

Stakeholder Perceptions of Mexico's Payment for Environmental Services  
Program: A Comparative Study of Socioeconomic and Environmental Impacts  
in Oaxaca and Yucatán

by

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## Abstract

This study evaluates the impacts of Mexico's national Payment for Environmental Services-Hydrological program (PSA-H), which has been touted as one of the most successful payment for ecosystem services (PES) programs worldwide. Survey and interview data was collected in the Mexican states of Oaxaca and Yucatán in order to assess stakeholder perceptions of PSA-H on the ground. These stakeholders consist of professionals who have worked closely in the design or implementation of PSA-H, and both program beneficiary and non-beneficiary private property owners and community members. We analyzed this data by comparing stakeholder perceptions to PSA-H design assumptions for the following themes: forest valuation, the potential for ecosystem service market development, and poverty alleviation. Discrepancies that arise through this comparison help to illuminate how PSA-H design and implementation could be improved so as to generate greater and more sustainable socioeconomic and environmental impacts. Furthermore, contrasts drawn between the states of Oaxaca and Yucatán demonstrate different obstacles to successful implementation that the national program may encounter depending on underlying social, economic, or environmental conditions. Not only are these findings useful for informing PSA-H design as the program continues to evolve, but they are also applicable to the design and implementation of PES programs worldwide.

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## I. Introduction

Over the last two decades, payment for ecosystem services (PES) programs have gained momentum as a conservation tool. Hundreds of PES schemes have been implemented across the globe, from local to national scales (Landell-Mills & Porras 2002). Despite the growing popularity of PES as a conservation mechanism, there are few empirical evaluations of PES programs that demonstrate clear environmental or socioeconomic impacts. This study aims to contribute to this knowledge gap through the collection and analysis of stakeholder perceptions of one of the most prominent PES programs worldwide: Mexico's national level Payment for Environmental Services- Hydrological program (PSA-H) which has been in operation since 2003. The scope and success of the program resulted in Mexico's selection for a REDD+ pilot program.

This study is based on both qualitative interview data and quantitative survey data collected in the Mexican states of Oaxaca and Yucatán. While we alone conducted the interviews, two additional enumerators also collected survey data in each state. This survey data was collected as part of a national-level program evaluation of PSA-H conducted by Jennifer Alix-Garcia and Volker Radeloff at the University of Wisconsin, Elizabeth Shapiro at Duke University, and Katharine Sims at Amherst College, in collaboration with Mexico's National Commission of Forestry (CONAFOR)(Alix-Garcia, 2009). A comparative case study of Oaxaca and Yucatán was ideal because it provided an in-depth understanding of how PSA-H is implemented on the ground in very different environmental and socioeconomic contexts. These contrasts reveal key characteristics and considerations that should be incorporated into national program design and implementation, and offer general insights that can be used in the design of programs in other countries and contexts.

Forest valuation, ecosystem service market potential, and poverty alleviation were selected as the themes of this study because they pertain to central assumptions and objectives of original PSA-H design. By contrasting how these themes are incorporated into design and how they are perceived on the ground, we are able to assess the program's progress

towards its stated objectives. Forest valuation addresses how program participants perceive the value of their forests in comparison to PSA-H design forest valuation methods used to calculate per hectare payments. Ecosystem service market potential addresses participant and intermediary perceptions of the possibility for ecosystem service market transactions between participants and external buyers- an important theme since market development was one of the original intended goals of PSA-H. Finally, poverty alleviation addresses whether or not the program appears to be alleviating poverty through program payments to participants, which is one of the program's stated goals.

This study focuses on Mexico's Payment for Environmental Services- Hydrological (PSA-H) program because it is one of the largest and most complex PES schemes worldwide (McAfee & Shapiro, 2010) and includes both forest conservation and poverty alleviation objectives. The experiences of stakeholders in the Mexican states of Oaxaca and Yucatán are contrasted in order to understand how the program has been implemented under very different environmental, economic, and cultural contexts. A comparison of stakeholder perceptions of PSA-H in practice to the stated goals of PSA-H provides an understanding of the successes and shortcomings of the program and how it might be improved moving forward.

In making this comparison between PSA-H in practice and PSA-H design, three key themes are considered which are based on assumptions of PSA-H design. The first theme contrasts the way that program participants value their forests with the way that PSA-H assumes that participants value their forest. The PSA-H design calculates forest value, or the payment made to participants for conserving their forests, based on the national average opportunity cost of conversion to corn. By design, PSA-H assumes that landowners will be incentivized to conserve their forests as long as the payment offered exceeds the opportunity cost of land use conversion. This study evaluates whether landowners consider land use conversion in valuing their forests and what other values or reasons might contribute to land use decisions to conserve or deforest.

The second main theme of this study is based on the PSA-H design assumption that program participants will find ecosystem service markets or buyers at the end of the five-year contract term. This assumption is compared to stakeholder perceptions on the ground of the feasibility of market development and the potential to sell ecosystem services. In order to assess the likelihood that participants will engage with external ecosystem service buyers in the near future, this study also evaluates whether the program seems to impact participants' awareness of the environmental benefits of their forests.

The third central theme of this study addresses the PSA-H design assumption that the program will alleviate poverty through providing payments to poor communities or landowners. In order to address this assumption, this study explores whether PSA-H payment use and distribution methods are likely to alleviate poverty, particularly over the long term. Secondly, this study evaluates to what degree PSA-H is impacting the capacity building of participating communities. Internal collaboration, or the way in which a community organizes and works together, is used as the first indicator of community capacity building. The second indicator is referred to as external connectivity, or the extent to which communities are connected to external entities.

By drawing contrasts between stakeholder perceptions of PSA-H in practice and PSA-H design in regards to these three themes, this study aims to produce recommendations to improve PSA-H's ability to generate lasting conservation and socioeconomic impacts. Not only will these recommendations inform PSA-H design as it continues to evolve, but they will also be applicable to the development of other PES programs across the globe.

The remaining sections of the introduction provide an overview of key concepts that pertain to this study. First, the economic theory, current trends, and common criticism of PES programs are explained. Secondly, we discuss Mexico's PSA-H program design in detail. Finally, the last two sections explain cultural and legal institutions that shape community governance, and other factors that have impacted communal land ownership in Mexico and consequently have impacted PSA-H.

## **i. Payments for Ecosystem Services Concepts**

Payments for ecosystem services (PES) are voluntary transactions in which ecosystem services are bought from a provider conditional upon the continued provision of that service (Wunder, 2007). The payment, whether it exists in the form of a subsidy, bi-lateral contract, or market credit, is meant to incentivize the production of an environmental benefit that would not otherwise be produced. Depending on the form of payment, the voluntary transaction of a PES scheme occurs at some point along a continuum from a market-based policy instrument to an actual market.

The notion of providing payments as compensation for positive externalities is an economic concept that dates back to Coase in the 1960s. Coase made the argument that socially suboptimal outcomes can be improved through voluntary market-based transactions, as long as transaction costs are low and property rights are well-defined and enforced (Coase, 1960). More recently, PES has been touted as a potentially cost-effective approach to conservation (Ferraro 2001; Ferraro & Simpson 2002). In comparison with other conservation schemes, PES is also claimed to be institutionally simpler, more likely to contribute to economic growth on behalf of the supplier of ecosystem services, and to serve as a new opportunity for financing conservation (Pattanayak, 2010). In addition to environmental impacts, it has been hypothesized that participation in PES schemes may serve to improve land-tenure security, internal organization of communities, and the visibility of communities for potential donors (Kosoy, 2008).

Ecosystem services are goods, processes, and functions provided by natural ecosystems that benefit human beings, directly or indirectly (Costanza, 1997). Common examples of ecosystem services include carbon sequestration and storage, the provision of water resources, biodiversity conservation, and protection of landscape beauty (Wunder, 2007). The assumption of PES schemes is that these ecosystem services can be measured, valued monetarily, and sold to those who benefit from their provision. Through this market-like transaction, the true value of ecosystem services to humans is more adequately captured,

and presumably the conservation of ecosystem services is more strongly incentivized (McAfee & Shapiro, 2010).

The theory behind PES posits that in order to achieve cost effectiveness in a PES transaction, payments should slightly exceed the ecosystem service provider's opportunity cost, or the cost of the foregone alternative use for the land instead of enrollment in a PES scheme (Pagiola, 2002). According to this theory, if the payment is lower than the opportunity cost, the rational service provider will choose the alternative land use instead of PES participation. If the payment significantly exceeds the opportunity cost, then the buyer is wasting their money and could buy the service for a lower price (Pagiola, 2002). For this reason, in designing a PES program it would be important to obtain information about the opportunity costs, or potential alternative land uses of program sellers.

In recent decades, PES programs have become particularly palatable among developing countries (Arriagada, 2012). National programs in developing countries have tended to opt for subsidy-based schemes, as opposed to strict command and control or market trading of ecosystem services. This likely results from national conditions common to developing countries, including weak institutions, political pressures, and the joint objective of alleviating poverty in addition to achieving environmental outcomes (Ferraro, 2012). Additionally, developing countries host a great proportion of the world's remaining tropical forests, which provide many of the ecosystem services that may be protected under PES schemes (Pattanayak, 2010).

Despite the global proliferation of PES programs, some researchers caution that the environmental effectiveness of these programs depends on where and to whom payments are directed and the degree of compliance of ecosystem service providers (Arriagada, 2012). In order to address whether PES programs generate impacts, the central question of "additionality" must be answered. Wunder (2007) defines additionality as, "the difference in service provision between the with-PES scenario and the without-PES baseline." If there is no difference between these two states then the program has not made an impact. Information asymmetries are likely to contribute to the non-additional environmental



protection of PES programs. For example, landowners may have more information about the opportunity cost of supplying environmental services than the buyer, or a contract may not be enforced because of monitoring expenses or the political consequences of administering sanctions (Pattanayak, 2010).

While PES programs were initially developed with the intention of improving the efficiency of natural resource management, they have also been employed as a poverty alleviation tool (Pagiola, 2005). However, some argue that coupling conservation and poverty alleviation goals can compromise the economic efficiency of PES programs (Wunder, 2008). Particularly when federal governments administer PES programs, there is a threat that program payments will be used to pacify poor constituents at the expense of efficient and additional forest conservation. As an example of this phenomenon, Pattanayak et al. (2010) state, “In Mexico, efforts to spread payments ‘fairly’ throughout the country meant that a substantial share of funding went to areas at little risk of deforestation or with limit or no threats to water supplies.”

## ii. Mexico’s Payment for Environmental Services- Hydrological

Mexico’s Payment for Environmental Services program (PSA) is often considered to be one of the most successful and largest PES programs globally (Info Rural, 2008). This study focuses on the branch of Mexico’s PES program that pays for hydrological services- the PSA-H program established in 2003. PSA-H is designed to incentivize production of the hydrologic services of improved quantity and quality of water provided to downstream users (Shapiro, 2010). Forest cover is used as a proxy for provision of these hydrologic services (Corbera, Soberanis, & Brown, 2009). The goal of PSA-H is to enable enrolled ecosystem service providers to enter an ecosystem services market after their five year PSA-H tenure (McAfee & Shapiro, 2010). The PSA-CABSA program, which encompasses agroforestry, biodiversity, and carbon services, was subsequently established in 2004. To facilitate transition into a PES market, CONAFOR began a program called *Fondos Concurrentes*, or Matching Funds, in 2008. In this program, CONAFOR pays 50% of the project funds and assists program participants to find local water users to fund the remaining 50% (Herbert and Tepper, 2012).

Development of a Mexican national payment for ecosystem services scheme was proposed by the Fox administration in 2000, and subsequently incorporated into CONAFOR's 2000-2006 strategic plan (Alix-Garcia, de Janvry, Sadoulet, & Torres, 2005). The program's legal framework was established in 2003 by the General Law for Sustainable Forest Development, and a modification of Article 223 in Mexico's Law of Rights. These changes established the Mexican Forestry Fund as the financial entity responsible for market-based conservation schemes (Corbera & Brown, 2008). A 2.4% tax on water use was initially proposed to fund PSA-H, which would create a direct link between service users and providers. However, this idea was rejected by the government in favor of an annual allocation from the federal water fund (Muñoz-Piña, Guevara, Torres, & Brana, 2008). Coupled with weak ecosystem services markets, this flat fee has essentially established the program as a subsidy (Alix-Garcia, 2005). The program has also been funded through a 2006 US\$45 million World Bank loan, and a US\$14 million Global Environmental Facility grant (Herbert & Tepper, 2012). Several of the design team's other suggestions regarding payments were also rejected, including reverse auctions and differentiating per hectare payments to reflect true opportunity costs (McAfee & Shapiro, 2010).

