



INNOVATIONS FOR SUCCESSFUL SOCIETIES

PROTECTING XALAPA'S WATER: SUSTAINABLE MANAGEMENT OF THE PIXQUIAC RIVER WATERSHED IN VERACUZ, MEXICO, 2005–2015

SYNOPSIS

In 2005, civic leaders in Xalapa, Mexico, sought to curb deforestation and unsustainable farming practices in the nearby Pixquiac watershed that threatened the quality and availability of water in their city. Xalapa's 400,000 residents relied on the watershed—a 10,727-hectare area that channeled water into the Pixquiac River—to provide almost 40% of their water supply. SENDAS, a small nongovernmental organization, created a program that aimed to ensure the long-term sustainability of the Pixquiac watershed by paying landowners to conserve and restore the watershed's forests. The program also helped farmers adopt more-efficient production methods and increase their incomes. By building partnerships with the municipal water commission, the state government, the National Forestry Commission, and Mexico's largest environmental foundation, SENDAS secured sustained financing for the program. The organization also assembled a management committee with broad representation to ensure that funds were distributed appropriately and transparently. By 2015, environmental leaders were hoping to replicate SENDAS's success in other important watersheds across the state of Veracruz.

Blair Cameron drafted this case study based on interviews conducted in Mexico City, Guadalajara, and Xalapa, Mexico, in March and April, 2015. Case published January 2016.

INTRODUCTION

"Water is a very sensitive topic in Xalapa," said Sergio Beauregard, who was with the municipal water commission in Xalapa, the capital city of Veracruz state in Mexico. "Every year there is a problem of water shortages, and there are water restrictions for several months."

During the early 2000s, that water problem grew steadily worse, and the need to address the city's water security concerns rose higher on the civic agenda.

The nearby Pixquiac River watershed supplied nearly 40% of the water that Xalapa's 400,000 residents used. The 10,727-hectare

watershed, home of 7,150 people and nearly 60% forested,¹ was under threat from new construction, unsustainable farming practices, and illegal logging.

The rest of Xalapa's water supply came mostly from the Huitzilapan watershed, which spread from Veracruz into the neighboring state of Puebla. Inhabitants of the Huitzilapan had a tense relationship with the Veracruz state government and the Xalapa municipal council because landowners in the watershed felt they were not being adequately compensated for supplying the city's water. In March 2006, 70 protesters from the region protested in Xalapa,

demanding the city pay for a new school and hospital for their community.² Beauregard said residents of the Huitzilapan regularly blocked the water supply. “They shut down the dam, demanding resources and public works from the municipality of Xalapa and the state of Veracruz,” he said.

As Xalapa grew, so did the risk that property developers would remove the trees that helped maintain the region’s clean water. Without the soil conditions and filtration that the trees and their roots provided, fertilizer and dairy runoff flowed into the water. Although total forest cover in the watershed had increased since the 1970s, landowners and outsiders were still cutting timber to make way for new buildings and roads. Farmers cleared land to plant potatoes and create pastures for dairy cows.

Protecting the Pixquiac watershed was difficult because doing so required cooperation among private landowners, farmers who managed their land communally, and several levels of government. The watershed spanned four separate municipalities: urban and rural jurisdictions equivalent to counties in some countries. No public agency, regional commission, or watershed association had authority to provide leadership. In addition, sustainability was subject to the vagaries of municipal officeholders who usually served three-year terms.

In 2005, a nongovernmental organization (NGO), Senderos y Encuentros para un Desarrollo Autónomo Sustentable (SENDAS), decided to take action. The NGO had been part of a coalition of landowners, civic groups, scholars, and citizens that had united to block the federal government’s plan to build a highway through the watershed. Arguing that the road and related work threatened the water supply and would damage the environment, the groups had succeeded in halting the project.

The leaders of SENDAS wanted to organize the same coalition to carry out a far more

challenging task: to design and implement a plan to protect the watershed’s resources for the foreseeable future. With research grants from the National Council of Science and Technology, the National Autonomous University of Mexico, and the Overbrook Foundation, SENDAS and its academic partners began to develop a strategy.

THE CHALLENGE

The SENDAS researchers first analyzed the economic pressures that affected land use in different parts of the watershed. “In the lower watershed, the urban areas were growing a lot without planning,” said Georgina Vidriales, one of three director-coordinators at the NGO. Developers had cut down both primary forest and coffee trees grown by the previous owners, thereby clearing the way for new housing and businesses. “There was also a problem of sewage and dead animals” polluting the water in the lower watershed, she said.

The middle watershed, where the cloud forest was located, had its own particular problems. As the name suggested, this forest was characterized by high humidity and persistent low-lying clouds. The ecosystem was particularly important to protect because of the wide range of native plant and animal species it supported. But farmers who owned or rented land in this zone had started to cut trees for firewood and to create space for potato crops. They also applied pesticides that polluted waterways.

In the upper watershed, the biggest problem was illegal logging. “There is a highly organized local mob, and they have a system of deforestation,” Vidriales said. “They invade with their trucks, cut, and leave.”

Working in the upper watershed was especially difficult because property ownership was unclear across much of the forested area. “There was a very big area that was like a no-man’s-land,” said Tajín Fuentes, another coordinator at SENDAS. “In the 1950s, the owners of the land, mostly rich families from

Ejidos in Mexico

Following the Mexican Revolution in 1910, the federal government of Mexico created ejidos to distribute land to poor peasants in rural areas. Several thousand ejidos were created across the country through 1991, with most ejidatarios (ejido members) tilling individually allotted plots. Ejidos also set aside larger areas for shared use.

