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The problems of water scarcity and deforestation are two of the most important environmental challenges of Mexico. Aquifer overexploitation, water quality degradation and high deforestation rates put at risk the availability of natural capital for future economic growth, endangering the capacity of future generations to achieve a level of welfare equal or better to of the present generation. These challenges are being met with efforts by the government and civil society. The federal government has a water policy and a forest policy. The program which we will be discussing in this document is an important interface between both.

The policy strategy dealing with forests has a series of programs that support commercial forestry, build capacities among poor forest-owning communities, and investing in reforestation. The Payments for Hydrological Environmental Services Program (PSAH, its acronym in Spanish) was designed to complement these initiatives 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. 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.

FORESTS, DEFORESTATION AND INSTITUTIONS

The significant biodiversity Mexico possesses includes its coniferous forests, cloudforests, rainforests and different types of dry tropical forests, in occasions very close to each other due to the rugged terrain and irregular topography, creating very rich transition zones. In the 2000 National Forest Inventory, Mexico appears with nearly 30.1 million hectares of tropical forests and 32.8 million hectares of temperate forests (Velasquez, et al. 2002). And they are everywhere throughout the country. Although Mexico's northern states are predominantly arid, large extensions of forests are found in their high mountainous areas. The central states, despite their high population densities, still have significant temperate forests in the areas that are far from the road networks, serving as refuges of the regions endangered and threatened species. Rain forests are concentrated mainly in the poorer southern and southeastern states, while dry tropical forests prevail in most of the hills and plains that meet the Pacific Ocean.

Deforestation

The other side of the immense natural wealth in Mexican forests is its alarming process of deforestation, probably the most extensive among inter-tropical countries after Brazil, and one of the most rapid processes observed. Despite debates concerning methodologies, there is no doubt that even by using the conservative estimate of the rate of deforestation of 1.3% per year the country is loosing its natural resources at a rate experienced only by the countries in worst situation (Torres y Flores, 2001). Out of the

70 million hectares of forest and tropical forest that Mexico had in 1993, by the year 2000, 3.1 million hectares had been transformed to agricultural uses and 5.1 million hectares had been converted into pasture (Velasquez, et al. 2002). In contrast, only 1.7 million hectares of agricultural land, pasture ground or degraded forest had experienced natural or human assisted recovery, and could be re-classified again in 2000 as being in good state of conservation.

Deforestation does not occur totally at random. It follows specific patterns depending on the type of ecosystem, climate, distance to population centers and road infrastructure. Potential yields in the alternative activity, and poverty of the owners are also important (Muñoz, et.al. 2004). Because of these conditions, some ecosystems were hit particularly hard during the 1990s, for example, tropical forests and wetlands were lost at a rate almost doubling that of temperate forests. Certainly, the causes of deforestation in Mexico are multiple. They include natural hazards such as pests and fires. However the main driving force appears to be intentional land use changes by the individual or collective land owners. Due to the fact that they generate higher rents, agriculture expanded over natural areas at a rate of 2% per year, while pastures grew at an annual rate of 4.6% between 1993 and 2000. Illegal logging is also a cause of concern both because it degrades the forests and because this damage lowers the yields and increases the risk that rightful forest owners take into account when deciding over the alternative uses of their land.

Land tenure and forests in Mexico

All payment for environmental services programs must take into account the structure of incentives imbedded in the land tenure arrangements of the target ecosystem to effectively achieve its conservation goals. Mexico has a special land tenure structure, resulting from more than seven decades of agrarian reform. Large private estates (known as *latifundios*) and land belonging to the government were redistributed among organized groups of peasants in an institutional arrangement involving both individual plots and common property areas (*uso común*). This type of property are known as either *Ejidos*, which include more individual plots, and *Comunidades Agrarias*, which are mainly common property. Reforms to the Agrarian Law in 1992, granted *ejido* members more clearly defined[1] individual property rights for their plots, making them almost private property. Because it is under common property that the majority of forests are owned, their land tenure rules have important implications for the design of PSAH.

Common property implies a potential problem of collective action. This does not mean that all forests in Mexico face the "tragedy of the commons", but it certainly makes it possible that the costly cooperation creates departures from what would be optimal decisions. Several studies in Mexico (Mc Carthy, et al.: 2001; Muñoz, et al.:

[1] For a detailed description of these forms of tenure and its recent evolution see: de Janvry, Alain, Gustavo Cordillo, Jean-Phillipe Platteau, and Elisabeth Sadoulet. "Access to Land and Land Policy Reform," in de Janvry et al. (eds.) *Access to Land, Rural Poverty, and Public Action*; Oxford University Press, 2001.

Muñoz-Piña Carlos, Alain de Janvry, and Elisabeth Sadoulet; "Re-Crafting Rights over Common Property Resources in Mexcio," in *Economic Development and Cultural Change*, 2 (1): 129-158 (2003)

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 tenure over collective ones, a problem for forests which tend to be associated with the latter options.

The individual-collective decision framework made us consider two options for the types of payments that PSAH would give. 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. It 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 owner of the forest is the *Ejido*, not the individuals. However it also had a political balance consideration, because the *Ejido* representatives are more involved in regional and national politics than the average members and the agency would benefit from favoring them. This leaves out –at least initially- the individual compensations, which we believe crucial. A series of review studies are currently being undertaken which will analyze the distribution and use of funds, to see how many ejidos and comunidades nevertheless chose to distribute resources to individuals, and how many chose to invest in different types of public goods.