Since the program's inception, there has been much debate and political negotiation regarding its rules and operation. The National Institute of Ecology was charged with developing the program, and a proposed pilot in 2002 outlined participant selection based on criteria of marginality, 80% forest cover, property rights, ecosystem types, and "priority watersheds," which are both overexploited and the main water source for population centers (Alix-Garcia, 2005). The responsibility of implementing the program was subsequently delegated to CONAFOR, and the aforementioned marginalization and overexploitation criteria were removed. In the year 2008—the cohort evaluated in this study—enrolled properties were required to have 50% forest cover, and areas of high water scarcity, aquifer overexploitation, and high deforestation risk were prioritized (CONAFOR, 2008). Poor and indigenous communities are also targeted as a consequence of the 2006 decision to include poverty alleviation as a main goal of PSA-H alongside forest conservation (McAfee & Shapiro, 2010). Participants must be either moderately or highly marginalized to participate in PSA-H; a criterion which has increasingly been emphasized

over water scarcity or proximity to downstream urban zones (Shapiro, 2010; McAfee & Shapiro, 2010; Muñoz Piña et al. 2006).

In exchange for hydrologic service provision, CONAFOR distributes annual payments to PSA-H participants during their PSA-H contract term (McAfee & Shapiro, 2010). Payments are calculated from the national average opportunity cost of land conversion from forest to corn agriculture, based on the logic that landowners will be incentivized to leave their forest standing if they are paid slightly more than the foregone income from alternative land use (Shapiro, 2010). The only payment differentiation is between forest types; while cloud forests receive higher per hectare payments because they are believed to play a more important role in water provision, all other forest types receive a uniform, lower payment (Muñoz Piña et al., 2008). As of 2008, cloud forests received a payment of MX\$860 per hectare each year, other forest types receive MX\$658 per hectare each year (CONAFOR, 2008).

Both communities and private properties are eligible to participate in PSA-H. The inclusion of communities is particularly pertinent, since approximately 80% of Mexico's forests are communally owned (Alix, Janvry, & Sadoulet, 2003). During their contract term, participants undertake forest conservation and management activities. For the 2008 cohort addressed in this study, required activities include posting signs that indicate PSA-H enrollment; prevention of hunting, and deforestation; maintenance of forest cover; and avoidance of land use change. Participants choose additional management activities from several options provided in the Guide of Best Management Practices (*Guía de Mejores Prácticas de Manejo*), such as reforestation or the construction of firebreaks (Secretaria de Medio Ambiente y Recursos Naturales, 2011). Program funds are set aside to contract a third-party technical advisor, or *técnico*, who develops Plan of Best Management Practices (*Plan de Mejores Practicas de Manejo*) (Herbert and Tepper, 2012). CONAFOR monitors program compliance through on-site verifications and satellite images. Between the beginning of the program in 2003 and 2009, 2.27 million hectares of forest were enrolled, with over \$360 million USD paid to the 4,893 participating property owners (McAfee & Shapiro, 2010).

### iii. The Mexican Rural Context

After the Mexican Revolution, community-based land tenure regained prominence in Mexico. Today, over half of the country's land is managed under community-based tenure and 80% of the country's forests are held by communities (Klooster & Masera, 2000; Bray & Perez, 2004). Over the past two decades, however, threats to the stability of community-based tenure have emerged. The first threat was Article 27- the 1992 amendments of Mexico's Constitution, which legalized the conversion of *ejido* tenure to private land tenure, legalized joint ventures between *ejidos* and private interests, and terminated the distribution of land to rural communities (Barnes, 2009). The emphasis on the privatization of communal lands was a neoliberal policies that emerged in response to the national economic issues of the 1980s, when hyperinflation exceeded 150% (Barnes, 2009). Beginning in 1993, a government program called PROCEDE (*Programa de Certificacion de Derechos Ejidales*) served to implement this new policy by certifying land for conversion to private property. As of 2008, 92% of all *ejidos* had joined PROCEDE, but only 3% had chosen to convert their land into private property and terminate the community governance system (Kosoy, 2008).

In addition to the Article 27 reforms, the ratification of the North American Free Trade Agreement (NAFTA) in 1994 also presents a threat to the resilience of community-based tenure. NAFTA has decreased the prospects for profitability among rural Mexican smallholders as the national agricultural sector was opened up to the global market (Barnes, 2009). Liberalization of the Mexican rural economy required the reduction of tariffs and elimination of price guarantees for commodities. As subsidies were withdrawn, small Mexican farmers faced increased input and capital costs, and steep competition from international imports. Since the implementation of NAFTA policies, poverty and income inequality have increased while employment in the agriculture sector has decreased (Barnes, 2009).

In order to cope with the changes to the rural economy of the 1990s, rural populations have pursued migration strategies, both to the United States and to Mexican urban centers.

This trend of out-migration presents the third threat to community-based land tenure. As people leave the countryside, it becomes increasingly likely the community-based tenure systems will be dismantled (Barnes, 2009).

Since the ratification of NAFTA and the liberalization of the agricultural sector, the Mexican countryside has become increasingly unstable (Gravel, 2007). There has been an overall decline in subsistence agriculture, paralleled with increasing rural poverty and food insecurity. Additionally, there is an underdevelopment of rural infrastructure and human capital and a lack of access to arable land, water, credit, technical assistance, and agricultural equipment (Gravel, 2007). As a result of these trends, rural populations have demonstrated an increasing dependence on migration remittances (Gravel, 2007). Mexican small agricultural producers are disorganized, disconnected, and have little clout or capacity for negotiating at the national level on agri-business or export strategies (Gravel, 2007).

However, NAFTA impacts were not uniform throughout Mexico. Although many states showed economic growth in the period following NAFTA, the country's southern states—including Oaxaca—did not experience these same benefits (Flores, 1999). As a fairly non-modernized agricultural state with little irrigation, mechanization, or improved corn varieties, Oaxaca unable to reap the benefits of more modernized corn production (Esquivel, Lederman, Messmacher, & Villoro, 2002).

#### **iv. Community Governance**

During the post-revolution period, from the 1930s to 1980s, thousands of communities were granted communal land ownership rights across the Mexican countryside (Kosoy, Corbera, & Brown, 2008). These communities are referred to as *nucleos agrarios*, and specifically include *ejidos* and *bienes comunales*. Only certain members of *nucleos agrarios*, called *comuneros* or *ejidatarios*, have the right to vote in the community general assembly and to use communal land. These *comuneros* and *ejidatarios* are generally male heads of household. *Comunero* or *ejidatario* status is traditionally passed by patrilineal descent.

Community members who do not hold land or voting rights, but may be temporarily allotted land by a rights-holder, are referred to as *avecindados* or *posesionarios*.

Through the general assembly, or *asamblea*, *nucleos agrarios* have the latitude to make decisions regarding community statutes and land management (Bray & Merino-Pérez, 2002). Traditionally, voting is either by majority rule or consensus of *comuneros* or *ejidatarios* (Antinori & Rausser, 2007). Community governance positions, called *cargos*, are held on a rotating basis with duration of several years. *Cargos* are unpaid positions awarded on merit, which community members are obligated to serve as compensation for their privileges as *comuneros* or *ejidatarios* (J. P. Robson, 2007; Merino Perez, Gerez Fernandez, & Madrid Zubiran, 2000). The system is hierarchical, such that completion of a cargo makes an individual eligible for a higher-level cargo with more responsibility.

The *Comisariado de Bienes Comunes* or *Comisariado Ejidal*, depending on the type of *nucleo agrario*, is the supervisory committee responsible for managing community assets, as well as the allocation and management of communal land and resources. The *Comisariado* is typically comprised of a president, secretary, and treasurer. Another important committee is the *Consejo de Vigilancia*, which is charged with oversight of community governance and ensuring that community decisions and actions abide by the law (J. Robson & Berkes, 2011). Another integral community institution is the community workdays, referred to as *tequios* (in Oaxaca) or *faenas* (in Yucatán). *Tequios* or *faenas* are mandatory community service workdays in which all capable *comuneros* or *ejidatarios* participate in community projects, such as maintaining roads or building firebreaks (Vanwey, Tucker, & McConnell, 2004).

## **v. Oaxaca and Yucatán State Characteristics**

This study draws similarities and differences between PSA-H implementation in the states of Oaxaca and Yucatán. A comparative analysis of these two states allows us to understand how program implementation and outcomes differ under varying environmental and socioeconomic contexts. Oaxaca and Yucatán are two of the poorest states in the country,

as indicated by the prevalence of poverty and extreme poverty. While there is a strong indigenous presence in both states, Oaxaca's indigenous population is divided into numerous ethnic groups and languages, whereas the majority of Yucatán's indigenous population is Maya. Economic sectors in both states are similar, with the prevalence of subsistence agriculture. Environmental characteristics in Oaxaca and Yucatán are distinct: Oaxaca's mountainous land supports a variety of forest types and high biodiversity, whereas Yucatán's flat land is less biodiverse. The diverse forest types in Oaxaca yield more valuable timber species, coffee, and non-timber forest products than in Yucatán. Both states are predominantly rural, and have experienced increased rates of emigration to the U.S. in recent years.

#### ➤ Poverty and Indigeneity

The National Council for the Evaluation of Social Development Policy (CONEVAL) ranks Oaxaca as the fourth poorest state in the country (Gobierno del Estado de Oaxaca, 2011). 67.4% of Oaxacans live in poverty, and 29.8% of the state's population is further classified as living in extreme poverty- defined as living on less than \$1.25USD per day (CONEVAL, 2011). Meanwhile, 48.5% of Yucatecans live in poverty, and 11.7% of the state's population lives in extreme poverty (CONEVAL, 2011). Based on these statistics, it is clear that while poverty is a serious issue in both states, poverty—and particularly extreme poverty—is more prevalent in Oaxaca.

Oaxaca and Yucatán also have weaker educational systems than most states in the country. Of all states, Oaxaca has the second lowest average number of school years completed- 6.9 (Gobierno del Estado de Oaxaca, 2011). Yucatán's educational system ranks in the bottom quarter of all states (Gobierno del Estado de Yucatán, 2007). However, compared with Oaxaca, Yucatán's illiteracy rate is much closer to the national average of 6.88%. In Yucatán, 9.23% of the population is illiterate, while 16.27% of Oaxacans are illiterate (INEGI, 2011).

Indigenous peoples comprise a large portion of both the Oaxacan and Yucatecan state populations. As of 2005, 45% of Oaxacans and 53% of Yucatecans self-identified as

indigenous (UNDP, 2010). However, the states differ markedly in regards to the diversity of indigenous groups. Sixteen indigenous languages are spoken in Oaxaca (Bernard, 1992), while 59.2% of the indigenous population in Yucatán speaks one language- Maya. In both states, the indigenous populations are more disadvantaged than the non-indigenous population. In 2010, the Human Development Index (HDI) for non-indigenous people in Oaxaca was 0.74, while the value for indigenous people was 0.66 (UNDP, 2010). In Yucatán, the HDI value for indigenous people was 0.71 and 0.79 for non-indigenous (UNDP, 2010). HDI is a standard statistic used to measure quality of life. It incorporates life expectancy, education, and income, and ranges between values of 0 for undeveloped countries and 1 for highly developed countries. Of the 32 Mexican states, these values place Oaxaca in 24<sup>th</sup> and 23<sup>rd</sup> place for lowest HDI for indigenous and non-indigenous populations, respectively. In contrast, the HDIs in Yucatán rank 15<sup>th</sup> for the indigenous population and 5<sup>th</sup> for the non-indigenous population (UNDP, 2010). Similar to the previously stated poverty statistics, these HDI values demonstrate that Oaxaca ranks below Yucatán in regards to human development.

#### ➤ Economy

In both Oaxaca and Yucatán, the three largest economic sectors are manufacturing, commerce, and real estate, measured as the proportion of total state gross domestic product (GDP) (INEGI 2011). In Oaxaca, 33% the state's employed population works in services, 30% in agriculture or animal husbandry, 16% in commerce, and 13% in the manufacturing industry (INEGI, 2011). In Yucatán, 18% of the state's employed population works in commerce and in manufacturing respectively, 11% in agriculture or animal husbandry, and 44% in services. The agricultural sector generates only 12% of Oaxaca's GDP. Similarly, agriculture, ranching and timber harvesting combined only account for 4% of Yucatán's state GDP (INEGI 2011).

Yucatán and Oaxaca have a similar proportion of land dedicated to agriculture- 14% and 16% respectively (INEGI 2011). However, agriculture contributes minimally to both state GDPs and to national production of agricultural crops, likely because of the prevalence of



subsistence agriculture in both states. Additionally, agriculture in both states is predominantly rain fed - 96% in Oaxaca and 92% in Yucatán (INEGI 2011).

Although Oaxaca produces a notable proportion of the country's timber, neither state makes a substantial contribution to national non-timber forest production. Oaxaca ranks fourth out of Mexico's 32 states for volume of wood production. It produces 7.6% of the country's wood by volume- predominantly pine species for pulpwood construction.