Every three years, ejidatarios voted on a leader, known as the commissary, as well as a secretary and a treasurer. The three elected representatives collectively governed the ejido and presided over community assemblies every one to three months, at which ejidatarios made collective decisions regarding the use of communal land, decisions about economic opportunities, and resolution of community concerns.

In 1992, the Mexican government halted the creation of new ejidos and established a two-step mechanism by which plots of ejido land could be converted to private property. The first step, called the Certification Program for Ejido Rights and Titles (known as PROCEDE, an acronym based on its name in Spanish), enabled ejidos to formalize titles for individual plots of land owned by their members. After the land-titling process, ejidos could choose to undertake a further step called *dominio pleno* (a freehold), which allowed ejidatarios to make independent decisions on what to do with their land.

Xalapa, clear cut the forest to sell the wood and then abandoned the properties. That was 40 or 50 years ago, so now the forests have recovered, but the land tenure is unclear.”

Diversity in the underlying cause of deforestation made it harder to frame a coherent protection strategy, but that was not the only challenge the SENDAS team identified. A second one arose from the disparate types of ownership systems in the watershed. Although most of the land was owned individually, some was held communally, as *ejidos* (See *Ejidos in Mexico* text box.) Ejidos distributed plots to their members, called *ejidatarios*, and some also reserved land for common use. Forty percent of the land in the Pixquiac watershed was owned communally by 11 ejidos, 3 of which were located wholly within the watershed.

The changing nature of ejidos complicated the task of working with landowners in the watershed. Until 1992, ejidatarios were not permitted to sell their individual landholdings, but in preparation for the 1994 North American Free Trade Agreement, the Mexican government opened the door to individual property ownership and sale. As a result, each ejido in the watershed functioned differently. “The ejidos that were on the border of the rural and urban areas had lost

their organizational structure,” Vidriales said.

“The way they used to organize ejido life and make decisions, the way they used to rule the land, was lost. And the people started to sell the plots of land.” Other ejidos, mainly in the upper watershed, maintained their traditional structure and continued to make collective decisions about how to manage their land.

Creating positive relationships with landowners was critical in order to avoid the tensions that had led communities in the Huitzilapan watershed to block Xalapa’s access to water sources. The SENDAS team worried that a similarly conflictual relationship could develop between the city and landowners in the Pixquiac watershed. “People in Pixquiac questioned whether [working with SENDAS] was better than just making the same threats as Huitzilapan,” Fuentes said.

SENDAS leaders knew they had to forge a mutually beneficial alliance between the predominantly rural municipalities in the watershed and the mostly urban municipality of Xalapa, but persuading the municipal government to invest in environmental projects or to take a leadership role was difficult.

Several circumstances contributed to government inaction. Municipal mayors

sometimes appointed poorly qualified candidates to run local government agencies, and with three-year mayoral terms, staff turnover was rapid. The turnover contributed to a shortage of knowledge and skills within the government. “It is very rare to find people working at the municipal level who understand environmental issues,” said Renée González, the Director of Conservation at the Mexican Fund for the Conservation of Nature, the country’s largest environmental foundation.

Further, the watershed lay outside Xalapa’s boundaries, and local leaders preferred to spend money on projects within their own jurisdictions. “Watersheds don’t respect political boundaries,” said Robert Manson, a Xalapa-based ecologist who became an adviser to SENDAS. “And for the mayor of one municipality to transfer money to another municipality . . . it goes against all political inclinations.”

Short election cycles also meant that government officials wanted quick solutions. But water supply improvement was a long-term undertaking. It would take decades before any program could have a significant impact on Xalapa’s water situation. Also, certain short-term tactics could have unintended results. For instance, planting more trees could worsen the water situation because young forests usually consumed more water than older forests did.

“The local government wanted to have guarantees that if they invested in the watershed, it would produce more water in the short term,” Fuentes said. “We could not guarantee that. We could only say that maybe in 40 or 50 years we will have more water once the forest has grown.”

FRAMING A RESPONSE

Organizing and implementing action toward the long-term goal of creating a sustainably managed watershed required a carefully considered, multipronged effort. SENDAS wanted to develop a program that aligned the interests of the water users in the city with those

of the farmers living on and working the land at the water’s source. To succeed, the program had to provide (1) significant economic benefits for the landowners in the watershed and (2) measurable benefits—greater quantities of better-quality water—for Xalapa’s citizens.

The Mexican government had already instituted a policy that was supposed to align the interests of water users and forest owners. The National Forestry Commission, part of the Ministry of Environment and Natural Resources, operated a payment-for-environmental-services (PES) program. Enacted in 2003 (see *PES in Mexico* text box), the policy provided landowners with yearly per-hectare payments for conserving forests on their properties—a function that counted as an “environmental service” because of the role forests played in protecting water resources. Participants signed five-year contracts to protect the forest in return for yearly compensation that averaged about US\$30 per hectare.

While researching the Pixquiac River watershed in 2006, SENDAS and its academic partners discovered that some ejidos there were already participating in the PES program but had experienced problems in working with independent technical advisers who were supposed to provide expertise, create management plans, and complete the paperwork the forestry commission required.

The researchers also met with many landowners who could not sign up for the national PES program because their land did not meet the forestry commission’s criteria. The program “was not designed to consider local environmental and social conditions,” Fuentes, one of the SENDAS coordinators, said. “For instance, the program had a minimum number of hectares for enrollment, but in this area, we had fragmentation. It was really hard to find 200 hectares of forest together to get into the national program.”