Poverty

One of the main features of forests in Mexico is that the majority of its owners are people who live in poverty, and that their communities include even poorer landless workers, which are either their neighbors or their relatives. INE's database shows that 86% of all villages within *ejidos* or *comunidades* that have 100 or more hectares of forest are considered highly or severely marginalized according to the National Population Council (*Consejo Nacional de Poblacion:* CONAPO 1998). Marginalization is measured through an index that combines the rates of illiteracy, incomplete elementary schooling, the share of heads of household that earn less than two minimum wages, as well as the percentage of houses with dirt floors, without water, electricity or sewage.

High levels of marginalization and poverty are a challenge for sustainability because it favors short term projects in agricultural or livestock land uses against a longer-term planning strategy that includes forestry (Guevara and Muñoz, 1990). Also, people living in poverty and lacking land titles have stronger incentives to deforest in order to claim as their own the common property land recently cleared for cultivation. The relationship is complex, because on one hand poverty may encourage deforestation as a short-term survival strategy, while on the other hand, excessive deforestation may accentuate poverty in the long run (Angelsen and Wunder, 2003). In fact, Pagiola (1995) suggests that under certain circumstances poor farmers have stronger incentives

to protect the environment than wealthier farmers, because the consequences of failing to achieve sustainability have worse consequences to them.

Empirical studies in Mexico suggest that poverty is strongly linked to increases in the deforestation rate. Deininger and Minten (1999) found that municipalities with higher levels of poverty lost a larger proportional share of their forests during the 80s than others of similar characteristics but less poverty. The econometric pixel approach developed by INE (Muñoz, et al. 2004) also confirms the hypothesis, providing evidence that during the 90s poverty and marginalization levels in the villages closest to a particular tract of forests increased the probability of it being deforested. These results do not imply that deforestation was higher in poorer areas. In fact, the influence of other variables like distance to market, slope and potential yields, result in a higher deforestation in the richer parts of the country. However, the effect of poverty still makes a difference when comparing forests of similar location and characteristics.

Indigenous Communities

The indigenous people of Mexico have an important presence in forested areas. Esteva's (2004) estimations show that 20% of the *ejidos* or *comunidades* that have large tracts of forests (>100 hectares) also have a large majority of indigenous households. In comparison, only 2% of the ejidos without forests have a similar indigenous presence.

How does this fact affect deforestation? One argument is that indigenous communities have a unique perspective about their forests, stemming from the very long-term ties that bind them to their ecosystems. This would provide them with a stock of traditional knowledge about its goods and services, allowing them to obtain more value from the same plot of forest than, for example, new immigrants to the region. Also, strong ties within the community due to a shared identity and extended family relations would imply higher costs of opportunistic behavior and make indigenous ejidos more efficient at achieving cooperative outcomes. These two elements would have the effect of increasing the relative profitability of keeping the forest, reducing the incentives to switch to agriculture or cattle operations. Finally, it is possible that forests themselves could have cultural importance for the indigenous people, so traditions and rules about its use would reflect the local bequest and existence values and help preserve them despite generating less income than its alternatives.

It is important to keep in mind that the indigenous factor is one among many that decide the fate of the forest, so the role of the other important variables might at the end favor deforestation despite its influence to the contrary. It would happen because the land is near to the roads, or because the community is poor, not because it is indigenous. Another important note is that any positive effect of ethnic identity towards forest conservation would also occur in a community of non-indigenous peasants with strong ties and social capital, and a history of living next to a forest ecosystem. It is the knowledge, the lower cost of cooperation, and the internalization of non-use values which make the difference.

WATER AND FORESTS

Water consumption patterns in Mexico are unsustainable. According to the National Water Commission (*Comisión Nacional de Agua:* CNA), 66% of the 188 most important aquifers in the country suffer from overexploitation. On them, the average extraction for human uses is 190% the level of natural recharge, a straightforward path towards depletion. The rest of the mentioned aquifers are not safe either, 28% of these 188 aquifers are considered in equilibrium, between 105% and 95% the ratio extraction/recharge, a fragile situation especially when consumption is projected to grow and natural recharge is threatened by deforestation.

Comment [CMP1]: cita

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, that of 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 design and implementation of a public policy regarding the payment of environmental services. Based on the research on the causes of deforestation and the existing policy array to reduce it, the basic policy proposal of PSAH was to create a financial link between those who gain from environmental services and the owners of the forest that are likely to provide those services.

PUBLIC POLICIES TO REDUCE DEFORESTATION

There are several policy reasons for wanting to reduce deforestation. From an environmental point of view, there is an interest in protecting the environmental services linked with biodiversity conservation and improving water supply and quality. In a country with severe water scarcity problems, this latter reason is important for both the wealthier and poorer segments of the population. From an economic growth point of view, there is also a generalized concern that in Mexico deforestation is in fact a waste of potential economic opportunities for poorer forest landowners. As such, deforestation would be signaling to the government that more efforts are needed to support poor forest landowners in the creation of forestry firms, so they will be able to capitalize the gains to be made from using the forest in a sustainable way. More recently, greater interest in climate change policy provides a motivation for both reducing carbon releases from deforestation, and selling the service of carbon sequestration to firms planning to expand their operations or compensate past emissions.

To reduce deforestation, the Mexican government pursues a strategy 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 requirement to obtain government authorization for projects that involve land use changes, one of the elements needed is an Environmental Impact Assessment.
2. The decree as Natural Protected Area (ANP) of certain ecosystems considered key for biodiversity conservation. The ANP's management plan involves tougher requirements, or absolute prohibition, for land use changes.
3. The need to obtain government authorization for timber extraction, one of the main requirements being the need to operate under a management plan that sets sustainable limits to extraction, sets aside fragile areas for conservation, and dictates practices to minimize environmental impact.