Oaxaca's non-timber forest production is reportedly only 0.3% of the national total, though much of the non-timber forest production is likely not captured by national statistics due to the fact that it is primarily subsistence production or distributed within the informal economy. Yucatán produces less than one percent of both national timber and non-timber forest products (INEGI, 2011).

Oaxaca is the country's second greatest coffee producing state (Lewis, 2005). 90% of the coffee-growing area in Oaxaca is cultivated by indigenous producers on parcels of 5 ha or less (Bezaury, 2007). Since the coffee crisis of the 1990s, many small producers have been forced to migrate to cities in search of employment. This migration trend has led to a cycle of poorly maintained coffee plantations, land abandonment, or conversion to more intensive land use (Blackman, Albers, & Crooks, 2005).

The international exportation of henequen—a fiber-producing plant—played a pivotal role in the Yucatán economy from the 1850's through the late 20<sup>th</sup> century. Henequen is ideally suited to the state's harsh environmental conditions, characterized by lack of water or cultivable soil (Joseph, 1982). Much of Yucatán's *selva mediana* was deforested for the development of henequen plantations (Gonzalez- Iturbe 2002). Yucatecan henequen production eventually succumbed to international competition, beginning in the 1920s. This economic downturn forced the state to rely heavily on federal support from the 1960s through the early 1990s (Eastmond, 2000). This henequen crisis resulted in vast desertification of plantation lands and subsequent forest regrowth. Approximately 7% of the originally cultivated henequen land remains in henequen production, while the rest has been transformed to cattle ranching or agriculture, or has been abandoned to vegetation regrowth (Gonzalez- Iturbe 2002).

### ➤ Environmental Characteristics

The convergence of three mountain ranges in Oaxaca creates highly variable topography, ranging from sea level to 3,720 meters (Oficina Estatal de Información para el Desarrollo Rural Sustentable, 2005). This topography change drives wide annual temperature and precipitation ranges, which in turn support approximately 15 forest types. Pine-oak, montane wet, and montane rainforests are most common forest types in the state (Gobierno del Estado de Oaxaca, 2010). Due to its diverse geophysical environment, Oaxaca is one of the most biodiverse states in Mexico. Oaxaca is home to the highest number of reptile species, second in bird and mammal species, third in flowering plants, second in fern species, and fourth in species of pine trees (SEMARNAT, 2010). In addition to its high species diversity, Oaxaca has a high degree of endemism.

In contrast to Oaxaca, Yucatán is quite flat, with a maximum altitude of 210 meters (INEGI, 2012). Yucatán is less biodiverse than Oaxaca, and consists of three predominant forest types: *selva mediana subcaducifolia* and *caducifolia* (semi-deciduous and deciduous jungle of medium height), and *selva baja caducifolia* (low deciduous jungle) (SEMARNAT, 2006). In Yucatán, 75% of the total annual precipitation occurs during the rainy season, which lasts from May to October and increases the susceptibility to droughts and floods. Calcareous rock underlies much of the land, making for rocky and largely uncultivable soil (Gonzalez- Iturbe 2002).

### ➤ Land Tenure and Use

Of Oaxaca's land area, 26% is privately owned, 41% is communal and 33% is *ejidal* (INEGI, 2011). Approximately 55% of Yucatán's land is privately owned, while the remaining 45% is occupied by *ejidos* (INEGI, 2010). 42% of Oaxaca's land surface is primary forest, 23% is secondary vegetation, 16% is agriculture, and 14% pasture (INEGI, 2011). 74% of Yucatán's total land area is secondary vegetation, 22% is agriculture, 1% pasture, 1% jungle, and 1% urban area (Gobierno del Estado de Yucatán, 2007).

Many of Oaxaca's common forest types yield valuable timber species as well as non-timber forest products, including resin, coffee, and fruit. Firewood collection for cooking fuel is

common throughout the state, which presents a threat to forest health (Ventura-Aquino, Rendón, Rebollar, & Hernández, 2008). In Oaxaca's highlands, much of the forest has been cleared for agriculture, cattle grazing, and timber harvesting (Asbjornsen, 2004). Although these forests are capable of regenerating in 3-4 years, continued firewood harvesting, land use, and fire suppression reduce regeneration rates. A recent study suggests that the low-intensity anthropogenic disturbance predominant in Oaxaca's highland forests has created a shifting agriculture-forest mosaic that supports both heterogeneous forest structure and high biodiversity (J. P. Robson & Berkes, 2011). Meanwhile, increased outmigration and consequent abandonment of farmland may actually decrease localized biodiversity. These findings suggest that indigenous people in Oaxaca should be considered an "agent of landscape renewal" rather than a destructive force (J. P. Robson & Berkes, 2011).

In Yucatán, anthropogenic activity has significantly degraded half of the state's vegetation over the last twenty years. This degradation has largely resulted from slash and burn agricultural practices and some timber harvesting. Approximately 40% of the coastal dune ecosystem has been destroyed, which is threatening some of the endemic species of the area (Gobierno del Estado de Yucatán, 2007). However, the causes and impacts of this environmental degradation are not well established, particularly given evidence that traditional shifting agriculture in Yucatán—which is attributed as a primary driver—potentially increases biodiversity by creating a vegetation mosaic (Barrera-Bassols & Toledo, 2005; Faust, 2001). In an effort to decrease land use pressures and generate income, Mexican environmental protection agencies have promoted the development of ecotourism in Yucatán (Garcia-Frapolli, 2007). The archaeological and natural sites of the Yucatán Peninsula have become some of Mexico's main tourist attractions over the last three decades. More than six million tourists visit the region each year (SEDETUR, 2006). This ecotourism approach assumes that tourist activities and infrastructure are less environmentally destructive than the traditional productive and extractive activities of local inhabitants, such as subsistence hunting or felling and burning forests for the development of agricultural plots (Garcia-Frapolli, 2007).

➤ Conservation

Oaxaca has a strong presence of non-governmental organizations (NGOs). Efforts to protect the Chimalapas rainforest through the *Comite Nacional para el Defenso de las Chimalapas* in the 1990s served as an impetus for conservation in the state (Umlas, 1998). One of the largest NGOs in the state is the World Wildlife Fund (WWF). Their *Bosques* program, initiated in 1990s, works in several priority ecosystems in Oaxaca and emphasizes community capacity building (Walker, Roberts, Jones, & Frohling, 2008). Another conservation milestone in Oaxaca was the Secretary of the Environment and Natural Resources' (SEMARNAT) collaboration with NGOs to form eight regional Natural Resource Committees within the state.

Two well-known PES-related conservation efforts in Oaxaca are *El Comite Regional de Recursos Naturales de la Chinantla Alta A.C.* (Corenchi), and *Servicios Ambientales de Oaxaca A.C.* (SAO). Corenchi is comprised of six agricultural communities that joined together in 2005 towards the goal of conservation and sustainable natural resources uses. In addition to becoming certified as a Community Area under the National Commission of Protected Areas (CONANP), the communities enrolled in PSA-H collectively (Anta, Mondragon, & Lavin, 2006). SAO is an ecosystem services-based organization based in Oaxaca's capital that builds capacity in rural communities to manage their forests for ecosystems resources and sell these ecosystem services. They currently work with ten communities on long-term carbon capture projects, and are beginning to explore water provision services (Servicios Ambientales de Oaxaca, 2012).

A strong community forestry sector has emerged in the last few decades, and has been touted as the next step towards achieving poverty alleviation, economic development, and forest preservation (Antinori & Bray, 2005). There were an estimated 290-420 community forestry enterprises in Mexico by 2002, including many in Oaxaca (David, Bray, & Merino-Pérez, 2002). One Oaxacan example is the well-known Zapotec-Chinantec Union, or UZACHI (Antinori & Bray, 2005). In some such projects, forest cover has stabilized or increased, and logging profits are re-invested in other endeavors, including water bottling, ecotourism, or resin production (Hébert & Gabriel, 2007).

As of 2009, 11% of Yucatecan land had been designated as a protected area (SEMARNAT, 2010). Over the last twenty years, an increased focus on environmentalism has also led to the development of community-based conservation programs in Yucatán. Two such initiatives include the Parks in Peril program and *Empleo Temporal* (Temporary Employment), which have helped to enforce the rules of natural reserves and have contributed to a decline in deforestation (Rueda 2010). Increased forest cover has also been attributed to the development of ecotourism in northeastern Yucatán Peninsula (Garcia-Frapolli, 2007).

➤ Migration and Urbanization

As a predominantly rural state, 52.7% of Oaxacans live in localities of 2,500 or fewer inhabitants, and 77% of the state's localities are smaller than 250 people (Gobierno del Estado de Oaxaca, 2011). However, widespread migration is shifting the rural-urban balance and threatening traditional community institutions (Gobierno del Estado de Oaxaca, 2011). The decline in middle-aged male *comuneros* and *ejidatarios*—community rights-holders—leaves a vacuum of candidates to take on *cargos* and participate in *tequios* (J. Robson & Berkes, 2011). During the first half of the 1900s, migration within Oaxaca was temporary- primarily to cities within Mexico (Durand & Massey, 2012). Lack of economic opportunity in Oaxaca has increased migration to the U.S., and the increased difficulty of crossing the U.S.-Mexico border has led immigrants to stay for longer periods of time. Additionally, the coffee crisis of the 1990s has forced many Oaxacan coffee farmers to migrate in search of employment (Bezaury, 2007). INEGI, reports a 21.6% rate of emigration from Oaxaca to the United States between 2004 and 2009 (INEGI, 2011).

Similar to Oaxaca, 93 of Yucatán's 106 municipalities are predominantly rural.

Approximately 40% of the state population lives in the capital, Merida, while the rest of the population is dispersed (Gobierno del Estado de Yucatán, 2007). Rapid urbanization has occurred along tourist areas of the Yucatán coast (Gobierno del Estado de Yucatán, 2007). Tens of thousands of Yucatecans have migrated from the countryside to Merida in pursuit of education or employment. The majority of emigrants leave Yucatán to find employment in the thriving tourism industry in Quintana Roo (Gobierno del Estado de Yucatán, 2007).

In addition to growth of the tourism industry, decreased agrarian support from the government has driven migration from the countryside to cities, both temporarily and permanently (Torres, 2011).

Emigration from Mexico to the United States has intensified in the 21<sup>st</sup> century, with approximately 20% of Mexican households participating in migration (Delgado Wise, 2003). Southern Yucatán in particular has experienced a dramatic increase in migration, partly attributable to recurring crop failures as a result of severe drought, increasingly variable rainfall, and hurricanes. A regional crisis in semi-subsistence agriculture combined with a lack of alternative income generating activities has driven increased international migration (Radel, Schmook, McCandless 2010). Between 2004 and 2009, 6.3% of Yucatecans migrated to the U.S. (INEGI, 2011). The liberalization of Mexico's agricultural sector, which began in the early 1990s with the Federal Agrarian Reform Law and NAFTA, was also a major driver of migration in Yucatán. Discontinuation of state-guaranteed crop prices decreased the profitability of smallholder farming, and amplified the attractiveness of U.S. employment opportunities (Schmook & Radel, 2008). In response to the legal changes impacting the rural economy, many *ejidos* amended internal rules to allow for greater migratory flexibility. For example, amendments enabled *ejidatarios* to maintain their *ejidal* rights despite extended absences from the community (Schmook & Radel, 2008).

## II. Methods

The traditions of inquiry for this study are formative evaluation and case study (Ernst, Monroe & Simmons, 2009; Yin, 1994). We utilized mixed methods, gathering both survey and interview data that was collected in the Mexican states of Oaxaca and Yucatán from June-August 2011 (Figure 1). In each state, surveys were conducted by one survey team, each comprised of three individuals. In addition to serving on these survey teams, the researchers of this study simultaneously conducted interviews in Oaxaca and Yucatán, respectively.

## Surveys

The surveys were implemented as part of a national-level research investigation undertaken by principal investigators Elizabeth Shapiro of Duke University, Jennifer Alix-Garcia and Volker Radeloff of the University of Wisconsin-Madison, and Katharine Sims of Amherst College, in collaboration with CONAFOR (Alix-Garcia, 2009). This investigation is an evaluation of the environmental and socioeconomic impacts of PSA-H, based on survey and global positioning (GPS) data for the 2008 program cohort. The surveys were conducted at the household level, and addressed themes regarding socioeconomic conditions, household characteristics, economic productivity, income and expenditures, land use, and participation in PSA-H program activity. The principal investigators of this study granted us access to select survey data from Oaxaca and Yucatán that we deemed particularly relevant to our study.

The survey sample was designed to construct a counterfactual that demonstrates how PSA-H beneficiaries would have behaved had they not received payments. In order to create this counterfactual, PSA-H beneficiaries of the 2008 cohort are compared to non-beneficiaries who applied to the program in 2008 but were rejected on the basis of administrative issues, insufficient forest cover, or location outside eligible zones. The administrative issues largely pertained to incomplete paperwork or the overall lack of funds to accept all who applied. Beneficiary properties were then matched to non-beneficiary properties based on geographic characteristics such as slope, distance to roads, and forest type. Based on this selection of treatment and control groups from the 2008 applicant pool and the subsequent matching process, the beneficiary and non-beneficiary properties are assumed to be similar in regards to unobservable characteristics like selection in treatment and institutional capacity to apply. Through the construction of this counterfactual, the study can make inferences in regards to program impacts.