PES in Mexico

In 2001, Mexico's incoming environmental minister began putting a team together to institute a national PES policy. Before entering office, he had contacted Carlos Muñoz-Piña, a doctoral candidate at the University of California, Berkeley, about the possibility of implementing PES in Mexico, and invited Muñoz-Piña to return to Mexico to work on making the PES policy a reality.

Muñoz-Piña and his team promoted PES as a solution to reverse Mexico's deforestation trend. They used the success of Costa Rica, which had the world's only national PES program, and Coatepec, which had Mexico's only local PES program, to build support for the policy. "Coatepec was particularly important," said Muñoz-Piña. "We invited the mayor of Coatepec to tour with us to convince people [of the importance of PES]. He was our poster mayor."

The team decided that water-user fees represented their best option for securing a sustainable funding source for PES. In its national PES policy, the Costa Rican government collected a dedicated tax on gasoline to pay for the carbon sequestration services provided by forests, but Muñoz-Piña said a similar policy was not possible in Mexico. "Mexico was not mature enough to make the link between forests, carbon, and climate change in the early 2000s," he said. Instead, Muñoz's team linked its policy proposal to water security, a more salient topic for politicians in Mexico. Severe droughts had occurred across Mexico in the late 1990s, and politicians wanted to do something about it. "I would say that everyone in Congress, or 99% of them, would mention water as one of their top three environmental priorities," Muñoz-Piña said. Tapping into that political will, Muñoz-Piña's team convinced Congress to fund a national PES program by allocating for such a program 2.5% of water fees collected.

The program was implemented by the National Forestry Commission (part of the Ministry of the Environment) with support from the National Ecology Institute, a federally funded research group where Muñoz-Piña worked. The US\$30-million budget was distributed to farmers across the country who agreed to conserve the forest on their land in exchange for a 300-to 400-peso (US\$25 to US\$35) per-hectare payment each year. In 2004, after the program's first year of operation, the government allocated US\$70 million more funding from the national budget to expand the program.

The researchers also found that the PES program had failed to overcome past patterns of behavior. Ejidatarios and rural landowners saw PES as a subsidy, similar to subsidies the government had offered for decades to rural farmers for producing agricultural goods. "People were used to getting money from the government in order to do nothing, really," Fuentes said. "The landowners involved in the national PES program had to commit to conserve the forest on their land, but in practice, they did not change the way they treated the forest; and some continued to cut trees. According to the law, they needed permits to extract timber, but this requirement was often ignored."

Still, SENDAS leaders believed PES could be an effective policy tool if the program were modified to fit the particular dynamics of the

Pixquiac watershed. "The PES program was not the final goal," said Fuentes. But "it was a way to get there." Fuentes and Vidriales embarked on an effort to redesign the way PES worked at the local level.

Members of the SENDAS team established several criteria to guide their planning. First, they aimed to conserve the existing forest, both young and old. "The national program paid only for old forest, but here we needed to invest in the young forest," Fuentes said. Much of the primary forest in the watershed had been cleared from 1950 to 1990, and new trees had begun growing in those areas. Fuentes wanted to create incentives for landowners to let the forest grow to its full potential.

Second, in addition to paying special attention to preservation of the cloud forest,

PES in Coatepec

In 2001, the mayor of Coatepec, a municipality close to Xalapa, created Mexico's first payment-for-environmental-services program. The PES policy was instituted in response to a water shortage in 1998, when water demand outstripped supply for the first time in Coatepec's history. The policy was inspired partly by the national PES program implemented in Costa Rica a few years earlier. (See [Creating a Green Republic: Payments for Environmental Services in Costa Rica, 1994–2005](#).)

Local residents paid a voluntary fee through their monthly water bills, and the funds were used to pay farmers in the watershed to conserve the trees on their land. Unlike Xalapa, Coatepec's water source was located in the same municipality as the city. Because government funds were distributed to landowners within the municipality, local politicians warmed to the program more readily.

After early success with the program, policy makers from the federal government used Coatepec's experience to design and promote Mexico's national PES program. (See *PES in Mexico* text box.)

After the mayor who created the Coatepec PES program left office, "a series of people were put in charge [of the program] that were not qualified and failed to explain the importance of the program to politicians and local water users," said Robert Manson, a local ecologist. "It's a famous program because it was the first one, but it has been mismanaged. One mayor came in and emptied the trust fund. He took the cars and the computers. . . . It was a hard blow to the program, but it was a predictable outcome because there was no support network," said Manson.

The SENDAS team learned two important lessons from the Coatepec program. First, it was important to ensure accountability in the management of financial resources, and second, they had to build a support base among local residents, who could pressure incoming administrations to continue the program after a change in government.

SENDAS prioritized the restoration of land that connected existing forested areas or that functioned as a filter between farms and rivers.

Third, the SENDAS team members sought to make existing farming operations more productive so that farmers would be able to commit more land to be conserved or restored.

A final consideration was sustainability. SENDAS had to find a way to fund its approach for the long term.

The team looked at examples of other local PES programs. Coatepec, a city just 10 kilometers from Xalapa, had pioneered PES in Mexico three years before the national program began. (See *PES in Coatepec* text box.). SENDAS researchers interviewed participants in the program and found that many did not plan to continue conserving the forest after their PES contracts expired. "Several of them told us they were going to save the money from the program and use it to cut down the forest and buy cows [after the PES contract had finished]," Fuentes said. "That made

us start thinking about developing economic alternatives that might help the forest owners."