The Federal Attorney for Environmental Protection –*Procuraduría Federal de Protección al Ambiente*, PROFEPA- is the institution responsible for the enforcement of these regulations, and directly sanctions those who do not comply. The task is daunting, given the hundreds of thousands of hectares lost each year to deforestation. However, public support and budget increases have allowed PROFEPA to double its efforts to stop illegal logging since the year 2000. This resulted in a significant increase in arrests and 39% more illegal timber confiscated in the first three years (PROFEPA, 2003), nevertheless much more is still needed.

Conservation vs. Poverty Reduction

Without the option of a payment for environmental services program we face a potential public policy dilemma. If regulations that prohibit land use change are effectively applied, deforestation rates will indeed decrease. However, among those forests of low commercial value, such enforcement will be actually eliminating income generation opportunities for their owners; and if those owners are poor then we have protected the environment at the cost of increasing poverty. The dilemma is between poverty reduction and environmental protection, between local and global benefits, and between present and future generations.

Some forest owners in Mexico are not poor. For them, considerations about regulatory takings should be no different than for other sectors of the economy: if there are more public benefits than private costs then it is worth prohibiting land use changes. Environmental Impact Assessment (EIA) instruments facilitate the identification of viable projects for authorization, as well as the conditions and compensation mechanisms required.

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. However, small scale land use changes are outside the sphere of government regulation capacity. In this context, programs for the payment of environmental services seek to complement existing land use change prohibition policies and sustainable forestry management programs.

Strategic support for forestry firms

The other basic element of the strategy against deforestation is strategic support for forestry firms. Sustainable timber production can provide forest owners with a continuous source of income, creating economic incentives for conservation in order to protect such and important livelihood source. As it will be discussed later, the timber production strategy is incomplete without a payment for environmental services (PES) tool, because the market does not pay everything the forest provides. As such, the current forestry firm strategy focuses only forests and tropical forests with (actual or potential) high commercial value, but ignores well preserved forests of non-commercial quality or characteristics, a point which will be crucial for the design of PSAH.

Fostering sustainable forestry is a complex task, and has different levels, but our claim is that the government has successful followed this strategy over the past two decades and results are showing. The basic level of support is the institutional framework. Providing and supporting land titling and solving agrarian conflicts provide the necessary legal certainty for any future project development. Without such legal instruments, the risk of outside appropriation and external timber extraction would go unpunished so easily that any forestry activity would become unprofitable, so people would prefer to take their natural capital and convert it into more secure assets such as cattle, vehicles, or bank accounts.

The current institutional framework was created by the structural reforms of 1992-1994, which established more transparent individual property rights in individual plots and common property land within *ejidos* and *comunidades*. Article 27 of the Mexican Constitution was modified and a new Agrarian Law was crafted to reflect this reinforced individual and community rights. The reforms still needed a legal tool to be operational, and so a land titling program named PROCEDE was launched to clear in a democratic, effective way the widespread informality of many land transactions, and provide modern, georeferenced documents to the land owners.

Besides the basic institutional framework, forestry can be the target of governmental subsidies, reducing timber and non-timber production costs, as a way to support emerging firms. The risk of generating a non-competitive forestry industry is high if firms are not weaned-out of the subsidy once they have consolidated, but most of the community firms are still in a take-off stage. The main programs are:

1. *PRODEFOR (Programa de Desarrollo Forestal)* whose aim is to support forestry producers by financing management plan development and training programs to trigger productive projects.

2. *PROCYMAF (Programa de Conservación y Manejo Sustentable de Recursos Forestales)* which provides training for sustainable timber production and is directed towards poor communities with emerging organizational structures.

3. *PRODEPLAN* (*Programa de Plantaciones Forestales)*, consisting on direct payments to landowners who wish to establish forest plantations, even if they use non-native species.

4. *PRONARE* (*Programa Nacional de Reforestación)*, a program to plant saplings in deforested or degraded forests, where poor community members are offered short-term employment to in order to carry out the required labor.

The main focus of these programs is either commercially viable forests, or heavily degraded areas. When they are successful, timber production operations can provide larger rents than agriculture or cattle ranching, so the forest is protected in the long run. On the opposite side of the spectrum, investment in degraded areas is a long term bet, and provides environmental services only gradually. As mentioned before, both of these types of programs leave out those well preserved forests which are commercially uncompetitive due to their location, type of soil or species composition. The problem was that this gap had not been recognized.

Over the past two decades, both NGO and producers' lobbies have focused on communities that could actually start their own forestry firms, but forgot about the rest. While the message to the public was that all forests should and would have sustainable and profitable timber operations in due time, this goal was unrealistic, and there was a need to create a new complementary policy. This is why the PSAH was crafted so its main target group would be non-commercial forests in a good state of conservation. If a landowner, individual or community, wishes to go through the path of sustainable timber extraction, they still have the option of applying to the forestry support programs. For the rest, payments for their environmental services are their main option.

PAYING FOR ENVIRONMENTAL SERVICES

There are three basic options to internalize the positive externality of an ecosystem's environmental services. All of them involve a flow of payments from those who benefit from the environmental services to those who preserve the habitat providing them. The options can be used in combination, but the nature of some of these services and the current property rights structure makes some of them better suited for a particular option than others, as is discussed below. The options are:

1. **Foster environmental services markets** by providing an institutional framework to facilitate transactions.
   Whenever there is a demand that can be articulated, then only strategic support to identify the supply is needed. An example of such approach is ecotourism, where the environmental service of landscape provision can be paid for. If tourism operators become partners with forest owners, then there is a flow of rents paid for their forests. Strategic government support might include training, support to draft business plans, develop regional marketing strategies and provide information, such as certification or other types of listings (Ceballos, 1996; North American Commission for Environmental Cooperation (CEC), 1999). Other examples of direct or indirect environmental services include shade-grown coffee, carbon offsets certification, and conservation easements (Environmental Law Institute, 2003).