Separate surveys were carried out with private property owners, community members, and community leaders of beneficiary and non-beneficiary groups. Ten community members were randomly selected to participate in the survey in each community, including five rights holders and five non-rights-holders. In the event that there were not five non-

rights holders, additional rights-holders were surveyed in order to reach the required ten surveys per community. For this study, the survey sample used for Oaxaca and Yucatán was as follows: 48 beneficiary and non-beneficiary private properties, 32 beneficiary and non-beneficiary community leaders, and 187 beneficiary community members (Table 1). This data was analyzed using basic summary statistics and t-tests for significant differences between Oaxaca and Yucatán.

Table 1. Survey sample by stakeholder group

	Private Properties		Community Leaders		Community Members
	Beneficiary	Non-Beneficiary	Beneficiary	Non-Beneficiary	Beneficiary
<b>Oaxaca</b>	15	9	8	6	80
<b>Yucatán</b>	10	14	11	7	107
<b>Total</b>	25	23	19	13	187

## Interviews

Semi-structured interviews were completed during the survey field excursions to private properties and communities, and therefore the interview sampling frame for program participants is the same as the survey sampling frame. However, in addition to the community member and private property interviews, semi-structured interviews were also conducted with intermediary stakeholders, including CONAFOR employees, technical forestry advisors called *técnicos*, and local government officials. The interviews focused on themes of forest management practices, understanding of ecosystem service markets, perceived forest benefits, community capacity, and the program’s potential to generate long term impacts in regards to these themes (Appendix A).

In most cases, the semi-structured interviews were carried out with the heads of households that were randomly selected to complete the survey in each community. Occasionally, other community members were interviewed so as to incorporate the perceptions of other demographic stakeholder groups. For example, wives of the head of households, community leaders, and some younger members of communities were also



interviewed. The intermediaries interviewed in each state were selected based on their knowledge and experience with PSA-H design or implementation in the region.

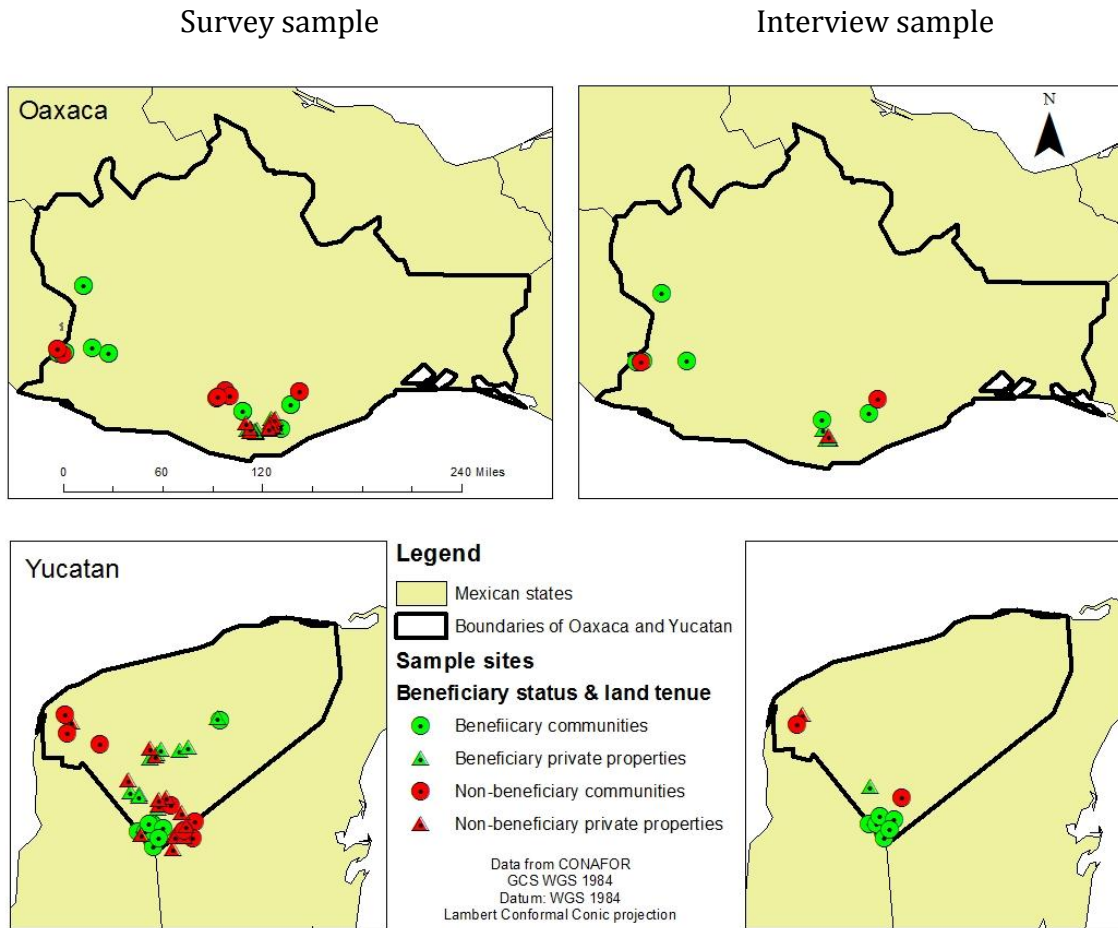
The interview sample in Oaxaca was comprised of eight private properties, including one non-beneficiary; 14 community members in nine communities, including three non-beneficiary community members; and 10 intermediaries: two current CONAFOR employees, two former CONAFOR employees, five *técnicos*, and one local government official (Table 2). In Yucatán, 22 community-members were interviewed in 11 different communities, including four non-beneficiary community members; two private properties; and four intermediaries: three current CONAFOR employees and one local government official. Three separate interview guides were developed for each of these populations (Appendix A). When appropriate, these interviews were recorded. All interviews were transcribed, and NVivo was used to code for themes and analyze respondents' answers in relation to specific attributes (Appendix B).

Table 2. Interview sample by stakeholder group

	Private property owners		Community members		Intermediaries			Total
	Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary	CONAFOR employees	Technical advisors	Government officials	
<b>Oaxaca</b>	7	1	11	3	4	5	1	32
<b>Yucatán</b>	2	1	18	4	3	0	1	29

This study follows a dominant/less dominant parallel mixed methods design, in which both types of data were collected simultaneously, but the qualitative data is emphasized (Creswell and Plano, 2007). The quantitative data is embedded within the qualitative data; the quantitative data provides a supportive, secondary role. In analysis of our data, themes from the interviews are analyzed, and complementary quantitative data is integrated where appropriate.

Figure 1. Survey and interview samples in Oaxaca and Yucatán



The study emphasizes qualitative data because the topics explored are more nuanced and complex, such as perceptions of forest value, awareness of forest benefits, and community dynamics. These themes are not easily quantifiable and are better understood through conversations with stakeholders. The surveys obtained more data from many more participants in each state than the interviews, serving to both complement and expand the scope of the qualitative data. The quantitative survey data fills some of the qualitative data gaps while the qualitative interview data enriches our understanding of the dynamics behind the quantitative results. Overall, the use of quantitative data in conjunction with qualitative data allows for triangulation. Particularly with a fairly small sample size, comparing results from the interview and surveys provides more confidence in our results, and more data to support our conclusions.

Data analysis is structured around three key assumptions of PSA-H design that pertain to forest valuation, ecosystem service market development, and poverty alleviation. In addressing each of these themes, stakeholder perceptions of the program and its impacts on the ground are compared to the program design objectives and assumptions. This analysis framework allows for a more thorough understanding of how the program is affecting participants in the states of Oaxaca and Yucatán, and how program design might be improved to more effectively meet the goals of efficiently incentivizing forest conservation, preparing ecosystem service providers to interact in a market setting, and alleviating poverty among program participants.

### **III. Results**

#### **i. Forest Value**

PES programs are based on the underlying economic principle that potential participants decide whether to enroll based on an internal calculation of the opportunity cost of land conversion. If the opportunity cost of conversion to a competing land use—such as pasture, agriculture, or timber—is greater than the PES payment, the participant will choose to pursue this activity rather than enrolling in the PES program. Conversely, participants will enroll if PES payments are higher than their opportunity cost. An ideal PES design should set payments equal to or slightly greater than participant opportunity cost and transaction costs. If payments are not accurately calculated, the effectiveness and economic efficiency of the program are compromised. For example, if a participant receives a payment that is significantly greater than the opportunity cost of conversion, then this participant could have been incentivized to participate in the program in exchange for a lower payment. By offering a payment that is greater than necessary, the program is wasting money that could otherwise have been awarded to an additional participant.

However, opportunity cost calculated by PSA-H designers may differ from the opportunity cost calculated by potential participants. The PSA-H design assumption is that program participants value their forest based on the potential to convert to agriculture or other non-conserving uses. This is indicated by the calculation of PSA-H payments based on the

national average opportunity cost of conversion to corn (McAfee & Shapiro, 2010). To assess how PSA-H applicants on the ground assign value to their forest, this study explores whether landowners value their forest for reasons other than the potential economic gain from land conversion and, if so, what other values influence individuals' choices to conserve or deforest. Interviewee perceptions of forest values were assessed through a number of questions so as to capture internal and external benefits; natural, monetary, and other use values; and understanding of the concept of ecosystem services. We asked interviewees about services and benefits provided by the forest, and how they would calculate the value of their forest.

When asked about forest benefits and calculation of forest value, interviewees did not mention the potential to convert their forests to agriculture. In the few cases conversion to agriculture was discussed, the cost of clearing the forest or farming the additional land was cited as being prohibitively expensive. If conversion to agriculture is seen as cost prohibitive rather than lucrative, PSA-H payments may not need to be very high to match participants' opportunity cost. Timber harvesting also was not frequently mentioned as an alternative use of forestland among community members in either state. When Yucatecan respondents were asked whether they would sell timber if they were not enrolled in PSA-H, only three interviewees responded affirmatively. Those who did not harvest timber in Oaxaca provided a variety of reasons, including the desire to conserve and prevent the damage inflicted on the forest by harvesting. When asked whether there is value in her forest's wood, one private property owner replied, "who knows- we don't cut trees," indicating that she had never considered timber harvest.

Survey data supports the notion that individuals in our sample rarely considered converting their forest to alternative uses. Table 3 depicts the most frequent responses to a survey question that asked the likely use of land enrolled in PSA-H after the program contract ends. In both Oaxaca and Yucatán, most program beneficiaries stated they would never use the land, or would enroll in PSA-H or a similar program. Only 10% of individuals in Oaxaca and 15% in Yucatán anticipated converting the land to alternative uses of agriculture or livestock.

Table 3. Survey Data: Perception of likely use of PSA-H enrolled forest after PSA-H contract conclusion

	Oaxaca	Yucatán
We will never use them	37%	36%
Enroll in PSA-H or other program	18%	32%
Use them for agriculture/ livestock	10%	15%
Sell environmental services	4%	1%

Individuals in our sample don't seem to value their forest based on potential for conversion to alternative uses. How they *do* value and use their forest is illuminated by the forest benefits they perceived, both internal and external to the community (Table 4).

Interviewees cited a wide variety of internal forest benefits, which were predominantly natural values or ecosystem services rather than productive uses. Among Oaxacans, there was relatively greater focus on food harvest, which was mentioned by 25% of interviewees, and services such as the provision of oxygen and water. Respondents in both states mentioned wood, although wood was a more common response in Yucatán. The response of "wood" typically referred to domestic use rather than timber harvesting. A few Yucatecan respondents mentioned carbon sequestration and climate change mitigation as internal benefits, whereas Oaxacans only listed these services as external benefits.