The SENDAS team members consulted with ejidatarios they had met during the protest movement against the federal highway, seeking to understand the problems the ejidatarios faced. "We invited people to meet and discuss different solutions to the problems in the watershed," Fuentes recalled. Interviews with ejidatarios found that payments of 300 to 400 pesos (about US\$25 to US\$35) per hectare through the national PES program were too low to convince most farmers to conserve. Successful forest protection required more-generous incentives.

Another finding that emerged from the consultation process was that landowners had a strong preference for planting pine trees, which grew quickly and had economic value. The National Forestry Commission provided pine saplings at low or no cost, and there was a profitable market for pine lumber. Although pine was native to the upper watershed, it was not

found naturally in the cloud forest, an important ecosystem to replant. Ejidatarios told SENDAS they would be interested in growing species native to the cloud forest only if it was financially profitable for them. “We told the owners we would find some kind of financial support for them to do that,” said Patricia Gerez, who conducted much of the research and became an adviser to SENDAS. “We were not actually sure we could get the money, but we were very sure that we did not want to exchange the young cloud forest for pine plantations.”

The outlines of a new program began to unfold, and the program continued to evolve over time. SENDAS’s initial goals were to create a governing committee that would help design the program and set priorities, attract funding from the Xalapa municipal government, increase incentive payments for farmers to preserve and manage forestlands, and sponsor additional environmentally friendly development activities to boost farmers’ incomes. Persuading citizens and government representatives to take an interest in management of the watershed and to share the costs of implementing a sustainable program was critical to achieving long-term goals.

GETTING DOWN TO WORK

With the water problem worsening in Xalapa each year, SENDAS and its partners had little time to waste. Although the directors of the NGO wanted to begin work immediately on a sustainable management plan for the watershed, they first had to work out the financial aspects.

Finding start-up support

In 2006, Héctor Hernández, director of forestry development for the state government, told SENDAS that the local water commission might help kick-start the NGO’s efforts to restore and protect the Pixquiac River watershed. “Hernández told us that the local water commission in Xalapa had some money to invest but did not really know what to do with the

money,” said Vidriales, one of the SENDAS coordinators. “He put us in touch with the mayor, and we started to talk about making a local PES program.”

SENDAS first had to persuade the mayor that it made sense to allow the local water commission to invest Xalapa’s money in the watershed program, even though the project was outside the municipality’s borders. Paying for the environmental services that landowners’ forests provided meant transferring resources from Xalapa municipality to farmers in the four other, more-rural municipalities that made up the watershed. “We tried to educate the local politicians to think in terms of the regional ecosystem and the watershed and not in terms of administrative borders,” said Fuentes.

The team also had to convince the members of the municipal water commission that the watershed project was worthy of their support. This was a difficult task because the water commission staff was not accustomed to considering the environmental component of water delivery services. “They were thinking only in terms of infrastructure—tubes, dams, pipes—what they needed to bring water to the city. They were not thinking about the watershed and the ecosystem’s capability to provide water,” Fuentes said.

After long negotiations, the water commission provided SENDAS with 420,000 pesos (approximately US\$38,000 at the time) to fund the proposed program for 2007. Under Mexican law, municipal councils could not finance any projects for longer than their three-year terms unless they obtained prior approval from the state congress. Obtaining such approval was difficult and time-consuming, and the municipality was not willing to institutionalize SENDAS’s program before it had been proven effective. That left the NGO with an additional task: attracting more funding to sustain the watershed program beyond the first year.

Managing the program

The SENDAS team had to create an effective and transparent mechanism to manage program finances and oversee tactics and strategy. “We knew we had to make it public and ensure that decision making would be as democratic as possible,” Vidriales stressed. “If decisions are made in a small group, there are a lot of bad decisions, and people start to avoid the program. It also permits bad money management and corruption.” After a corruption scandal that rocked the Coatepec PES program (see *PES in Coatepec* text box), SENDAS planners wanted to put in place a system that would minimize the chance of corruption affecting the Pixquiac program.

The SENDAS coordinators decided to set up an umbrella committee that would include all program participants as well as representatives from groups that had interests in the watershed program: ejidos, four local NGOs, three higher education institutions, councils from all local municipalities, the state government, the National Forestry Commission, and the National Water Commission.

The committee, known as the Comité de Cuenca del Río Pixquiac, or Pixquiac River Watershed Committee, played a central part in the evolving design of the program, including setting priorities regarding which landowners and which land should be involved in the program. “All decisions about the program are taken to the committee,” said Fuentes. “First, we choose criteria to select candidates [program participants]. Then we revise each proposal and give points based on the criteria. . . . It is a slow procedure, but we prefer to do that than make fast executive decisions. [Without the committee], there would be no transparency and no empowerment process.”

Initially, Luisa Paré, one of the three coordinators of SENDAS, was director of the committee. After local community members gained experience working with the program,

Paré handed over the directorship to a local representative who had been elected by the program participants. “The committee gives the authority to the director to make the decisions,” Fuentes said. “The participants go to the [committee meetings] and say their main points and then tell the director to go and represent them. It takes a long time to make a decision, but it is important.”

Although SENDAS managed the day-to-day program work, the director of the committee played an active role in every aspect. “We go to Xalapa municipality to negotiate funds, and the director comes with us; and when we go to the national forestry commission or the Veracruz government, we go together,” said Fuentes.

SENDAS also created a technical committee of local experts to decide on specific program details, which then had to be approved by the watershed committee. After giving up directorship of the committee, SENDAS leaders sat on the technical committee and did not vote on decisions the watershed committee made.