2. **Channel grants or international transfers,** converting them into payments or direct local support.
   This option is applicable when international organizations make donations or provide grants on behalf of global beneficiaries of the environmental services. This

is the case of the Global Environmental Facility (GEF) funds transferred into the Mexican Natural Protected Area System and the carbon credit purchases by the World Bank's Prototype Carbon Fund (PCF).

3. **Government acts as an intermediary,** using the tax system to charge beneficiaries and pay forest owners through specific programs.
   This option is the best one when the environmental service provided is in itself a public good, either local or regional. It is also a good choice when demand is not yet as well articulated through the consumption/investment decisions of individuals and firms (as in option 1), or through the action of governments or large scale organizations (as in option 2). Hydrological environmental services can be classified in this category because the benefits occur at the watershed or aquifer scale, the provider of the good that embodies the service (water) is the government, and disperse water users have difficulties coordinating their actions.

LOCAL AND INTERNATIONAL REFERENCES

There were several cases that were closely studied for the preparation of the national program for the payment of hydrological services. In Mexico, a local initiative in the municipality of Coatepec was very important for us to know how the concept would work in our institutional setting. In Latin America, the cases of Ecuador and Costa Rica were also an important reference for the design of our program, because they had either similar types of beneficiaries or forest owners.

Coatepec

Coatepec is a municipality of approximately 45 thousand inhabitants in the state of Veracruz, on the Gulf of Mexico. It is part of the *La Marina* watershed, which drains directly into the gulf. Its main population center, the city of Coatepec, had always enjoyed abundant water, both surface and underground. Thanks to its climate, water availability, and entrepreneurship the municipality became one of the top producers of coffee in the country, its city becoming a key commercial center for the region. People from Coatepec were confident that their prodigal natural resources would always support their growing economy. That is why they were shocked to find out that in May and June of 1998 the surface water from *La Marina* River was barely enough to cover the town's consumption. Not even the great-grandparents in the community remembered it happening before.

It is true that 1998 was an unusual year because of the strength of "El Niño" climatic pattern, and the whole Gulf region had a harsher dry season. However, the general perception was that its effect was compounded by three decades of uncontrolled deforestation in the upper watershed. The link between water and forests in Coatepec was especially clear to its residents, since the community is strongly dependent on its cloudforests for the capture of moisture from the coastal fog, their main source of surface water in the dry season (García-Coll: 2002).

Concern over the municipality's sustainability, led the Mayor Miguel Cervantes to plan an innovative idea in 2001. He requested the municipal legislative body (known as *Cabildo*) and the local water utility, to petition for a donation of $1.00 Mexican peso

(approximately $0.09 USD[2]) in the water bill sent to domestic users, earmarked for watershed forest conservation. The funds would be used to pay an annual fee to owners of well preserved forests in exchange for their conservation. During the first year more than $9 thousand USD were collected, evidence of the willingness to pay for conservation by local households.

The Mayor added funds to this voluntary donation from the municipal budget and from CONAFOR's programs. By pooling resources, he was able to pay $1,000 Mexican pesos (approximately $90.10 USD) per hectare to the 500 best preserved forest hectares in the watershed. According the Mayor's office, this amount was chosen because it represented the average profits obtained from coffee harvesting. A puzzling reasoning because land use changes were mainly towards cattle pastures, and despite the slump in coffee prices, coffee plantations in the region are almost all shade-grown.

Contrary to INE's recommendation to pay a lower amount, the municipality went ahead with the proposed sum, and received applications for twice as many hectares as it could actually pay. Their reaction was to select the best preserved hectares of forest, good providers of environmental services, but not necessarily the most at risk of being deforested (García-Coll: 2002). The Coatepec program pays this sum annually, using a trust fund created especially for that purpose. In 2003 the municipality expanded its options to include the direct purchase of plots, creating a forest reserve for environmental services.

Looking closely at the design and implementation of Coatepec's PES program, we were able to obtain some important lessons for the federal PSAH program:

- There is political acceptance for specifically targeted water charges to compensate watershed forest conservation in Mexico.
- Fixing payments around $90.00 USD or near the average of the opportunity cost is an overshoot, especially if the program is looking to maximize coverage by incorporating at first areas with positive but low opportunity costs.
- On-site verification is a costly proposition; however the use of satellite imaging or aerial photographs is enough to send the signal that payments are based on results, and will not follow if there is no compliance with the implicit contract of the program rules of operation.
- The first plots of forest offered are actually those with lowest opportunity costs, those that most likely won't be deforested in the near future. A method to separate higher risk areas is necessary to better target the program. (As discussed below, this lesson could not be integrated soon enough and the federal program is still struggling with the issue.)

Lessons from other countries

To design the Mexican PSAH program we analyzed carefully the experiences of the city of Heredia in Costa Rica, the city of Quito in Ecuador, as well as the national

[2] The exchange rate used throughout the document is $11.00 Mexican pesos per $1.00 USD.

PES program of Costa Rica, among several others. The team identified the following relevant aspects of these experiences:

1. Large water consumers such as hydroelectric utilities, breweries and water utilities have demonstrated a willingness to pay to preserve the forests in the watershed that serves them. Nonetheless, like any other voluntary contribution, if faces problems of collective action. Firms would prefer that others in the watershed would contribute first before committing their own contributions. Also, voluntary donations are likely to fall with time as opportunistic behavior settles in once the initial crisis is perceived to be solved. These behavioral patterns led us to design the Mexican program with a mandatory fiscal instrument as the main financial source.

2. Programs like the one for Quito, seek to fund additional conservation activities that increase environmental service of a particular plot instead of making a payment per hectare. Such approach is actually paying for the labor involved in these activities, not for the land's opportunity cost. We believe that ignoring such costs would not reduce the deforestation rate as much as it could, but would still pass a Cost-Benefit analysis. The effectiveness of either depends on the specific circumstances. Because Mexico faces a high deforestation rate, and because a national program would have problems monitoring many detailed plot specific programs, we decided that the payment per hectare was the best approach.