Table 4. Interview Data: Most frequently mentioned internal and external forest benefits

	Internal Benefits	External Benefits
Yucatán	PSA-H payment, Wood	Oxygen, None, Wood
Oaxaca	Water, Food Harvest, Wood	Oxygen, None, Water

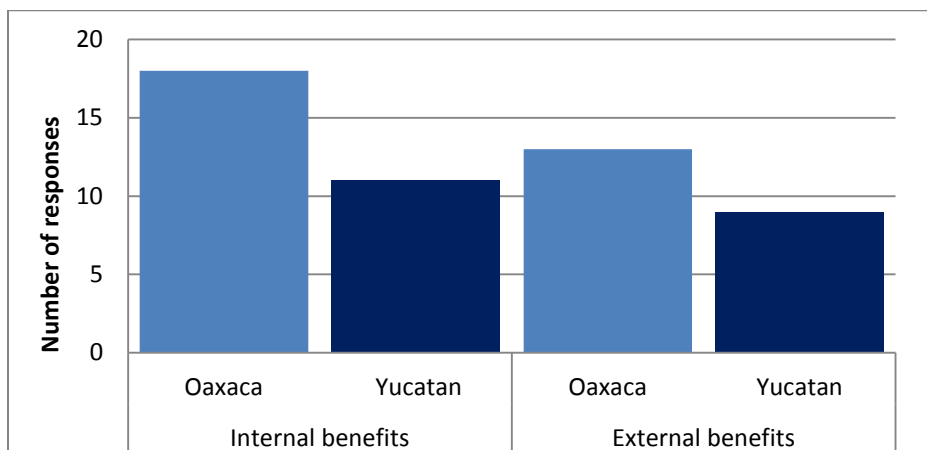
The focus on monetary benefits is a notable difference between the internal benefits mentioned in the two states. 35% of interviewees in Yucatán cited the PSA-H payment as the only benefit derived from their forest, while only one interviewee provided this response in Oaxaca. Yucatecan *avecindados* demonstrated the same perspective by stating that they don't experience any personal forest benefits since they do not receive PSA-H payments. Financial income from PSA-H may not be a widely cited forest benefit in Oaxaca

because Oaxacans appear to derive more tangible benefits and necessities from their forests compared to Yucatecans. In addition to household necessities, Oaxaca's forests provide sources of income from coffee and timber production that may overshadow PSA-H payments. The low percent of Oaxacans who cited PSA-H payments as a forest benefit may also be due to the small amount of program funds received by each household, or lack of awareness of their community's participation. Both of these factors may be due to relatively larger population size in Oaxaca. There was a common perception in Oaxacan communities that PSA-H is a subsidy for rural producers, rather than a payment for forest conservation. Consequently, interviewees may perceive PSA-H as a social benefit rather than as a forest benefit.

Private property owners in Oaxaca provided more long-term perspectives on internal benefits of their forests than community members, including potential for tourism and forest preservation for their children. One interviewee explained, "If we don't care for it, the children are not going to know what a forest is." The majority of private property owners interviewed in Oaxaca were coffee-growers. Coffee-growers rely on the forest for their livelihood, and must engage in long-term planning to cultivate and sell coffee.

When asked about benefits external to the respondent's community, many responses overlapped with perceived internal forest benefits (Table 4). Fewer external benefits than internal benefits were listed in both states, and many individuals did not perceive any external benefits (Figure 2). This result indicates that many interviewees do not believe that their forest provides benefits to external actors, which may present a barrier to ecosystem service market participation and development. External benefit responses were distinguished by a greater emphasis on ecosystem services, which were mentioned by the majority of respondents in both states. Additionally, a greater number of internal and external benefits were listed in Oaxaca than in Yucatán. As previously mentioned, this discrepancy may speak to a greater reliance on forest products in Oaxaca due to the different forest types present in the two states. Greater reliance on forest products may also relate to isolation from markets or low income levels, both of which impede individuals from purchasing market goods.

Figure 2. Interview Data: Internal and external forest benefits



Survey and interview data demonstrate a reliance on forest products in both states. When asked about use of forest products in our interview, 81% of respondents in Oaxaca reported collecting at least one forest item, most commonly firewood. The vast majority collected a second item, generally fruit or mushrooms. Cultivated agroforestry crops were mentioned as well, such as coffee, cacao, and organic material for fertilizer. In Yucatán, 64% of interviewees produced honey in their communities. Other responses in Yucatán included firewood, orchids, and fruit.

Survey data also demonstrates the variety of non-timber products collected in both states (Table 5). A greater diversity of products are collected in Oaxaca, which supports the assertion that Oaxacans perceive greater internal benefits because of their frequent use of forest products. The importance that Oaxacans place on forest products is further demonstrated by the fact that the decision of whether or not to participate in PSA-H is reportedly controversial in some Oaxacan communities. One intermediary interviewee in Oaxaca explained that the *asamblea* often cannot reach consensus on PSA-H participation because community members are unwilling to consent to program prohibitions of hunting and firewood collection. This forest product use indicates a clear perceived value in standing forest and a potential opportunity cost associated with program prohibitions.

Table 5. Survey Data: Forest product collection

Yucatán	Oaxaca
firewood, honey, trees, mud (for constructing dwellings)	mushrooms, firewood, fruit, quelites, chepiles, flowers, mustard seed, cactus

In order to understand whether interviewees believe a price can be assigned to their forest and the benefits it provides, we asked respondents how they might calculate forest value. The majority of interviewees in Oaxaca could not provide substantive responses, whereas interviewees in Yucatán provided a variety of responses. Six Yucatecans interpreted the question in terms of the monetary value of their land, and estimated a price per hectare. A few interviewees stated that forest value depends on the type of trees, others mentioned the connection between forest cover and rainfall, two respondents mentioned the forest’s provision of clean air, and two others stated that the forest value was incalculable because of the natural and social benefits it provides. Three Yucatecan respondents replied that they did not know how to calculate the forest value.

In Oaxaca, 36% of participant interviewees replied that they did not know how to calculate forest value. Several more thought that it was possible to calculate the value, but did not know how to do so. Approximately a quarter of Oaxacan respondents stated that communal land tenure inhibits forest value calculation. Only two interviewees in Oaxaca—both beneficiaries—assigned a monetary value to the forest, although the per-hectare values they provided differed by several orders of magnitude. One of these respondents explained that his calculations were based on timber value. In contrast to perceived internal forest benefits, which were provided by all respondents, many respondents had no sense of how to value their forest as a whole. These results suggest that calculations of forest value and decisions of whether or not to enroll in PSA-H are not typically based on an established monetary value of the forest or a consideration for forest conversion to other uses. Furthermore, if any alternative land use were incorporated into forest valuation, timber harvesting would be a more realistic option than agriculture. It should be noted that rather than hastening deforestation, timber harvesting may actually facilitate maintenance of forest cover when conducted under appropriate management and harvest regimes.



Intermediaries offered support for the findings from community and private property interviews that landowners do not generally consider land use conversion to calculate forest value. A common theme in intermediary interviews was the belief that internal norms and the cultural recognition of the forest's value support conservation among some rural populations. Several interviewees stated that communities have conserved for centuries because they perceive the benefits the forest provides: water, firewood, food, and medicinal plants. This sentiment was expressed by a former CONAFOR employee in Oaxaca, who said that communities "have a worldview that the forest is important, that the forest gives them life... that for the forest they live. Already as a community they had the custom of caring for it." Additionally, intermediaries described Oaxaca's indigenous people as stewards of the forest. One Oaxacan intermediary stated that most beneficiaries would conserve even if they were not participating in PSA-H because they want their children to have a traditional education and experience the same benefits that they enjoy. This pragmatic point of view was explained by a Oaxacan intermediary: "They know that the forest has a use value- it does not give them money, but it gives them wood, it gives them plants, water, no? Then they say, 'If I don't have my forest, I have to pay? Then I'll conserve the forest.'" Intermediary interviewees in Oaxaca cited beneficiary perception of forest value as crucial to PSA-H success. These intermediary comments suggest that many communities value the intrinsic value and benefits of the forest, and not exclusively the potential economic gain of land conversion.

Unlike in Oaxaca, Yucatecan intermediaries did not mention traditional or environmental values as motivation for program participation, but instead cited economic gain as the primary reason for Yucatecan participation. Three Oaxacan intermediaries similarly mentioned the motivation of economic gain. One Oaxacan interviewee explained that community members value the pursuit of money more than the forest, and are blinded by the "global search of supposed well-being." In Yucatán, the absence of other income-generating activities was specifically cited as the primary reason for PSA-H participation. Intermediary perspectives on why beneficiaries choose to participate in the program support the notion that the decision to participate in PSA-H is more complex than an

opportunity cost calculation, and often does not include a consideration of alternative land uses.

In both states, intermediary interviewees expressed a belief that many PSA-H beneficiaries would maintain their enrolled forest in conservation regardless of program participation. They explained that many lands enrolled in PSA-H are too isolated or inaccessible to make land conversion a realistic alternative. This perception would explain why conversion does not seem to weigh into the participants' forest value calculations. As one Yucatecan CONAFOR employee explained, "Many areas continue conserving because they are lands without pressure."

Many intermediaries believed that participation in PSA-H alters the way beneficiaries perceive forest value. The most common sentiment was that some beneficiaries began to assign greater value to the forest after receiving PSA-H payments. A Yucatecan CONAFOR employee explained that participation in PSA-H increases the opportunity cost of selling enrolled land; while landowners would previously sell their land cheaply because there was no alternative use, they now demand a higher selling price that at least matches the program payment. One intermediary warned of a negative ramification of increased appreciation of forest value. He explained that once program participants become accustomed to receiving payments for their forest, they begin to perceive the value of their forest as a means for generating income and will develop a "strategy" for receiving continued income from the forest- often through environmentally detrimental extraction, such as unsustainable timber harvesting.

A Oaxacan CONAFOR employee explained that in his experience, the most successful beneficiaries have a better grasp on the value of their forest- either because they have participated in other CONAFOR programs in the past, or because they engage in diverse land management such as timber harvesting. It seems as though prior experience in timber harvesting or forest management programs would make landowners more likely to excel in PSA-H and provide them with a more in-depth appreciation of forest value. These

characteristics would make them more likely to become actors in a future ecosystem services market.

Forest valuation on the ground differs substantially from the opportunity cost of conversion to agriculture, which is used to derive PSA-H payments. Our results indicate that many enrolled properties in our sample have conserved their forest for many years due to lack of conversion pressure or an appreciation for natural benefits and cultural values, and they likewise plan to continue conserving in the future. The wide variety of perceived forest benefits demonstrates a reliance on forest products and appreciation of ecosystem services, but little consideration of land conversion. When the importance of forest products is incorporated into forest value calculations, timber harvesting seems to be a more attractive and feasible land conversion option, as opposed to agricultural conversion. Forest valuation is more complex and multifaceted than a national average opportunity cost of conversion to agriculture. Furthermore, participant perception of forest value seems to be altered by PSA-H participation as we will explain more thoroughly in the following section.

## **ii. Ecosystem Service Market Potential**

The second PSA-H design assumption this study addresses is that participants will sell ecosystem services (ES) to buyers other than the Mexican government after the five-year PSA-H contract term. In order for PSA-H participants to have the capacity to engage in market transactions, they must understand ES concepts and ES markets, and believe there to be interested buyers of their services. In order to assess the program's progress toward the goal of generating ecosystem service market transactions, we analyzed participants' understanding of ecosystem services and the potential to sell these services, and stakeholder perceptions of the feasibility of ecosystem service market development. Our results illuminate how PSA-H seems to have influenced perceptions of internal and external environmental benefits, and the potential for the development of ES markets.

Before program participants can be expected to seek out buyers of their ecosystem services, they must first appreciate that their forest benefits external actors. In contrast to

internal forest benefits, which were perceived by every interviewee, many individuals in both states failed to recognize external forest benefits. One interviewee stated, “There aren’t any [external benefits]- foreigners don’t come here. The land isn’t important to them.” Although approximately one third of interviewees in both states provided this ‘no benefits’ response, there was a variation in *who* responded in this way. In Yucatán, only non-beneficiaries or wives of beneficiary *ejidatarios* did not perceive external benefits, while all beneficiary *ejidatarios* were able to list at least one external benefit. In contrast, there was no apparent correlation between perceived external benefits and beneficiary status in Oaxaca. Instead, the dichotomy was between type of land tenure: while community members frequently stated that there were no external benefits, private property owners rarely gave this response. The external benefits provided by private property owners were usually more sophisticated and extensive, likely because they are personally responsible for PSA-H implementation, and directly receive CONAFOR and *técnico* training. A Oaxacan intermediary voiced a similar sentiment, stating that there is greater program impact in private properties due to better understanding of conservation and ecosystem services. Additionally, private property owners are more likely to be better educated and have greater access to outside sources of information compared to community members.

Among interviewees who mentioned external benefits, wood and services were common responses, including water provision. In Yucatán, timber was mentioned more commonly by non-beneficiaries, while non-timber forest products were listed by both beneficiaries and non-beneficiaries. Yucatecans also cited current or potential exportation of forest or agricultural products as an external benefit- never mentioned in Oaxaca, despite the fact that Oaxacan respondents mentioned timber and wood as internal benefits. Since Oaxacans clearly utilize forest resources—as indicated by our forest value discussion—their omission of these products as external benefits seems to indicate that they are more internally focused, or less involved in external markets than respondents in Yucatán. This may be due to the greater isolation in Oaxaca, which results in more inwardly focused communities.