Launching the program

SENDAS staff helped landowners complete the paperwork required to enroll in National Forestry Commission programs and also provided advice for other aspects of land management. “The government had not provided [free] technical assistance for decades, so the technical assistance we provided was appreciated,” said Gerez. Landowners already participating in National Forestry Commission programs had hired private technical advisers, a requirement to participate. SENDAS staff were recognized as technical advisers by the commission. While undertaking the work necessary to enroll landowners in the commission’s programs, SENDAS staff also informed landowners about the new, local PES program that the NGO was launching. Some ejidatarios were leery because of previous negative experiences with private technical

advisers. Earlier, the ejidos had hired the private advisers to help write best-practices manuals (a type of land management plan), and handle other paperwork required by the national PES program and other National Forestry Commission programs. But the advisers sometimes omitted important steps. As a result, the ejidos sometimes did not receive payments for the contracts they had signed. In one case, the technical adviser “took his share of the money and never went back to the ejido,” Vidriales said.

Other ejidatarios were open to SENDAS’s proposed PES program. Rafael Hernández, a trout farmer in the ejido San Andrés Tlalnelhuayocan, saw the benefits that forest conservation could provide. “We were interested in the program because we believed that conserving the forest would mean having more water, and I needed water for my trout,” he said. Hernández owned 6 hectares and enrolled 4.5 hectares of that in SENDAS’s local PES program.

Hernández was one of the first ejidatarios to join the program. Others, he said, “were scared to participate” because they did not trust the intentions of the NGO. “SENDAS needed all our legal property documents, and there was a rumor that they were going to steal the land,” he recalled. After the first participants received their payments, more people joined the program.

SENDAS staff worked closely with the ejidatarios throughout the year. “Our technical advisers go in the field with them and pay close attention to make sure the agreements are fulfilled,” said Vidriales. The National Forestry Commission paid each technical adviser for the land each enrolled in the commission’s programs, but according to Vidriales, the payments were not enough to provide a full salary for a private adviser who could work as closely with the ejidatarios as SENDAS did. SENDAS put the money it received from the National Forestry Commission toward paying staff salaries. Because SENDAS’s technical advisers were salaried

employees of the NGO, their pay did not depend on how many hectares they enrolled, and they could commit more time to managing and monitoring each hectare of land.

SENDAS provided other assistance for landholders as well, including helping ejidos get permits to harvest some of the trees on their land. Field staff ensured that the removal of the trees did not have a negative environmental impact and also helped the ejidatarios obtain the best sale price for their timber.

In 2007, SENDAS worked with San Andrés Tlalnelhuayocan and San Antonio Hidalgo, two ejidos located in the cloud forest part of the watershed. “They had forest cover in a good state of conservation, and the ejidatarios were interested in putting some areas into conservation and doing some reforestation,” said Vidriales. “That was the condition [to participate in the program]: they had to put some land into conservation and other areas into restoration, and then they could work the rest of their land.”

The number of ejidos involved in the program grew in 2008 as word spread throughout the watershed. “We started with two ejidos, and then another ejido, San Pedro Buenavista, the biggest one, came to us asking us to work there,” said Gerez. “That indicated to us that we were doing something right.” San Pedro Buenavista was located in the middle to upper watershed. In 2009, El Agua de los Pescados y Tembladeras, an ejido in the upper watershed, also joined the program.

Hernández, the ejidatario who farmed trout in the middle watershed, said that preserving the upper watershed was important for his business. “We had been worried about the river getting contaminated from activities in the upper part of the watershed,” he said. “It helped us a lot to know that SENDAS had our back.” made.

Encouraging forest protection and restoration

The watershed committee set the financial incentives to conserve and reforest based on

advice from the technical committee. The conservation program offered 1,000 pesos (approximately US\$90 at the time) per hectare per year to participating landholders who agreed to conserve their forests for five years, which was about three times what the national PES program offered. For reforestation, the committee paid 1,000 pesos per half hectare planted with a minimum of 500 trees. The restoration efforts focused on land next to rivers and on connecting fragmented areas of forest. Although the trees would consume more water in the short term as they became established, they would help regulate water flow and improve water quality in the longer term. SENDAS leaders negotiated with the National Forestry Commission and local tree nurseries to subsidize and grow tree species that were native to the cloud forest.

After participating in either reforestation or conservation for one year, landowners were offered grants and loans toward implementing a “sustainable productive project.” Those projects, designed to increase incomes, diversify the local economy, and promote sustainable land management, included initiatives to grow flowers and vegetables, operate fish farms, and improve dairy production through pasture rotation. The projects potentially would yield higher returns per hectare than existing alternatives.

Ejidatarios in the watershed had an average of four hectares each, and with the three different payments, they received an average of 7,000 pesos each (about US\$500-600), according to Fuentes.

Over time, SENDAS developed flexible funding mechanisms for productive projects. For example, introducing a pasture management program for dairy farmers was usually more expensive than other projects because of the costs of buying electric fences. According to María Luisa León, SENDAS’s head of PES who also oversaw several productive projects, the cost was sometimes more than 10,000 pesos depending on the number of cows and the total area of pastureland. SENDAS provided money to

pay all of the initial conversion costs and gave landowners one to two years to pay back half of the initial grant.

Another project involved producing vegetables. Women in the watershed grew vegetables seasonally for their families’ consumption, and they sold surplus produce in Xalapa. But according to León, “they were getting in trouble with the police for selling their vegetables on the streets.” The program introduced new growing techniques so the women could grow vegetables year-round, and SENDAS advisers negotiated with organizations in Xalapa so the women could sell their produce at a local farmers’ market, where they received a better price for the goods they sold.