3. Some PES programs reviewed rely heavily on civil society involvement. NGOs frequently play an intermediation role between forest owners and environmental service beneficiaries in local projects. While this is the equivalent of local markets with an independent broker, and would actually help efficiency, making it a requisite in a national government funded program would unnecessarily limiting the geographical coverage to where there is already presence of such organizations. For the Mexican case, the decision was to widen the coverage by directly making the PSAH contract with the forest owners, which in Mexico are in themselves collective organizations.

4. To pay or not for conservation activities is an important debate. Land owners tend to favor the first option because it gives them larger net rents. Environmental groups and public officers on the other hand, prefer micromanagement schemes, because they feel they are "paying for something". INE's final recommendation was to pay just for results, leaving to communities to find the best way to conserve their forests. Though it was highlighted that those who wanted to undertake additional activities for their own merits, such as reforestation or developing community firms, would still have the support of the existing government programs that attend these issues.

II DESIGNING THE PROGRAM

The PSAH analysis and design phase took from mid 2001 to May 2003. The INE-CONAFOR team was supported by a group of researchers from the *Universidad Iberoamericana*, the *Centro de Estudios y Docencia Económica (CIDE*), and the University of California at Berkeley, led by Professors Alain De Janvry and Elizabeth Sadoulet. Additional support was provided by the World Bank's Environment Department staff, which channeled a donation from the government of Japan to finance data gathering and analysis, and provided advice and feedback throughout the different stages. To all of them we are deeply grateful.

Once the initial proposal was drafted, it was presented to the Secretary of Environment and Natural Resources SEMARNAT and CONAFOR's Director General. Both of them decided that it would be one of the key policies to be put forward by the administration, and that they would strongly negotiate with the Finance Ministry, with Congress and the agricultural lobbies to pass the necessary legislation.

The first step of the strategy was to create a fiscal instrument that would provide the resources for the program, and a trust fund to administer them. This fund was called the *Fondo Forestal Mexicano,* and its purpose was to be a commitment device to ensure participants that the resources that would pay them for the following 5 years were already set aside.

The strategy to sell the program involved convincing government officials from agencies linked to SEMARNAT, most notably the National Water Commission CNA. Their reluctance was due to their view of water scarcity as a problem of investment in infrastructure. Simultaneously, a strong internal lobbying effort had to convince the Ministry of Finance (SHCP) officials that the fiscal instrument was well designed and that it could be approved by Congress. It was too different from existing fees for them to approve of immediately. Staff from CNA and SHCP strongly opposed the PSAH because there was a previous negotiation with municipalities that had promised to give them back 100% of what they had paid for water to the federal government, so it would be used to invest in water supply infrastructure. The main rebuttal given by SEMARNAT to this argument was that it was equally important to invest in natural capital, and that that could only be done at the watershed level.

The support of high-level members of the academia was essential in transmitting the program's strengths and in persuading early hesitance to the program's innovative nature and associated risks. In addition, empirical studies and consultations with professionals working with forest communities, facilitated an initial review of the monitoring and incentive generation capacities of the PSAH program, which in turn developed a more realistic and pragmatic program to operate in the field.

During the lobbying process with the Mexican Congress, several key members of the Environment, Natural Resources and Taxing Commissions where very supportive of the draft initiative, and even declared to opposing Finance Ministry officials that they would present it as their own if these official effectively blocked its formal presentation by the Executive. At the end, a compromise version was presented, which symbolically excluded municipalities from making the contribution, but the expected amount was effectively earmarked from the water fees collected from other users. Interest from

different political parties stemming from their diverse agendas (environment, poverty reduction, water supply and forest conservation) helped to build the necessary consensus to pass the initiative through the Review Commissions, and be approved by a large majority by the entire chamber.

Once the fiscal instrument was approved it was necessary to draft a set of operating rules (*Reglas de Operación*) for the program. During this phase, agriculture lobbying groups from the *Acuerdo Nacional por el Campo*, an umbrella organization, had a very active participation. Since most its associated groups represent **producers**, their lobbying efforts were aimed at focusing payments to communities that had already timber operations or shade-grown coffee plantations. INE and CONAFOR resisted this, because as discussed earlier, it was expected that if payments went to communities already obtaining significant income from their forests we would be missing those that do not and thus could be facing a higher deforestation risk.

Non-commercial forest owners aren't as well organized as timber producers; they lack the lobbying power to countervail the producer's groups. The Mexican government took a firm position on their behalf at the beginning, but had to negotiate certain clauses to allow some restricted PSAH payments in timber production areas.

2.1 Federal Fees Law and the PSAH

Lakes, lagoons, aquifers and rivers are considered national property in Mexico and are managed by the federal government. This feature allowed the establishment of the fiscal instrument to pay for the hydrological environmental services, because the government can charge for the utilization of national goods through the Federal Rights Law (*Ley Federal de Derechos LFD*). It is used to charge for natural resources like water and minerals (Cortina, 2002). Articles 222, 223 and 224 contain the water fees, charged to different users. Farmers pay nothing, municipalities very little, while manufacturing companies and service providers pay the highest fees.

The LFD is presented and approved each year by Congress. The initiative is prepared by the Ministry of Finance (SHCP) and can be modified by the Congress' commissions. The INE-CONAFOR team prepared a modification of article 223 that earmarked a specific share of water revenues for payments for forest environmental services. Initially it allocated 2.5% of the annual revenues, but negotiations with SHCP left it in nominal terms: $200 million Mexican pesos ($18.2 million USD) per year.