Beyond perceiving external benefits provided by the forest, the next hurdle to engaging in ES markets is an awareness of ecosystem services in particular. The majority of interviewees in both states demonstrated an understanding of ecosystem services: 70% of respondents in Yucatán and 71% of respondents in Oaxaca were able to list at least one accurate example. Demonstrating an understanding of ecosystem services did not require interviewees to explicitly use or define the term, but rather describe a forest ecosystem service. Although interviewees were asked directly what forest services they use, responses given in the context of other questions were used to assess ecosystem services understanding as well. The most frequently cited services were production of oxygen, rain, and water purification- two of which are in fact hydrologic services. One interviewee in Yucatán listed ecosystem services as described by “the CONAFOR course,” suggesting that PSA-H participation is impacting perception of forest benefits. CONAFOR training might be responsible, in part, for the superior understanding of ecosystem services exhibited by beneficiaries in both states. Nearly all beneficiaries in Yucatán were able to list an ecosystem service, while non-beneficiaries could not. Responses provided by non-beneficiaries in Oaxaca were more tangible ecosystems services, e.g. ‘work,’ firewood, and shade. However, these differences between beneficiaries and non-beneficiaries may also be attributable to pre-existing differences between the populations.

Several interviewees in Oaxaca provided detailed responses about ecosystem services provided by their forests. One non-beneficiary *Comisariado* stated that since seven rivers originate from his community, his community’s actions impact the lower altitude zone. A beneficiary community member made a similar comment, and a private property beneficiary described his forest as “the lung of Pochutla”- a neighboring town. He estimated that 80-90% of Pochutla’s water originates in his locality. Responses describing downstream water provision may have been unique to Oaxaca because water flow dynamics in the state’s mountainous terrain are readily apparent. In contrast, Yucatecan intermediaries said that designating hydrologic service providers and beneficiaries was complicated, both from the standpoint of program designers and participants. More sophisticated responses provided in Yucatán pertained primarily to climate change, perhaps driven by the threat of drought in the state. Interviewees explained that the forest

counteracts the pollution and deforestation that cause climate change, several stated that the forest mitigates the earth's rising temperatures, and another mentioned carbon sequestration. These findings suggest that ecosystem services are included in our respondents' framework of the natural world, even if they do not explicitly use the term 'ecosystem services.'

In order to gauge perceptions of the forest's influence on hydrologic services, we asked interviewees about the connection between the forest and water quantity and quality. While only one interviewee in Oaxaca was unsure whether there is a forest-water relationship- a non-beneficiary, five interviewees in Yucatán either did not believe there was such a relationship or could not describe it. Four of these five interviewees were non-beneficiaries or beneficiaries' wives. In both states, the majority of interviewees expressed a reciprocal linkage between forest cover and water, and the predominant characterization of the forest-water relationship was that trees have an impact on the quantity of water. "The trees bring the rain," was a widespread response in both states. Some individuals in Oaxaca described how loss of trees diminishes rainfall and the water in springs. One individual specifically mentioned the positive relationship between quantity of trees and duration of rainfall. Additionally, reforestation was said to increase rainfall in Oaxaca, and a few examples were given of communities that have experienced decreased rainfall due to timber harvesting.

Less commonly, some respondents described a relationship between trees and water quality. 20% of respondents in Yucatán mentioned the trees' ability to purify water, while fewer Oaxacan respondents described a water quality connection and were less explicit about these impacts. Another relatively infrequent response was that the trees themselves require water, which was noted by a few Yucatecans and one Oaxacan. Overall, interviewees in our sample demonstrated an appreciation for the hydrological services that their forests provide, with a particular emphasis on the relationship between forest conservation and increased rainfall. One Oaxacan intermediary supported the notion that water provision is at the forefront of beneficiaries' minds, explaining "It is very clear that the day they don't have water, they are going to suffer, no?"

Since interviewees demonstrate awareness of ecosystem services and hydrologic services, the subsequent question is whether they anticipate finding buyers for their services. In the majority of cases, respondents did not think anyone besides the Mexican government would pay them for their services or to conserve their forest generally. This opinion was stated by half of the Oaxacan interviewees and all Yucatecan non-beneficiaries and beneficiary *avecindados*. In the cases in which Oaxacan interviewees did see a potential for ES buyers, they typically listed government agencies or programs besides CONAFOR: PROCAMPO, PROFEPA, CONAGUA, SEMARNAT, CONAFOR, and PROARBOL. Yucatecan interviewees also expressed a belief that conservation payments can only be expected to come from the government. These interviewees voiced skepticism about the potential for external buyers, stating that financial support is exclusively from the government but administered through different programs.

Interviewees in both states explained their disbelief in the existence of ES buyers based on the indifference of external actors towards the conservation of their forests. In Oaxaca, one interviewee explained that conservation “doesn’t matter to other people, because they don’t live here and don’t have the necessity that we have.” Similarly, an interviewee in Yucatán indicated that foreign companies would be unwilling to invest in conservation, and their only role in the natural world is to pollute. One private property owner gave an example of the resistance of downstream users. She described a tourist destination downstream of her property where developers had cut down trees and built hotels “without any vision for the future.” She said, “We always fight, because if they are beneficiaries of the water, why don’t they bring a load of trees to reforest?”

Eight Yucatecan respondents, all of whom were private property owners or beneficiary *ejidatarios*, mentioned potential non-governmental ES buyers. Of these eight responses, foreign investment was most commonly mentioned. One *ejidatario* leader explained that he would prefer to negotiate directly with international parties, because he would make more money without CONAFOR as an intermediary. Another Yucatecan *ejidatario* described the concept of a public good to justify why external parties should pay for forest conservation: just as people pay for roads and highways, they should also pay for the benefits of the

forest. One private property owner in Yucatán described a civil association he formed with other landowners in order to create a nature reserve and solicit ES payments from external parties. He predicted that this group of producers would sell ecosystem services to domestic and international companies within three years. In order for markets to develop, he believed that PSA-H beneficiaries must spread the idea that water has social value, and that conservation can mitigate climate change.

In contrast to Yucatán, only one respondent in Oaxaca mentioned foreign sources of conservation funding- a private property owner. In Oaxaca, all five interviewees who perceived potential to engage in an ES market were private property owners. They usually provided more innovative responses, citing non-governmental buyers such as the World Wildlife Fund. The clear distinction of private property owner responses may be due to their higher education levels and external connectivity, which may be preconditions for selling ecosystem services. Coffee growers in particular often interact with various outside organizations- either through coffee grower cooperatives or to receive government aid. Two Oaxacan respondents mentioned downstream users as potential buyers. This was a surprisingly infrequent response considering that downstream municipalities are the intended post-PSA-H service buyers.

In contrast to forest benefit awareness results, results regarding potential for ES buyers are not as encouraging in regards to the potential for ES market development. Interviewees in our sample largely do not see potential for non-governmental ES buyers. This result is supported by survey data, in which only 1% of survey respondents in Yucatán and 4% in Oaxaca indicated that they plan to sell ES after PSA-H (table 3). The wide variation in perceptions of market potential is likely strongly influenced by the quality of CONAFOR trainings and technical assistance. Insufficient emphasis on ES market development during PSA-H training coupled with the absence of a developed ES market may be responsible for the low percent of interviewees who saw potential for ES markets. Furthermore, the few respondents who mentioned downstream municipalities as potential buyers—the intended PSA-H hydrologic service buyers—indicates a gap in training specific to PSA-H.



Intermediaries in both states expressed doubts about ES market development, and discussed barriers that prevent communities from engaging in an ES market. Mirroring our community interview results, a Yucatecan intermediary explained that although program participants understand PSA-H requirements and objectives, the majority do not understand the concept of an ES market. He attributed this shortcoming to the difficulty of defining buyers and sellers in the market. As long as the market terms remain abstract, it will be difficult to convey the concept to beneficiaries. Another barrier to engaging in ES markets was described by a Oaxacan community member who observed that his community does not have the technical capacity to verify their conservation actions without external assistance.

Both *técnicos* and CONAFOR employees interviewed in Oaxaca stated that the majority of community members in beneficiary communities are not aware of their community's participation in PSA-H. One individual laughed in response to this question, and stated "I want to tell you the contrary, but very few know the program." Women, non-land rights holders, and newly enrolled communities were cited as particularly unaware. Another intermediary attributed lack of program awareness to large community population size. In the Oaxaca survey sample, average community size was 3,700 people. While it is possible that only a subset of the community is participating in PSA-H in these situations and therefore has the potential to participate in a market, the overall lack of awareness in participating communities does raise some concerns. This lack of awareness could stem from organizational or communication issues and could lead to conflict within communities. Other individuals mentioned that politically corrupt or indigenous communities that predominantly speak an indigenous language are less likely to receive information.

In discussing ES market feasibility, many *técnicos* interviewed in Oaxaca emphasized that more effort must be devoted to developing ES markets more fully because PSA-H funding is unsustainable. Most interviewees were not confident in CONAFOR's ability to stimulate a market, with one individual noting that CONAFOR is "subsidizing, subsidizing, and you are never going to generate a market." Another interviewee said that in her opinion, the

absence of an ES market indicates that PSA-H has failed to meet its objectives. A CONAFOR employee responded to criticism about ES market development by explaining that CONAFOR is currently carrying out pilot studies of ES valuation, but he admitted that “there are many themes missing,” and ES markets are “very complicated, but we have to start with something.”

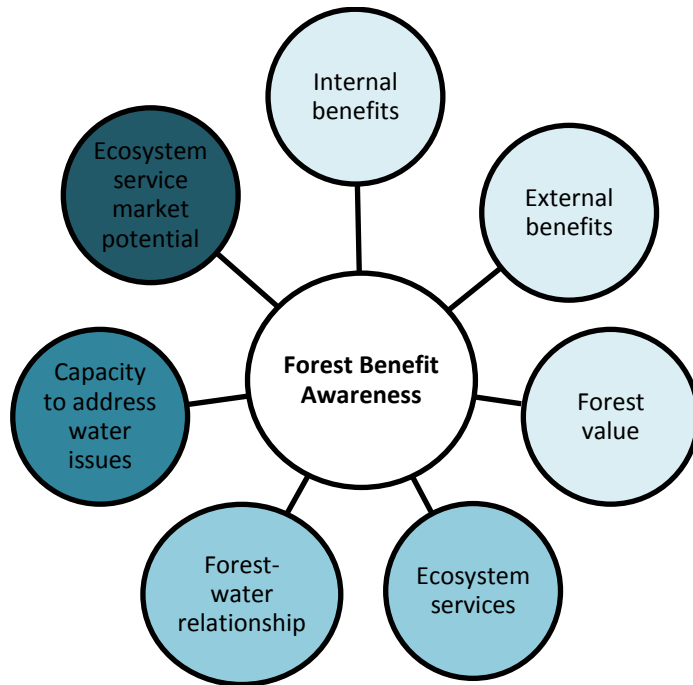
Another interviewee viewed buyers as the major hurdle of ecosystem service markets. She stated that, “It is a process, because many are now aware [of ecosystem services], but at the hour of payment, many don’t want to pay.” A Yucatecan intermediary enumerated various hurdles that must be overcome before an ES market is developed: amendments to laws and regulations, additional government aid, monitoring for illegal activity, more scientific studies, identification of supply and demand, designation of a governing body to oversee the market, and better scientific information on the provision of services like carbon sequestration and water purification. Another Yucatecan intermediary mentioned a lack of information regarding potential buyers and sellers in hydrologic service markets. He said that the Yucatán watersheds are difficult to define, and it is therefore ecologically and politically challenging to determine service providers and service users. Rather than selling services to downstream municipalities, one *técnico* saw the greatest potential for conservation funding in ecotourism. He described ecotourism as a more intuitive transaction for users, who pay for a clear service or for access to a physical attraction. He believed that it is the *técnico*’s role to both help communities find ES buyers and develop unique tourist attractions.

Awareness of forest benefits is a necessary pre-condition to participating in an ES market. In order to assess the forest benefit awareness of community members and private property owners in our interview sample, we developed a metric that combines the indicators of awareness previously discussed: appreciation of internal benefits, external benefits, and forest value indicate appreciation of forest benefits; understanding of ecosystem services and forest-water relationship indicate understanding of ES concepts; ability to address water issues is another opportunity to demonstrate ES understanding; and belief in ES market potential builds on all these concepts and is an indicator of

preparedness to enter ES markets (Figure 3). Each of these indicators is derived from specific interview questions. For each interview question that the interviewee provided a meaningful or sophisticated response, we awarded one point. We totaled the points for each interviewee to yield individual forest benefit awareness scores. Additionally, responses of subsets of the sample were examined in each state: women, leaders, private property owners, non-beneficiaries, and specific communities. This metric allows us to compare awareness among sub-groups of our sample and make inferences regarding the program's impact on increasing awareness.