As program participants came to appreciate the economic benefits of being involved in these activities, more people wanted to join, and the watershed committee had to restrict the number of projects because of limited financial resources. According to León, the committee decided who to include in projects based on “which land was most important for maintaining the health of the watershed and on the ejidatarios’ previous participation in the program, as well as their reputation within the local community.”

Ensuring compliance in forest conservation

León and other SENDAS staff monitored the forests enrolled in the PES program each year. “We walk through the whole forest—except the areas in big canyons that we can’t access,” León said. “By doing this, we can see tree stumps; and because we check each year, we know whether they are recent or old and we can see whether they show evidence of deforestation.”

Although the national PES program prohibited the felling of trees on enrolled land, León said, the local PES program included provisions that allowed landowners to cut trees under certain circumstances. “We let each landowner cut up to three trees a year—but only in cases of extreme financial need. They can only

cut trees of low environmental importance and the landowner has to inform us beforehand," she said. "They have to justify to the committee why they need to cut the trees—for example, if something unexpected happened and they need to build something for their house or if they need to sell the wood to pay for medical bills."

Although SENDAS's policy allowed for more tree cutting than the national PES program did, the NGO's monitoring was far more stringent than the National Forestry Commission's. "The National Forestry Commission has a monitoring process, but it isn't very effective," León said. "They look at satellite images but cannot see the finer characteristics of the forest. . . . They visit only a few of the areas each year—maybe 10 out of the 93 [plots of land enrolled]."

Because of its stronger monitoring, SENDAS was able to identify far more infractions than the forestry commission could. The watershed committee removed five participants from the program for egregious infractions from 2011 to 2015. "Last year, someone cut 10 trees from his two hectares in the program," committee president Don Juan Hernández said in 2015. "We decided to kick him out." made.

Developing a financial base

SENDAS leaders worried that the municipal water commission, which originally had pledged funding for the first year only, might stop financing their program at any time. Because of the uncertainty, they looked for other revenue streams. First, they turned to the state government, which in 2005 had launched a fund within the state agricultural ministry to support watershed management. In 2008, the ABC fund, named after the Spanish acronym for *water, forests, and watersheds*, offered to match the resources allocated to SENDAS by the municipal water commission. The money from the ABC fund doubled the program's budget. SENDAS also

received support from the Mexican Fund for the Conservation of Nature, one of Mexico's largest environmental nonprofit organizations.

A year later, SENDAS sought federal funding by contacting the National Forestry Commission, which was in the process of launching a matching funds program to support local PES initiatives. Paola Bauche, who designed the new program at the forestry commission, invited NGOs and other groups that managed local PES programs to apply to the commission for funding to increase the impact of their programs. "We wanted to use the commission's money more wisely and adapt it to local conditions," Bauche said.

SENDAS was accepted into the matching funds program for one year, and in late 2008, the National Forestry Commission contributed 25,000 pesos (approximately US\$2,000). The forestry commission increased their contribution the following year and after 2012 further increased their support to 500,000 pesos (approximately US\$40,000) per year. The commission made payments directly to program participants, but it allowed the landholders to work under the rules the SENDAS coalition had developed instead of those of the national PES program.

With the three revenue streams—from the municipal, state, and federal governments—the watershed committee became able to increase per-hectare payments and expand the number of hectares included in its program.

OVERCOMING OBSTACLES

Developing sustainable financial support for their program was the biggest difficulty that confronted SENDAS and the watershed committee. The SENDAS coordinators had sought to obtain long-term funding when they first started working in the Pixquiac watershed in 2005, but creating a long-term funding mechanism proved difficult. From 2007 through 2015, SENDAS struggled to sustain the local

government's interest in supporting the project. Local and state government representatives attended watershed committee meetings only when the protection of the watershed was high on the administrative agenda or when individual representatives took a specific interest in environmental issues.

Negotiating municipal funding

In 2008, the Mexican Fund for the Conservation of Nature invited SENDAS to join a national network of NGOs called Watersheds and Cities. The network, which was launched in 2001, linked NGOs that supported the sustainable management of watersheds throughout Mexico. Being part of the Watersheds and Cities network facilitated knowledge sharing about local PES programs, and the staff at the Fund supported SENDAS in their negotiations to renew their contract with the municipal water commission each year. Those negotiations "were a struggle," said González, the Director of Conservation at the Fund.

Fuentes said that the support SENDAS received from the Mexican Fund for the Conservation of Nature helped boost the NGO's credibility. The Fund's support "was very important for local negotiations with the state government and local government," he said. "It made them take us seriously."

But even the Fund's support failed to help SENDAS reach an agreement with the municipal council and the water commission in 2009. While the first contract that SENDAS signed for the PES matching-funds program was for one year, from 2009 onwards the forestry commission required local partners to sign a five-year commitment. That new criterion presented a problem for SENDAS. "Xalapa municipality was not able to make a longer-term commitment to the program," said Fuentes. "They gave us money each year, but each year we had to negotiate for it." The problem stemmed partly from a law that

prevented municipal councils from allocating money beyond their three-year elected terms.

When the municipal water commission refused to sign the five-year contract, members of the watershed committee decided that the committee should sign the contract directly with the National Forestry Commission. With no revenue stream of its own, the committee had to find sufficient funding to stay in the matched funds program each year regardless of whether the municipal water commission continued its support.

Two years later, negotiations with the municipal government were again difficult, and the watershed committee feared that the water commission would discontinue their financial support. This time, the committee decided to take a more confrontational stance. "The whole committee, with all of the ejidatarios, came down from the mountain to protest outside the municipal palace and pressure them," said Fuentes. Eventually, the protest made its point, and the program survived for another year.

Fuentes, Vidriales, and Paré saw citizen pressure as one way to press politicians to be more forthcoming with support. Through the Watersheds and Cities network, the three directors learned about an NGO in the north of Mexico that had set up voluntary payments from water users in the city to pay for a PES program in the nearby watershed. "It was not a lot of money, but it built awareness," said Vidriales. "If you want to create a social base, you need to get the [water] users involved."

To sustain citizen pressure on local politicians the SENDAS team members decided they needed a way to communicate regularly with residents. In 2012, they asked the water commission to collaborate by distributing leaflets and questionnaires about water issues through the commission's own billing system, but the municipal council blocked the planned campaign. The mayor "was terrified about the problems

people would raise in the questionnaire we wanted to distribute,” Vidriales recalled.

After Xalapa elected a new mayor in 2014, municipal support for the program grew. The new mayor revamped the municipal water commission and created a new department for watershed management. He appointed Beauregard, a lawyer, to run the new department.

Beauregard researched the water commission’s legal status and found that as a separate entity from the municipal council, the commission had the authority to sign agreements that continued for longer than mayoral terms. In 2015, with its newfound independence, the municipal water commission signed a contract with the watershed committee to fund the PES program through 2019. Later in 2015, SENDAS’s information campaign got off the ground. Vidriales said that attracting voluntary donations could serve the dual purpose of increasing funding and raising awareness about the water issues the municipality faced. She saw generating that support as an important factor in ensuring the program’s long-term sustainability. “You create a social base, and then, when there is a change in government, the people can pressure the new administration to keep the program,” she said.

The Veracruz Environmental Fund

Another of the program’s main sources of support also proved unreliable. In 2010, the state government’s ABC fund was embroiled in a corruption scandal and stopped providing support for all of its participating programs. In December, a new governor took office and immediately created a state environment ministry. Two years later, the new ministry resurrected the ABC fund and renamed it the Fondo Ambiental Veracruzano, or Veracruz Environmental Fund. The state government administered water delivery for 69 of Veracruz’s 212 municipalities and charged water users in those municipalities a 1% fee to finance the new environmental fund.

“First, we needed to build capacity and credibility,” said Victor Alvarado, the state’s first environmental minister. “Credibility is something that government institutions lacked.” For advice, Alvarado reached out to the Mexican Fund for the Conservation of Nature. González and her staff helped Alvarado and his team set up a committee to administer the money and ensure that recipients would be held accountable for their spending. “The technical committee of the Veracruz environmental fund is the only public trust in the country that has 50/50 representation from social organizations and government institutions,” said Alvarado. Independent experts from other parts of the country evaluated all applications for support.

In 2015, the Veracruz Environmental Fund signed a five-year contract with the Pixquiac watershed committee, committing 500,000 pesos (approximately US\$30,000 at the time) per year to support SENDAS’s productive projects. Alvarado expressed optimism that the state’s investment in the Pixquiac watershed would be successful and that SENDAS could replicate its model elsewhere. “We are hoping that NGOs can build local capacities and then retreat and start working in other areas and build capacities with other communities in the state. Unfortunately, there are not many NGOs with the morals and the technical skills to do this work. . . . SENDAS is one of the best examples of NGOs that are starting to have success.”

ASSESSING RESULTS

In 2015, 1,040 hectares of forest within the Pixquiac watershed were enrolled in SENDAS’s local PES program, and 81 individuals had signed contracts to preserve the forest through 2019. Twenty-four of those were involved in a “productive project,” such as vegetable production, as well as several more ejidatarios in the ejidos of San Pedro Buenavista and El Agua de los Pescados y Tembladeras. Those two ejidos had enrolled their common-use land—a total of

834 hectares—in the program, and payments were split among all the ejidatarios within each ejido. Individual ejidatarios had enrolled 0.5 to 9 hectares each, and private owners had enrolled up to 30 hectares each.

From 2010 to 2014, 33 landowners in the watershed left the program. Most had failed to provide sufficient documentation to meet program requirements. Four left voluntarily, and five were ousted for deforesting part of the land they had promised to conserve.

After pushing for reforestation efforts during the first five years of the program, planting 131 hectares of trees from 2006 to 2010, the watershed committee chose to focus more on conservation of existing forest and improving land management practices. “The reforestation program was reduced because most of the land that could be reforested had been reforested,” said León. “Everything that was not forest was being used for agriculture, and we could not ask people to stop growing corn or get rid of their cows in order to plant trees.”

Even with the payments from the local PES program, which paid landowners two or three times the average amount paid by the national PES program, conserving trees was not an attractive economic proposition by itself. “Each ejidatario in El Agua de los Pescados y Tembladeras gets 6,000 pesos [approximately US\$350 in 2015] each year from PES. I would say it is around 2% of their income,” said Fuentes. Although participating in the forest conservation program provided only a small monetary payment, it opened the door for other benefits such as the productive projects.

One of the most effective productive projects was with dairy farmers and cattle owners. “Before, farmers had maybe three cows per hectare, and the cows wandered everywhere—right up to water bodies—and there were no trees on the pastureland,” said León. “Now, they have electric fences to rotate pastures, and they have better-quality pastures. They have also reforested

areas near water bodies with native trees and planted fruit trees in the pastures.” After introducing this project in 2007, SENDAS expanded to working with 15 to 20 farmers in 2013. The NGO also helped farmers analyze the milk their cows produced and helped them improve the health of their livestock through veterinary visits.

As of 2015, SENDAS had not monitored the environmental impacts of its projects. Measuring environmental benefits was difficult because it would take several more decades to see the impacts the program had on erosion, carbon capture, biodiversity, and water quality and quantity. Fuentes said he could not say with certainty that total forest cover had increased since the program began, but he was confident that the density and biodiversity of the forest had improved.

The benefits the forest programs provided for water users were especially difficult to measure. According to Manson, the ecologist, water quality would likely improve far sooner than water quantity. He underscored the importance of SENDAS’s reforestation work in the first years of their program. “More forest cover, especially along [riverbanks], helps filter contaminants and increases water quality,” he said.

Manson said SENDAS’s program appeared to be on track to provide benefits to water users, but it would take decades for forest growth to make an appreciable impact on annual water flow and that flow would likely diminish initially because the younger trees had higher rates of evapotranspiration. At the same time, greater forest cover would likely improve *seasonal* flow in a shorter time frame. “Increased forest cover can reduce peak flows and flooding during the rainy season and increase base flow during the dry season,” Manson said.

The municipal water commission were satisfied with the progress SENDAS had made towards improving Xalapa’s water supply, and

continued to increase their support for the program. “I think the program has been a huge success,” said Beauregard. “The people [in the watershed] are committed to caring for the forest and are convinced that what they are doing is important.”

By 2015, the broad coalition between the landowners in the watershed, the water commission in Xalapa, the state government of Veracruz, and the National Forestry Commission had formed a strong base, and the program’s funding appeared sustainable for the foreseeable future. In March 2015, the municipal water commission signed a contract committing to support the program through 2019, a deal achievable only after the commission had gained greater independence from the mayor’s office. The state environmental fund also signed the contract, promising its support for a further five years as well. In 2015, the watershed committee received no support from the National Forestry Commission because of the commission’s own financial problems, but SENDAS staff were optimistic the commission would renew its commitment to the program in 2016.

The Veracruz environment ministry recognized the success of SENDAS’s work in the Pixquiac watershed during the 2005–15 decade and encouraged the NGO to expand its model to other watersheds in the state in need of restoration. In January 2015, SENDAS started working with the municipal government of Xico, a city close to Xalapa, to set up a similar program there with the local water commission and with communities in the watershed where the city’s water came from.

One of SENDAS’s, the Xalapa municipal government’s, and the state government’s main goals was to replicate the program in the Huitzilapan watershed, where local residents regularly threatened to shut down the pipes that delivered water to Xalapa. “We need a different approach there because a lot of political issues are at play,” Vidriales said in 2015. The municipal

water commission was pushing the NGO to develop the program soon. “The protests [that occur in the Huitzilapan watershed] do not happen in the Pixquiac watershed because of the work of SENDAS,” said Beauregard. “We hope to replicate the program in Huitzilapan within the next three years.”

REFLECTIONS

SENDAS’s program in the Pixquiac watershed showed how a local nongovernmental organization (NGO), by working in concert with other organizations with similar interests, made significant strides toward protecting forests and improving water quality.

The NGO’s work helped amplify the impact of a national payment-for-environmental-services (PES) program. When payments alone were too small to entice many farmers to conserve, a broader policy mix that focused on sustainable land management proved more effective. SENDAS took an approach that said, “Sure, we’ll make payments to people, but we’re also going to provide technical assistance that will promote other sustainable practices,” said Robert Manson, a Xalapa-based ecologist that advised the NGO.

Manson saw that more holistic approach as key to breaking “subsidy mentality” that he said had persisted in Mexico because of past rural development policies. “PES in Mexico has expanded rapidly because it has fit right into the subsidy mentality of politicians’ giving payments to rural communities in exchange for votes,” he said. “If you don’t break that subsidy mentality and provide options for more sustainable livelihoods, and if one day the program disappears, what has your long-term gain been?”

Because local farmers had indicated to SENDAS staff that they would likely choose to deforest if the payments stopped, reorienting the local economy toward sustainable management of the forest or hybrid agroforestry systems, instead of traditional agricultural production, could potentially provide a more sustainable solution.

Although the SENDAS team had success in improving land management in the cloud forest in the middle area of the watershed and in protecting pine forests in the upper watershed, in 2015 the team had yet to address deforestation pressures in certain other areas—such as the middle to lower watershed—where land sales were more common. Illegal logging persisted in some areas of the watershed as well. Georgina Vidriales, one of the director-coordinators at SENDAS, said those issues were largely beyond SENDAS's control, although the NGO had lobbied local governments to introduce regulations on land use in the lower watershed to prevent those moving to the area from clearing the forest.

At the policy level, the National Forestry Commission made progress in improving the effectiveness of its programs by collaborating

with nongovernmental organizations like SENDAS and—through the matched-funds program—by supporting payments for environmental services tailored to local conditions. Collaboration with other government agencies, however, was still lacking.

Veracruz environment minister Victor Alvarado said that lack of coordination between environmental ministries and agricultural ministries at both the state and national levels had created conflicting incentives for landowners. "The agricultural ministry has to reach targets . . . and increase the number of cattle," he said. "There is no vision of how this negatively affects the land. We [the Veracruz environment ministry] work with them near protected areas, but outside of that, there is no coordination."

¹ Luisa Paré and Patricia Gerez. "Al filo del agua: cogestión de la subcuenca del río Pixquiác, Veracruz." Mexico City: Secretaría de Medio Ambiente y Recursos Naturales, 2012. 75-100.

² Lev García and Francisco Rivas. "Condicionan Poblanos El Recurso De Xalapa." *Reforma*, March 16, 2006; http://materiales.am.com.mx/hemeroteca/2006/2006-03/16MAR2006/LERFB160306_04.indd.pdf

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