Mexican fiscal policy opposes the earmarking of taxes. However, thanks to the successful negotiations of Francisco Giner de los Ríos, at that time, Director General in the Undersecretariat of Revenue in SHCP, several environmental fees were earmarked, with the policy justification that fees, not taxes, were paid in exchange of the goods and services provided by the government. This is the way it works, for example, for fees collected from the visits to Natural Protected Areas or from wildlife utilization in federal lands.

The justification for excluding municipalities was based on the objectives of a program called the *Programa de Devolución de Derechos (PDD* in CNA: 2005) which was creating strong incentives for municipalities to actually collect water fees through linking the amount collected to the budget the federation assigned to municipalities. It

was a political decision difficult to assess from a public policy perspective, because water supply infrastructure deficits are significant in Mexico and the PDD was delivering fee collection results unseen before in Mexico (Sainz, et al. 2004). On the other hand, a 2.5% allocated to natural capital is a very good investment given that it is a complement to physical capital. The modifications to the initiative that excluded municipalities definitely softened the political message the PSAH wanted to transmit; which is that all users, amongst them preponderantly urban centers, should contribute to the protection of the ecosystems that supply them with environmental services.

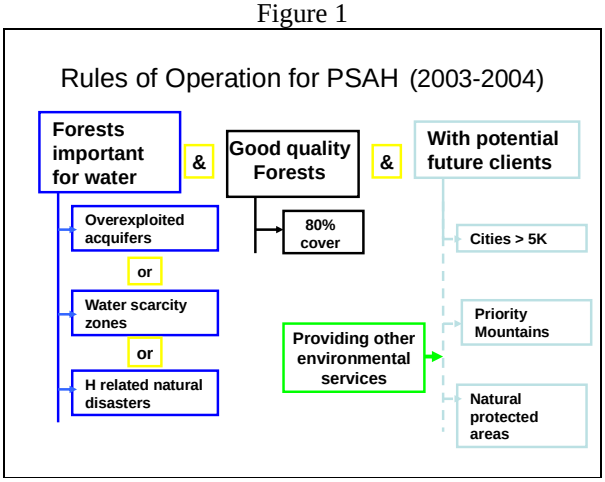
2.2 Rules of Operation

One of the criteria employed 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 were at risk of deforestation, were important for water, and which had the lowest but positive opportunity cost.

The coffee growers wanted to participate in the program, arguing that shade-grown coffee provides an environmental service similar to those provided by forests. The reply was that since the program was at an early stage with limited funding, resources needed to be channeled to non income generating forests where PSAH payments could make an important difference. During the final negotiations, coffee growers' pressure was undermined by making it known that they were already receiving in excess of 3 billion pesos ($273 million USD) each year to ensure their "competitiveness" in the face of crowded international market.

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.

Figure 1



2.2.1 Water benefits

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 "elegibility" that CONAFOR used as a guide to approve 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. One 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, bring them lower political gains, and fail 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 priorities[3].

As a result, both of these policy priorities: water scarcity and natural disaster areas were left without clear indicators. In retrospective 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 it meant that the criteria were not integrated into the "eligible" areas defined by CONAFOR. To correct the mistake, INE suggested the incorporation of the specific indicators mentioned into the 2005 Rules of Operation, not as prerequisites, but as components of a grading system to evaluate the applications.

There was an important debate regarding the hydrological value of different 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.

2.2.2 Potential Future Clients

The third criteria for eligibility tried to reflect two facts: 1) that the federal government expected local governments to join in the effort of protecting their own

[3] Such map is now available at: CENAPRED (2004)

watersheds; and 2) that other proxies for the value of the environmental service were needed. That is why an application necessarily has to be linked to at least one of these three items: in the area of influence of a population center of more than 5 thousand inhabitants, inside a Natural Protected Area, or in a mountain belonging to the "Priority mountain program".

The population center option was opened because of our assessment of the capacity of a local government to develop their own PSAH program or to generate enough revenue to make an environmental fee collection worthwhile. If we observe smaller cities and towns interested in our 2005/2006 program to develop local PSAH then we would recommend that the option is extended to them.

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 through a multicriteria analysis. However it had stopped there; the strategic support for these mountains was an unfunded mandate. So their inclusion into the PSAH program was the solution.

The Natural Protected Areas on the other hand were 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 of them, who saw these payments as a way to ease the application of regulations prohibiting changes in land use to poor peasants. These were understandably reluctant to be providing for free the global service of biodiversity protection, and the regional public good of watershed protection, now that CONANP was pursuing more strongly their compliance. Their inclusion was justified for the watershed protection reason, despite not being all of them in critical condition and even fewer of them having possibilities of a local government joining in. In meetings with NGOs, some of them praise that we are obtaining two types of environmental service for the price of one.

2.2.3. Forests in good state of conservation

The aim of the PSAH program is to pay for results, for the environmental services in fact being provided. As mentioned before, the main target group is non-commercial primary forests. As a practical indicator, the RoOp required an 80% of forest cover in participating lots. The problem was that the criterion wasn't properly understood in 2003 and faced implementation problems in 2004.

In 2003 it was interpreted as requiring an 80% of the plot to be covered by forests, not as an 80% density of forest cover per hectare. That mistake created a bias towards the largest ejidos and comunidades with forests, where agricultural plots were relatively small. In 2004, the personnel responsible for the program mentioned that their satellite imaging system could not interpret correctly the forest cover, and that they were not going to consider it for the evaluation. Furthermore, forester organizations in northern Mexico argued that their forests have naturally low densities. For 2005 CONAF is working on a practical and not expensive system to estimate density, but in the review of the RoOp some members of the Technical Committee suggested dropping the indicator altogether until this idea can be tested.

2.3 Choosing the amount paid

To estimate the distribution of the opportunity costs of keeping a forest, a team from INE studied the profits obtained from agriculture and livestock operations near forested areas (Jaramillo: 2002). The data was obtained from the main commercial agricultural credit organization of the government, the *Fideicomisos Instituidos en Relación a la Agricultura* (FIRA). We expected an overestimation of actual rents, since FIRA's clients tend to be the high end of agricultural production, but this was the only readily available information.

The results obtained show average profits from corn production at $37 USD per hectare per year, while 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 1.1 shows the results corresponding to the amounts considered in the design phase.

Table 1.1

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

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

The initial proposal was to pay annually $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) because of their higher value in terms of hydrological services. This amount would be paid each year, after verifying that no land use change occurred, for 5 years. During the approval process of the RoOp, rural organizations put pressure for a higher payment. It was puzzling at the beginning, because with a fixed budget that meant less people would receive the benefits of the program, but later it became clear that the organizations' leaders wanted higher payments focused exclusively on their 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 would receive $400 pesos per hectare ($36.4 USD).

It was decided not to differentiate payments between regions based on opportunity cost, in view of a potential controversy with regional interests groups. Such groups could argue that opportunity costs in their land are in fact higher or that they were being discriminated, easily derailing the implementation process. The academic advisors had suggested applying an inverse auction to properly act as discriminating monopsonist and obtain more rents for the water users. That would have created the perfect payment differentiation according to the opportunity costs. However, the potential higher administrative costs, and difficulties selling such an unusual allocating mechanism in Mexico, convinced CONAFOR officials that the two tiered payment option was the best one for the first version of the program.

Opportunity costs might be zero

There are forests which would be preserved independently of governmental intervention, mainly because agriculture and grazing are not profitable. Their owners would clearly be interested in participating in PSAH, since environmental services payments come without an opportunity cost. However, it would be a waste of funds, because no modification of conduct is taking place. For this reasons an instrument (like the deforestation risk map) is required to objectively distinguish between these lots and those at a higher risk of being lost.

Opportunity costs might be too high

The self-selection process implies that forests that would yield very high income as agriculture, livestock, industrial or urban projects choose not to participate in the program. The limit is the amount paid per hectare. A property owner could also just delay the project if participating in the PSAH yields more profits that the cost of delaying.

During the initial design stages, local authorities interviewed wanted to have a PSAH program that would provide a solution to urban expansion pressure over natural areas. We avoided assuming that goal because urban land values are significantly higher than agriculture or cattle ranching. Conserving forests in such areas can only be achieved through direct expropriation or prohibiting urbanization by way of direct sanctioning. Once prohibition is in place, some payments for environmental services can come as a way of (partial) compensation, but they would need to be very high to work without zoning regulations or transferable development rights.

Limiting benefits

Regarding upper limits to the benefits, the PSAH had two objectives pulling in different directions. On the one hand, there are advantages in protecting large compact areas where the benefits of the program could be easily observed. On the other hand, if more forest owners participated in many different regions, then the program's profile and learning experience would be enhanced, so it would be convenient to pay some forest to many than all the forest to a few. In the end, two types of restrictions were chosen: the first was to place a limit of 4,000 hectares for any individual application where there were non commercial timber operations, and a limit of 200 hectares to those with timber operations (a concession to the producers lobby) and even there only on their conservation areas.

Selection process

PSAH funds assigned in the federal budget are transferred into the Mexican Forest Fund. Potential beneficiaries fill out an application form, attaching the necessary documentation to validate their eligibility according to the RoOp. In an initial review, applicants are informed of any missing documentation or their disqualification if they fail to meet any of the requirements. All complete and valid applications that comply are then evaluated by CONAFOR´s regional offices. The implementation and evaluation costs are required by law to be no more than 4% of total costs. CONAFOR bears much of the costs through its own staff or by hiring external suppliers, but

probably the highest costs are the satellite images and their processing required for monitoring and evaluation.

When the contract is breached

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 does get paid for whatever was preserved.

In this latter case, it is required that the community informs CONAFOR of the natural disaster or theft. 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 combat training.

OTHER ISSUES

Deforestation risk

We have argued that if the PSAH aims to have the largest impact in reducing deforestation in areas important for water recharge given a limited budget, it makes little sense to pay for areas that would not be deforested in the near future. This can happen for two reasons: 1) the forest is already generating higher rents than agriculture or cattle ranching, or 2) neither agriculture nor cattle ranching would turn a profit if they substituted the forest. The first item could have as an indicator the formal forestry activity and could be used for the eligibility criteria. The second item is more difficult to measure.

Knowing that it would be an important targeting problem, INE began to collect data to estimate an econometric model of deforestation. The hypothesis was that the incentives to deforest would be negatively related to the distance from roads and towns, the potential agricultural yields of the land, and the slope of the plot. It would also have an influence from the levels of poverty of the people living next to it, and whether or not there was a National Protected Area declared in the zone.

We constructed a data set with a grid of pixels that showed whether or not a hectare of forest in 1993/1994 had been deforested or was still there by the year 2000, which were the years for which we had a forest inventory. Econometric models with qualitative dependent variables (probit and ordered probit) were used, and the predicted probability for forests in the current period was our index of risk.

Because the econometric analysis is based in the observation of deforestation patterns during the past decade, we could have biased predictions. Economic growth and increasing trade liberalization produced changes in important variables influencing forest opportunity costs. Real corn prices have declined while agricultural wages have

increased. However, it is the best estimate we have. INE's recommendation in the PSAH Technical Committee is that the index is incorporated into the grading system for evaluating proposals. We divided the deforestation risk in quintiles creating risk category tiers. Each pixel then receives a value, and the average value from this index is used in the evaluation of the plot

IMPLEMENTATION

The PSAH program was announced in early October 2003 after a long period of negotiations to get the operating rules approved and published in the Federation's Official Gazette, and there was little time to undertake the promotion, receive the applications and evaluate them, before the deadline of December. It was very important not to wait for another year, since we could loose Congressional if no result were shown the same year when the earmarking of fees were fought over.

The program was welcomed by collective and private forest owners, who expressed their satisfaction that for once, all the restrictions they had on land use were being compensated. Communicating in detail the nature and objectives of the operating rules to CONAFOR field operatives was not an easy task. For the communities there is also a problem of communication. Contracting obligations are not clearly explained and understood by the general membership of the ejido. The most common story seems to be that elected representatives of the *Núcleos Agrarios* negotiated directly with CONAFOR and only partially informed on the restrictions and duties of the program to their members, asking in the Assembly only the authorization of the community to participate in a federal program that will transfer financial resources if they conserved the forest.

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:

2003-2004 Beneficiaries

The launching of the PSAH program strongly attracted the attention of *ejidos*, *comunidades* and private owners. In 2003, this resulted in the reception of 900 applications offering close to 600 thousand hectares. Out of these 271 forest owners with 127 thousand hectares were incorporated into the program. In 2004, 960 applications were received, incorporating 352 new participants into the program with more than 170 thousand hectares.[4]

During both selection processes a large number of applications were discarded for missing part of the information required. The main omissions were the Assembly Record from *ejidos* or *comunidades* stating the collective owners' discussion, vote and decision to participate in the program, or proof of up to date taxing compliance for private owners. Another important omission were the maps of participating plots,

[4] This number was calculated from the lot selection process in 2005, it does not use clearly defined "polygons" in a Geographical Information System (GIS).

needed to have a reliable use of satellite imaging to measure forest cover. That is why having participated in the program PROCEDE was a key variable for communal owners, as having their land in the Public Property Registry was for private owners.

Independently to the selection criterion used, an important lesson is that payments ($36.4 USD and $27.3USD per hectare) were set too high, and that the deforestation risk was not valued. Excess in applications was in part due that expected payments were higher than forest opportunity costs for a large number of participants. This possibility was taken into account since designing the program. It was presumed that lots with high deforestation risk and located in important water recharge areas were going to be selected, in order to maximize welfare gains. However, we found out that CONAFOR's eligibility criteria were not enough to achieving such goals., but are not sufficient. Indicators like the deforestation risk and the degree of importance of hydrological services are required to play a larger role in the future.

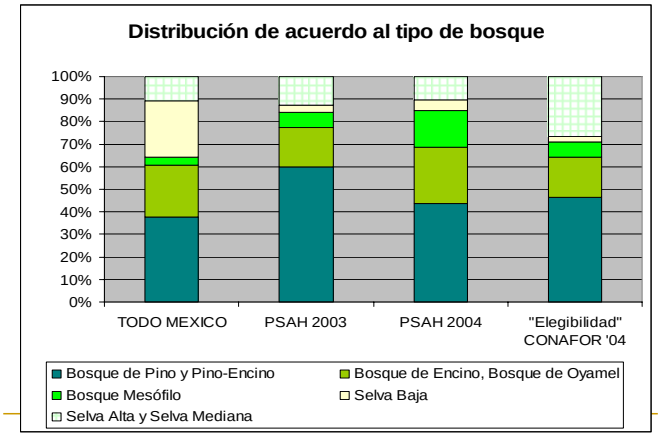
Focalización: Acuíferos sobreexplotados

Tipo de Acuífero	Superficie a nivel nacional	Población en la zona	Hectáreas beneficiadas por PSAH en 2003	Hectáreas beneficiadas por PSAH en 2004
Extremadamente Sobreexplotados (+100% a +800%)	0.05 %	9.2%	0.02 %	0.00 %
Fuertemente Sobreexplotados (+50% a +100%)	0.04 %	19.5%	0.00 %	0.00 %
Sobreexplotación Moderada (+5% a +50%)	18.6 %	14.5%	13.3 %	9.61 %
En equilibrio (- 5% a +5%)	2.9 %	11.3%	0.01 %	0.00 %
Con margen de expansión (< - 5%)	65.1 %	45.4%	78.7 %	85.04%
Sin información	13.4 %	0.1%	8.0 %	5.3 %
TOTAL	100.00 %	100.0 %	100.0 %	100.0 %

Focalización: grado de marginación

Grado de Marginación	PSAH 2003	PSAH 2004	Total Nacional en Propiedades Sociales con >100 has de bosque
	Hectáreas %	Hectáreas %	%
Muy Alta	*25.0*	*21.5*	*69.1*
Alta	*46.9*	*61.4*	*17.2*
Media	*18.1*	*7.9*	*8.6*
Baja	*7.9*	*5.7*	*3.3*
Muy Baja	*2.1*	*3.4*	*1.8*
Total	*100*	*100*	*100*

Focalización: Tipo de Vegetación



Focalización: Índice Riesgo Deforestación

Índice de Riesgo de Deforestación (por quintiles)	Bosques a nivel nacional	PSAH 2003		PSAH 2004		Superficie Elegible CONAFOR	
	%	%	Ha	%	Ha	Ha	%
Muy Alto	20%	*4%*	5,922	*11%*	18,550	404,549	*12%*
Alto	20%	*7%*	11,034	*17%*	28,529	198,762	*6%*
Medio	20%	*17%*	28,446	*20%*	34,953	613,763	*18%*
Bajo	20%	*30%*	50,046	*30%*	50,940	856,519	*25%*
Muy Bajo	20%	*42%*	68,815	*22%*	37,133	1,350,704	*39%*
Total	100%	*100%*	164,263	*100%*	170,105	3,424,297	*100%*