On average, interviewees met 2.8 criteria in Oaxaca and 1.7 in Yucatán, out of a total possible score of 7 criteria. Nine interviewees in each state demonstrated strong forest benefit awareness, defined as providing meaningful responses to at least three of the seven criteria. In Yucatán, seven of the individuals with high awareness were beneficiary *ejidatarios*, and the other two were private property owners- one beneficiary and one non-beneficiary. In Oaxaca, all nine interviewees were members of beneficiary communities or beneficiary private property owners. In Oaxaca, two *non-comuneros* and family members of *comuneros* in beneficiary communities were included within this group, suggesting that participation in PSA-H has a positive impact on environmental knowledge of all community members in Oaxaca regardless of rights-holding status. This finding is likely due to the fact that many Oaxacan communities in the sample allowed *non-comuneros* to participate in the *asamblea*, and there was very little distinction among community members. In contrast Yucatecan communities consisted predominantly of rights-holders and their families, and there was greater emphasis on rights-holding. The notable trend that emerges from this analysis is that beneficiary respondents consistently showed greater awareness of the external benefits of forests than non-beneficiaries. This result offers evidence that program participation is improving knowledge of forest benefits, ecosystem services, and ES markets.

Figure 3. Forest benefit awareness metric



With the exception of a community leader in Oaxaca, non-beneficiaries in both states demonstrated inferior forest benefit awareness. They more often cited forest products as benefits as opposed to more complex ecosystem services such as water provision or climate change. This contrast was even more drastic in Yucatán, where non-beneficiaries did not demonstrate environmental knowledge in any category. There was also a clear distinction between community members and private property owners. In Yucatán, private property owners more often demonstrated greater environmental knowledge in all categories. In Oaxaca, private property owners were more likely to perceive an opportunity for conservation payments and mention ecosystem services as internal or external benefits, but less frequently perceived water issues, described a complex forest-water relationship, provided an ecosystem service when asked directly, or gave a substantive response regarding calculation of forest value.

Women interviewed in Yucatán demonstrated limited forest benefit awareness in all categories. The sole *ejidataria* interviewed was also the only Yucatecan woman to report

knowledge of forest management activities. Although she participated in PSA-H activities, she said that the leaders of the *ejido* did not share information regarding PSA-H with her, which could explain her lack of awareness of forest benefits. In contrast, only one woman in Oaxaca demonstrated low forest benefit awareness- a middle aged community member. The three other women interviewed in Oaxaca demonstrated forest benefit awareness equal to or greater than the rest of the population. Two of these interviewees were community members in their early twenties, and one was a private property owner closely involved in coffee growing on her property. One of these women—the secretary of her *ejido*—was the only individual in either state to demonstrate forest benefit awareness in all seven categories considered.

Two or more interviews were conducted in most communities, which gave us a sense of awareness of forest benefits by community. While some community trends emerged, the small sample size should be taken into consideration. In Yucatán, two *ejidos* consistently demonstrated greater forest benefit awareness, two demonstrated inferior forest benefit awareness, and two did not show any trends. In Oaxaca, two communities demonstrated greater than average forest benefit awareness. One of these communities was the interview site most accessible from Oaxaca City, is involved in timber harvesting, and has a strong presence of external organizations. Another community consistently showed poor ecosystem services understanding among all three interviewees, which may be influenced by the particularly geographically dispersed and remote nature of this community. These trends suggest that individuals' awareness of forest benefits likely result from factors that impact the entire community as opposed to characteristics of individual community members. These factors could include community isolation, community interaction with external actors or other government programs, or level of technical assistance and training received in the community.

Intermediaries supported the finding of improved forest benefit awareness among PSA-H beneficiaries. Most intermediaries in Oaxaca believed that increased awareness of forest value is the greatest social impact of PSA-H. One Oaxacan *técnico* described the types of changes in mentality that he has observed in participating communities: “They themselves

said that, well, they had always extracted many things from the forest, but they had never thought that in some moment, it could run out. It is as if they are starting to think, ‘Yes, it can run out, and we are going to do things to conserve.’” A few Yucatecan intermediaries also mentioned how participation in PSA-H had changed beneficiary communities’ perspectives on the value of forest resources and understanding of ecosystem services. One intermediary had observed participant *ejidos* making greater efforts to avoid contaminating their water resources, and planting trees for the benefit of future generations.

Our results show partial progress towards the PSA-H design goal of the sale of ecosystem services after five years of program participation. While interviewees demonstrated some awareness of the external benefits offered by their forest and high awareness of ecosystem services—particularly hydrological services—most PSA-H participants don’t perceive potential to sell ecosystem services. Although our analysis of both environmental benefit awareness and intermediary data indicate improved ES understanding among PSA-H beneficiaries specifically, these beneficiaries largely do not believe that non-governmental buyers would be interested in paying them for ecosystem services. The widespread skepticism in the potential for ES market transactions in both states could be improved through a greater emphasis on ES market development in CONAFOR and *técnico* trainings, more assistance in connecting service providers with buyers, and more effort on behalf of CONAFOR in creating ES markets.

### **iii. Poverty Alleviation**

Whether or not PES programs should couple conservation and poverty alleviation goals is a controversial topic. Critics argue that poverty alleviation objectives can detract from the cost effectiveness of achieving environmental goals (Wunder, 2008). The primary concern is that prioritizing poverty criteria in targeting participants could lead to enrolling properties with minimal risk of deforestation or low quality provision of hydrological services (Wunder, 2008; Pattanayak, 2010). A second argument is that forest conservation initiatives can exacerbate poverty by denying local people access to forest products or eliminating income-generating forestry activities (Kerr, 2002). Although controversial

throughout program design, Mexico's PSA-H program has included poverty alleviation as a central goal, in addition to forest conservation, since 2004. To achieve this poverty alleviation goal, the PSA-H selection process incorporates criteria prioritizing highly marginalized applicants, based on poverty levels and indigenous populations.

PSA-H aims to alleviate poverty through annual program payments to participants. PSA-H design assumes that making direct payments to poor people to conserve their forest will reduce poverty. In order to evaluate the validity of this assumption, this study explores whether or not the current distribution and use of program payments is likely to reduce poverty both in the short and long term, based on the perceptions of PSA-H stakeholders on the ground.

This study also assesses the relationship between program participation and community capacity building as a mechanism for alleviating poverty, particularly in the long term. Community capacity refers to a community's internal organization, access to external information and opportunities, and ability to leverage existing skills and resources for community development and wellbeing. Two indicators are used to gauge community capacity. The first indicator, internal collaboration, refers to the community's internal organization, specifically their ability to manage resources and work together to carry out income generating or communal projects. The second indicator, external connectivity, refers to the community's relationships with other communities or organizations.

Engagement with external actors is particularly important in order for participants to enter ecosystem service markets after the five-year program contract ends, as PSA-H design assumes will occur. This section primarily addresses these concepts in relation to community members and beneficiaries in order to understand the program's impact on poverty alleviation in participating communities.

### ➤ **Payment Distribution**

According to interview data, the vast majority of communities in both Oaxaca and Yucatán distributed PSA-H funds directly to individual community members. Payments were reportedly used for community goods or income generating projects in very few instances.

In addition, individuals in both states indicated during interviews that the payments were used for immediate household needs, such as food or clothing, rather than savings or investment.

Survey data also demonstrates the absence of a savings culture in these communities. According to the survey data for Oaxaca and Yucatán, only 30% of the sample reported saving money as a component of household expenditures. Additionally, savings accounted for only 6% of total household expenditures in the sample. Furthermore, 84% of survey respondents in Oaxaca and 80% in Yucatán indicated that no member of their household had a bank account. When asked how they would get money immediately in the case of an emergency, the majority of respondents in both states responded that they would obtain the money from family or friends. Selling livestock or household items was also a common response.

There was a key discrepancy between the two states in regards to the method of distributing payments to individual households. In Oaxaca, community members are paid daily wages for participating in community workdays in which PSA-H-required forest management activities are completed, such as constructing firebreaks. In Yucatán, *ejidatarios* receive an annual payment conditional upon participation in community workdays. As a result of these different payment distribution schemes, participation of Yucatecan *ejidatarios* in PSA-H workdays is usually mandatory, while participation of Oaxacan community members is often left to their discretion.

This difference in payment distribution between the states is likely a result of the larger population size of Oaxacan communities compared to Yucatecan *ejidos*. According to survey data, the average population of Oaxacan communities was 3,700, while the average Yucatán population size was approximately 320. The population of many Oaxacan communities was large enough that equal distribution of the PSA-H payment among all community members would result in trivial individual payments that would likely not incentivize participation in PSA-H workdays. In contrast, the Yucatecan *ejidos* in the sample may have been too small to complete PSA-H requirements without the participation of all *ejidatarios*. Additionally,



during interviews, Yucatecan beneficiaries often reported that the PSA-H payment was their primary source of income, which suggests a strong incentive to participate. Based on the contrasts drawn between these two states, it seems as though smaller communities with fewer alternative economic opportunities are likely to have a higher proportion of participation in PSA-H, greater familiarity with the program throughout the community, and consequently greater accountability to the program.

In both states, there were some exceptions to direct household distribution of payments. Other uses of payments included the purchase of PSA-H signs, administrative costs of the program, communal agricultural expenditures, and renovation of community buildings. In neither state did community interviewees indicate that PSA-H funds had been invested in a community project or income generating activity.

An *ejido* leader in Yucatán offered an explanation of the consistent trends of PSA-H payment use and distribution methods observed in both states. He indicated that the conditions of the *campesino* lifestyle are inherently counter to a culture of savings or long-term investments, such as those required by silviculture. He stated that, “Silviculture needs many years to see the results, and we have to see the earnings more quickly. There would be benefits to planting trees, but we don’t have this culture. We need immediate resources. We cannot wait 20 years to see the results.” If, as this *ejido* leader suggests, long-term financial planning is not part of rural Mexican culture, then investment guidance should be incorporated into PSA-H program training. Such training could make the long-term goals of poverty alleviation and forest conservation more compatible with the *campesino* way of life, thereby increasing the likelihood of positive and sustainable environmental and socioeconomic outcomes.

Intermediary interviewees in both Oaxaca and Yucatán expressed the belief that in order to generate poverty alleviation impacts, PSA-H payments should be invested in income generating activities, rather than being distributed to individuals for household needs. One Yucatecan intermediary specifically stated that payments should be invested in productive activities such as agriculture, artisanship, or forestry. He stated, “The payment is not

reinvested in production- it arrives, it is spent for personal use, and they don't reflect on improving their livelihood conditions." He further explained that *ejidos* are not investing their PSA-H payments in productive activities because they are not well organized, their various programs and sources of aid are not integrated into a holistic development plan, and they do not communicate well within communities or with external parties. One obstacle to improving this failed system, he explained, is the lack of technical expertise to coordinate aid programs and assist communities in realizing their full development potential. This technical and organizational financial planning expertise could be incorporated into PSA-H program assistance and requirements.

Similar to the Yucatecan intermediary views regarding payment distribution, a *técnico* in Oaxaca stated, "In the Sierra Norte, they work in a different way... They devote all the money to a social project- for example, restoration of the church, the school, the hospital... This is a good strategy." Although this Oaxacan *técnico* had worked with many communities, she had not experienced communal investment of PSA-H payments first hand. She believed communal investment strategies to be advantageous for community development, but also acknowledged that this would be a difficult approach to incentivize in many communities. In her opinion, community members would not be motivated to participate in PSA-H workdays if funds were allocated to communal projects instead of directly to individual workers. However, a combination of communal and individual allocations could adequately incentivize participation while building community assets.

The notion that community members might resist communal use or investment of PSA-H payments was supported by community level interview data. Community member interviewees consistently expressed the belief that PSA-H payments should be distributed to households. This perspective presents an obstacle to financial planning and investment strategies, and long-term poverty alleviation in general. Furthermore, encouraging community investment is likely to be particularly challenging in larger communities, where only a subset of the population is participating in PSA-H work and receiving payments. However, PSA-H could still encourage this subset of the community to invest in an income generating activity in these instances, if not a communal good. In this way, the payment

would be more likely to generate returns, at least for this subset of individuals, and alleviate poverty over time.

Another challenge to encouraging communities to invest payments in community goods or income generating activities is the external force of migration. Although PSA-H payments may enable *campesinos* to continue their rural lifestyles in the near term, it seems unlikely that these payments will mitigate factors that influence migration over the long term. These factors include extreme drought, failing agricultural systems, and a waning desire to live a rural lifestyle- particularly among younger generations. As the younger generation migrates out of the countryside, communities are likely less incentivized to invest PSA-H payments in productive activities that will yield long-term socioeconomic impacts, because the loss of the younger population reduces productive capacity and the likelihood that the community will even exist in the long-term.

Interviewees in Oaxaca indicated that approximately half of the children in rural communities leave the countryside. A similar estimate was made in Yucatán, where about half of respondents believed that the next generation would work in agriculture in the community. The other half of the sample believed the younger generation would migrate to work in other industries. In both states, interviewees stated that only older members of the community prefer to live and work in the *campo*.

A few Yucatecan intermediaries stated that the older population continues to work in agriculture because of culture and customs, but younger generations are migrating to the cities of Cancun, Playa del Carmen, Merida or even the United States. This trend reportedly developed in Yucatán as result of the limited profitability of agriculture and difficult working conditions. One community member cited the inability of small Yucatecan producers to compete with large foreign producers from the U.S., China, and Japan. He said that contemporary agriculture in Yucatán is a traditional practice and not a means of survival.

A Yucatecan intermediary explained that as prospects for agriculture and livestock production dwindle with increasingly severe drought, *ejidatarios* in the region are faced with the decision to either migrate or apply for government support. He added that many *ejidos* in the region have been abandoned due to lack of work, water, and resources. There was clear evidence of *ejido* abandonment in the Yucatecan interview sample. In four of the eleven *ejidos* interviewed in Yucatán, *ejidatarios* no longer lived in the *ejido* full-time. In three cases, *ejidatarios* lived in a nearby town, and only worked in the *ejido* periodically. In the fourth case, half the *ejidatarios* worked in agriculture on the *ejido*, and the other half worked and lived in Merida during the week while their families stayed in the *ejido*. Another Yucatecan intermediary mentioned that in recent years, he had witnessed decreasing community participation within rural *ejidos*. For example, community parties are held less frequently or not at all. This decreased frequency of community events is indicative of less community cohesion. This phenomenon is likely a result of out-migration and *ejido* relocation or abandonment.

In Oaxaca, community interviewees explained that out-migration was primarily a result of the younger generation's disinterest in the rural lifestyle. Intermediaries cited the strong stigma associated with indigeneity and the *campo*, which makes the younger generation seek to dissociate itself from this identity. Oaxacan migration was characterized by temporary migration to the United States or Mexico City, as opposed to the permanent out-migration that was common in Yucatán. Additionally, Oaxacan community members did not travel regularly between their communities and other residences, as in Yucatán. These disparate migration dynamics likely result from the states' different environmental and economic conditions. In Yucatán, extreme drought and limited economic opportunity were said to drive migration, whereas interviewees in Oaxaca did not describe changing environmental conditions in Oaxaca. On the contrary, interviewees in Oaxaca often commented that nothing ever changes in the countryside.

In both states, community members voiced the sentiment that children would ideally leave the countryside to pursue an education instead of working in agriculture. Several intermediaries in Oaxaca expressed a hope that the younger generation would create

opportunities for themselves by leaving the *campo* to pursue an education and returning to benefit their communities. Barriers to education, however, were different in the two states. In Yucatán, education was cited as inaccessible primarily due to prohibitive costs; in Oaxaca there was often no community access to higher levels of school because of physical distance and isolation.

As PSA-H strives to alleviate poverty, it should assist communities in developing financial planning and investment strategies that are likely to generate returns over time. These strategies should be mindful of local and regional economic potential and constraints, including migration dynamics. Furthermore, PSA-H designers should consider how program participation impacts the continued viability of the *campesino* lifestyle, particularly as the culture and aspirations of rural people change.

#### ➤ **Internal Collaboration**

As an indicator of community capacity, community interviewees were asked to provide a recent example in which their community had worked together to achieve a common objective. Responses were analyzed in regards to the level of demonstrated internal organization and the relationship between program participation and tendency to work together as a community.

Approximately 70% of Oaxacans provided an example of community collaboration, including all non-beneficiaries in the sample. Most examples in Oaxaca were independent of PSA-H participation, such as coffee growers helping each other harvest or community workdays, called *tequios*. In most Oaxacan communities, *tequios* were a regular occurrence and an important part of community culture. Forest management activities such as reforestation and constructing firebreaks were also mentioned, and were often carried out as part of PSA-H implementation. A unique example of internal collaboration was a tourism project initiated by an Oaxacan community several months prior to the interview. Community members worked together to construct *palapas* in their community as a place for tourists to eat while visiting the community on day trips.

Oaxacan non-beneficiaries mentioned two substantial community projects: one to create a network of potable water and improve community roads, and another to plant avocado trees in community member *parcelas*. Non-beneficiaries in Yucatán, however, were generally unable to give examples of collaboration within their communities. The fact that non-beneficiary Oaxacans provided examples of community collaboration, while Yucatecan non-beneficiaries did not, suggests that community collaboration in Yucatán may be more dependent on PSA-H participation than in Oaxaca.

While communal work appeared to be an integral component of Oaxacan communities independently of PSA-H participation, the vast majority of community collaboration examples reported in Yucatán pertained strictly to PSA-H compliance activities. One *ejido* leader specifically stated that his *ejido* works together in order to receive government support, because the government only gives money to groups or communities. Four Yucatecans explained that before PSA-H enrollment, their work was much more individualized due to each *ejidatario's* focus on their own agricultural parcel. Two non-beneficiaries could not provide examples of the community working together, and expressed a similar sentiment: that agricultural work created an individualized dynamic within their *ejido*. This perspective on the nature of agricultural work contrasts with that given in Oaxaca, where agricultural work was cited as an example of collaboration rather than a driver of individualization.

In neither Oaxaca nor Yucatán did interviewees give many examples of involvement with local organizations or participation in collaborative community activities. In a few instances, Oaxacan interviewees mentioned the role played by community committees or churches in collaborative community projects, but no such examples were given in Yucatán. Survey data indicated that Oaxacan communities may have stronger internal collaboration independently of PSA-H, based on participation in community festivities, committees, and holding leadership positions. In Oaxaca, 61% of survey respondents had attended a community festival in the last year, compared to 35% in Yucatán. Similarly, 54% of Oaxacan respondents reported participating in a community committee during the past year, whereas only 38% of Yucatecan community members had participated in a

committee. Finally, 60% of Oaxacans compared to 44% of Yucatecans held a community position during the past four years. The relatively greater internal organization and sense of community in Oaxaca compared to Yucatán could be a result of differences in community size, isolation, culture or regional migration trends.

Based on interviewee responses, it seems as though PSA-H had a more significant impact on the internal collaboration dynamic of Yucatecan *ejidos* than Oaxacan communities. This is supported by the fact that interviewee examples of community work in Yucatán typically pertained to PSA-H, but were predominantly unrelated to PSA-H in Oaxaca. Furthermore, some Yucatecan community members directly stated that their communities were more individualized before PSA-H enrollment. These trends likely result from the difference in community size between the two states, and from differences in external forces such as migration, environmental conditions and economic opportunities. In Yucatán, where *ejidos* are decreasing in size and in some cases disbanding entirely as drought worsens and the viability of a subsistence lifestyle change, it is reasonable that community dynamics and internal collaboration would also deteriorate. In this context, PSA-H provides a unique opportunity for communities to maintain their rural livelihoods by working together to receive the program payments. However, the fact that community collaboration in Yucatán was centered on PSA-H activities raises the concern that this improved collaboration will deteriorate after program enrollment ends.

In contrast, PSA-H seems to impact a smaller subset of each community in Oaxaca, because the much larger community populations preclude participation of all community members. Additionally, Oaxacan interview data does not demonstrate clear PSA-H impacts on community capacity compared to Yucatán, likely because Oaxacan communities already had relatively strong internal organization and a culture of collaborative work, as suggested by survey and interview data.

The notion that participation in PSA-H has increased internal community collaboration was supported by a Yucatecan intermediary. He stated that participation in government programs incentivizes *ejidos* to become more organized, participatory, and transparent in

order to avoid corruption in managing new financial resources. For example, he said that some beneficiary *ejidos* have modified their internal rules upon enrolling in PSA-H. Oaxacan intermediaries similarly stressed the importance of strong internal organization and community institutions in enforcing PSA-H rules, and as a key component of successful program implementation. Most intermediary discussion of internal collaboration in Oaxaca pertained to the *asamblea*. Precisely due to the awareness raised in the *asamblea*, one *técnico* believed PSA-H impact to be greater in communities than private properties. Another intermediary argued that PSA-H's impact is limited by the exclusion of non-*comuneros* and women from *asambleas*, who are generally uninformed. Furthermore, communities have as few as one *asamblea* each year, giving *comuneros* little opportunity to learn about PSA-H.

Another Yucatecan intermediary argued that smaller *ejidos* tend to implement PSA-H more effectively because of their greater ability to self-organize and make decisions. He explained that in larger *ejidos*, there is a greater likelihood that not all *ejidatarios* will be involved in PSA-H. This can create a tension within the *ejido*, particularly at the point in time when communities receive PSA-H funds. An Oaxacan CONAFOR employee provided a similar perspective on PSA-H's potential to generate conflict. Even when communities have conserved in a traditional manner for centuries, the arrival of aid for a previously unfunded effort often creates conflict. Another intermediary mentioned that conflict is most common in poorly organized communities.

In addition to examples of internal community work, community members were asked about *vigilancia* practices in their community as an indicator of internal collaboration. *Vigilancia* refers to monitoring the forest for threats such as illegal hunting, deforestation, or forest fires, and is a required PSA-H management practice in all participating properties. According to data from the community leader survey, 100% of beneficiaries in both states are conducting *vigilancia*. However, among non-beneficiary communities, only 83% of Oaxacan communities and 57% of Yucatecan communities reported carrying out *vigilancia*. Although the fact that *vigilancia* is a program requirement may have given participating



communities an incentive to bias their responses, these results suggest that program participation has increased community *vigilancia* practices.

However, half the interviewees in both states acknowledged that *vigilancia* efforts had been ineffective at some point in the recent past, as evidenced by instances of illegal hunting or deforestation. The illegal activities were often reportedly committed by neighboring *ejidos*, which were also PSA-H beneficiaries, in two cases. It is possible that interviewees blame illegal activity on neighboring *ejidos* rather than members of their own community for fear of repercussions. However, if they were concerned about the consequences of admitting illegal activity had occurred in their forest, they could have chosen not to mention illegal activity at all during the interview. A point of contrast between the two states is that in Oaxaca, illegal activity mostly revolved around illegal logging, whereas in Yucatán, most illegal activity reported pertained to hunting. Oaxacan interviewees also occasionally mentioned the need for *vigilancia* to monitor for forest fires, which was rarely mentioned in Yucatán. These different motives for *vigilancia* point to differing forest threats in the two states.

In Oaxaca in particular, confusion was expressed over responsibility for conducting *vigilancia*. *Vigilancia* activity seemed to be carried out in a fairly informal and individualized manner, and many respondents reported that everyone was responsible for carrying out *vigilancia* on their own parcels. *Vigilancia* practices in Yucatán appeared to be more systematic and formal. In the majority of Yucatecan properties, individuals were designated to conduct *vigilancia* on a rotating basis, as a service to their *ejido*. These different approaches to *vigilancia* support the previously mentioned notion that PSA-H requirements may be more difficult to fulfill in larger communities because of the greater challenges in coordinating program activities.

The shortcomings of current *vigilancia* practices demonstrate that organizational challenges specific to larger communities should be considered by PSA-H program designers in order to improve community forest management capacity. Formalizing *vigilancia* requirements would mean clearly designating responsibility among community

members and standardizing expectations of the frequency of this activity. Communities could also be required to record *vigilancia* activities in order to increase accountability. Formalization of requirements would help communities to conduct *vigilancia* in an organized and consistent manner, and increase their capacity to mitigate threats to their forests. Additionally, CONAFOR could formally communicate with neighboring *ejidos* during PSA-H implementation of to ensure understanding of forest protection, clarify consequences associated with violations, and mitigate instances of illegal activity.

Involvement of private property owners in community organizations was also assessed. Of the seven beneficiary private property owners in Oaxaca, two were previously presidents of their municipality, two participated in coffee cooperatives, and one was involved in a community greenhouse- all prior to PSA-H enrollment. The sole Oaxacan non-beneficiary private property owner was the only respondent to demonstrate no community involvement. Although conclusions cannot be drawn from such a small sample size, private property beneficiaries appear to be well connected and involved in their communities, in contrast to the non-beneficiary in the sample.

In the Yucatán interview sample, one beneficiary private property owner was leading his community in a collaborative PSA-H effort. This participant formed a group of neighboring landowners, with the help of a civil association in Merida, in the hopes of creating a nature reserve that could receive ecosystem service payments. He believed that within three years, this group would receive ecosystem service payments from organizations, large agricultural producers, or international companies like Bimbo or Coca Cola. According to this interviewee, the formation of this group was inspired by PSA-H.

Internal collaboration is an important component of community capacity, and is likely to dictate participants' degree of success in the PSA-H program. While PSA-H does seem able to bolster internal collaboration, particularly among smaller communities, deficiencies in internal collaboration exist for which communities could benefit from more programmatic support. PSA-H design should consider community size and pre-existing collaboration dynamics when promoting internal collaboration among communities. Furthermore, the

program should help communities strengthen internal organization by developing specific rules and standards for practices like *vigilancia*. If this improved support were offered, communities would be better prepared to become involved in new financial planning and investment strategies, and leverage resources for income generating projects that could benefit the community as a whole.

### ