pesos per hectare (\$18.2 USD) more than two fifths of forest owners that opened cornfields on forested land would not have done so. The same payment would have stopped 12% of pasture owners from deforesting. Table 1 shows these point estimates.

INE and CONAFOR proposed initially a payment scheme of \$200 pesos (\$18.2 USD) per hectare to owners of all types of forests except for cloudforests, which would be paid \$300 pesos per hectare (\$27.3 USD) due to their higher value in terms of hydrological services. This amount would ensure that at least a fifth of the candidates

in the areas more likely to switch to agriculture would be interested in joining the program. The payment would be done each year, after verifying that no land use change occurred, and would be renewed for 5 years if the conditions were fulfilled.

During the approval process of the Rules of Operation, rural organizations put pressure for a higher payment. Their negotiation position was puzzling for us at the beginning, because with a fixed budget it meant less people would receive the benefits of the program. Later it became clear that the organizations' leaders wanted higher payments, but focused on the areas where they had their constituency. After lengthy negotiations, where CONAFOR took a tough stance, the compromise and current status is to pay \$300 pesos per hectare (\$27.3 USD) to all forest except cloudforests, which receive \$400 pesos per hectare (\$36.4 USD).

Consequences of breaching the contract

The conditions of the PSAH program are simple and at the same time aim to provide well defined incentives to conserve and protect the forest. In order to perform as a true economic instrument the program must have clear negative consequences for noncompliance. In this case these are of two types. If there was a purposeful land use change, then there is no payment at the end of the year, no matter how small the change was. If deforestation occurred for other reasons, for example because of a forest fire or timber theft, then the participating community is still responsible and does not get paid for what was lost, but it does get paid for whatever forest was successfully preserved. The only requirement is that the owner informs CONAFOR once the event happens.

This helps the agency monitor the threats to its priority forests, and can offer the support of other programs such as reforestation or the forest fire prevention training.

RESULTS FOR 2003 AND 2004

The launching of the PSAH program strongly attracted the attention of ejidos, comunidades and private owners. In 2003 more than 900 applications were received offering close to 600 thousand hectares. Only 271 forest owners were selected incorporating 127 thousand hectares into the program. In 2004, thanks to Congress support, the budget was increased in 50%. The number of applicants grew to 960, of which 352 new participants were chosen with approximately 180 thousand hectares.

During both selection processes a large number of applications were discarded for missing part of the information required. This is relevant because the main omissions were 1) the Assembly Record needed from common property forests, -a signal of transaction costs for Ejidos-, and 2) the property maps coming either from the private property registry or the national agrarian registry, a signal that land registry could be a relevant barrier to participation for a sector of the candidates.

The first lesson that can be drawn from the 2003 and 2004 PSAH experience is that the payments were set too high. The reception of nearly three times as many applications as participants could be accepted, is a signal that the opportunity costs of many is below the threshold fixed by the payment amount. This outcome had been predicted by INE because the estimation of the distribution of opportunity costs had shown a potential participation of between 20% and 40% of those offered the program.

The eligible area set in 2004 was nearly three million hectares, so the 600 hundred thousand hectares offered roughly corresponds to this estimation.

Given the fact that nothing could be done about the high prices in the negotiation phase, and any future recommendations to reduce it will probably not be successful, there is another course of action. Whenever there is an excess of supply and the price of a heterogeneous good cannot go down, then it could be possible to select and acquire only the best among those offered. The environmental services of the different forests are not a homogeneous good, and it is possible to differentiate according to the degree of water scarcity, other environmental services provided, or even additional characteristics like the level of poverty of owners. This was done in an ad-hoc manner in 2003 and 2004, choosing those plots that had more than one of the optional characteristics desired. The Technical Committees' recommendation in 2005 is to formalize this grading system, providing weights that correspond to the policy objective of the program.

By analyzing the patterns of those who were accepted into the program we observed several biases from what would have been an optimal targeting. What follows has the summary of our findings:

Water scarcity, Natural Protected Areas and Priority Mountains

Both in 2003 and 2004 there were interpretation problems when implementing the criteria of the rules of operation. The first year suffered an ad-hoc and heterogeneous justification of watershed problems, understandable situation for being a

trial year rushed by the lengthy negotiations. The second year, it seems that instead of combining the 2 requisites of water problems and future clients, the implementing agency used them as interchangeable criteria. It is true that no evaluator has completed the analysis that includes medium-range recharge areas of aquifers and relevant watersheds for population centers with high water scarcity. Also, one could argue that almost any forest in Mexico is linked through one of the macro-watersheds to areas with water problems. However, a narrow interpretation presented in Tables 2 and 3 would suggest that most of PSAH resources went to natural protected areas or priority mountains, but not to areas which had water-related crisis.

With regards to the type of forests, the combined effect of a higher price per hectare and CONAFOR's highlighting its importance, made cloud forests have a larger than proportional share of applicants and accepted participants in the program compared to both temperate and tropical forests. While nationally cloud forests represent 3.4% of total forests, and 6.6% of the 2004 eligibility areas, these ecosystems represent nearly 12% of all the area receiving PSAH payments.

Targeting the poor

Because of the patterns followed by the Mexican land reform during the XX century, and the investment in infrastructure and industrial development during those years, areas that remain with large tracts of temperate and tropical forests are generally poor and have few public services. We used the 1998 National Population Council's indicator of marginalization to classify those population centers inside the Ejidos and Comunidades which had more than 100 hectares of forest, and found that indeed more

than 85% of were classified as having high and very high marginalization. Then we did the same for all population centers inside the communities participating in the PSAH program, and those that were closest to the private plots participating. The results are shown in Table 4.

A first and positive result is that, despite not being an explicit criterion, 72% and 83% of PSAH payments in 2003 and 2004 respectively went to forest whose population centers have high or very high marginalization. PSAH is a program that definitively benefits more the poor. That said, there is also a strong contrast between the relative participation of communities of high and very high marginalization. The former have a much smaller presence. We still have not tested whether this is due to a correlation with some other characteristic important in the selection process, in which case it would not be a problem, or it is due to a barrier in participation linked to poverty, for example, having less lobbying power with the regional implementation office or less capacity to formalize applications. If barriers indeed exist, then PSAH should be complemented with an outreach and support campaign to level the playing field for the poorest of communities to participate.

Effectiveness in reducing deforestation

By the first measure of its direct objective, PSAH was a success. Between 2003 and 2005, satellite images showed that less than 0.1% of the nearly 300 thousand hectares paid by the program was deforested. And those areas that were lost suffered from unintentional and very difficult to control forest fires, not to land use changes. In

comparison, deforestation loss for the country had previously been estimated in nearly 600 thousand hectares per year.

However, we want to strongly call the attention to the fact that the program's true effectiveness can still be improved. This vision of success in avoiding deforestation must be tempered by looking at the real baseline: what would have been the observed deforestation in the areas paid by the program if it had not existed. We know from our analysis that one weakness of the program's design was that it had no mechanism to filter out those plots with an opportunity cost of zero, and that rational forest owners would offer those areas first to the program. There was the risk that PSAH would end up having a large share of its participating forests from those that would not have been deforested in the first place. And that is what happened.

During 2004 INE built and estimated a spatial model of deforestation (Muñoz, et.al. 2004) using the evidence from the 1993/4 and 2000 forest inventories to assess the risk of future deforestation on currently existing forest areas. This econometric model found a basic pattern of deforestation in Mexico, where land use changes depended on the type of ecosystem being replaced, the climate, distance to population centers and road infrastructure, potential yields in agriculture, and poverty of the owners. All variables either indicators of the opportunity cost of the land or restrictions on the decision makers.

Using a geographical information system, a grid was constructed over the 1993/4 forests and changes in the pixels at the intersections were observed, comparing the outcome in 2000 to see if the forest had been degraded, was still there, or had been

changed into agriculture or pasture. This is why the dependent variable models was qualitative, and the models used were a probit and an ordered probit. The predicted probability for deforestation on remaining forests became our risk index.

Limitations on the predictive power of the model should be acknowledged. Economic growth and increasing trade liberalization in Mexico since 2000 have produced important changes in variables influencing forest opportunity costs. For example, corn's real prices have declined while agricultural wages have increased. Nevertheless, in absence of panel data, where time series of prices can be introduced explicitly in the model, this is the best baseline available.

To assess the risk of deforestation of plots participating in PSAH, first we assigned each hectare of forests in Mexico its predicted deforestation risk, sorting them from the lowest to the highest risk. These are divided in 5 equally sized groups, giving them a label presented in the first column of Table 5. We then classify the hectares participating in PSAH according to this same index, and compare how many of them fall into each category. The same thing is done to the 2004 eligible area set by CONAFOR.

The results confirm the hypothesis that those plots offered and chosen by the program were not the ones more at risk. In 2003, only 11% of the participating hectares were classified as having high or very high deforestation risk. It gets much better in the 2004 selection, when 28% of the hectares are in these two groups, clearly higher than what a random draw from the eligibility area would have been, but not yet what could be obtained from a grading system that would give a higher weight in the selection

process to those areas more at risk. If 20% of the 600 thousand hectares offered to the program in 2003 would have been high or very high risk forests, and they could have been identified and chosen, then almost all of the hectares receiving now the economic incentive would have been amongst those more likely to suffer deforestation. The program's true effectiveness in protecting environmental services would have been much higher.

Conclusions and Next Steps

The Mexican experience shows that it is possible to generate an economic instrument to collect fees from water users for paying the watershed environmental services of forests, especially when citizens are conscious of the severity of water problems. It also shows the benefit of having a trust fund to send a signal to participants that the program's payments will be there for their medium-term efforts to protect their forests.

There are two key design lessons. The first one is that it is difficult to set the right amount to pay. There will be political pressures to pay higher prices, and this will result in an excess supply of participants. However, if this happens, it opens the opportunity of selecting those plots which provide more valuable environmental services, and society still receives good value for its taxes or fees. The second lesson is that when no additional actions are asked for, only conservation, it is important to filter out those plots with zero opportunity cost. Those forests would be conserved anyway, and while positive in distributive terms, not selecting them out fails to maximize the area where deforestation is avoided.

To achieve a better targeting and efficiency, the Mexican PSAH Technical Committee has recommended that an explicit grading system for evaluating proposals is incorporated in the rules of operation; one which would help identify those areas more valuable for their environmental benefits, and where true modification of conduct would be achieved by the economic instrument. For the latter objective, the deforestation risk analysis and resulting index is a fundamental piece of information.

On the question of what should happen when time limited PES benefits expire there are two basic ideas. One of them is that the development of local PSAH programs should be encouraged, as well as the emergence of sustainable forestry operations should continue, as will be done in Mexico. However, from our point of view, if given those efforts there still are significant positive externalities on forests where commercial forestry would not happen soon, and where PES payment would make a difference, then PES payments should continue.

We are witnessing an exciting emergence of new PES systems in different countries, experimenting with different rules and sets of incentives. It is a blooming which will certainly yield a very important collective learning over the next decade. PES programs are not the panacea. They just are a new and valuable addition to the set of policies available to solve both deforestation and water related problems, one where market failures are corrected in a straightforward way and one which defines property rights over environmental services in favor of the owners of the forests.

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Tables

Table 1

Estimated percentage of farmers that obtained profits equal or lower than the proposed amount

Activity	Average net profits per year	annual payment per hectare	
		\$ 200 pesos (\$18.2 USD)	\$ 400 pesos (\$36.4 USD)
Agriculture	\$ 37 USD	21%	43%
Pastures	\$66 USD	12%	20%

Table 2

Distribution of PSAH (2003-2004) beneficiaries

Variables	Nation wide (surface)	Approved 2003	Approved 2004
Priority Mountains	3.8 %	63 %	46 %
Natural Protected Areas	8.9 %	22 %	27 %
Overexploited Aquifers	17.1 %	14 %	11 %
Private Property	29 %	10 %	8 %
Social Property	51.6 %	90 %	92 %

Table 3

Distribution by Overexploited aquifers

Overexploited aquifers

Type of Aquifer	Nationwide (surface)	Nationwide (population)	Hectares benefited by PSAH in 2003	Hectares benefited by PSAH in 2003
Extreme Overexploitation (+100% a +800%)	0.05 %	9.2%	0.02 %	0.00 %
Strong Overexploitation (+50% a +100%)	0.04 %	19.5%	0.00 %	0.00 %
Moderate Overexploitation (+5% a +50%)	18.6 %	14.5%	13.3 %	9.61 %
In Balance (- 5% a +5%)	2.9 %	11.3%	0.01 %	0.00 %
With expansion margin (< - 5%)	65.1 %	45.4%	78.7 %	85.04%
Without Information	13.4 %	0.1%	8.0 %	5.3 %
TOTAL	100.00 %	100.0 %	100.0 %	100.0 %

Table 4

Distribution by Marginalized Zones

Poverty

Marginality	PSAH 2003	PSAH 2004	National Total in Social Properties with >100 has of forest
	Hectares %	Hectares %	%
Very High	25.0	21.5	69.1
High	46.9	61.4	17.2
Medium	18.1	7.9	8.6
Low	7.9	5.7	3.3
Very Low	2.1	3.4	1.8
Total	100	100	100

Table 5

Distribution by Deforestation Risk

Index of deforestation risk (by quintiles)	Forest at national level	PSAH 2003		PSAH 2004		CONAFOR's Eligible Area	
	%	%	Ha	%	Ha	Ha	%
Very High	20%	4%	5,922	11%	18,550	404,549	12%
High	20%	7%	11,034	17%	28,529	198,762	6%
Medium	20%	17%	28,446	20%	34,953	613,763	18%
Low	20%	30%	50,046	30%	50,940	856,519	25%
Very Low	20%	42%	68,815	22%	37,133	1,350,704	39%
Total	100%	100%	164,263	100%	170,105	3,424,297	100%

Figure 1

Rules of Operation for PSAH (2003-2004)

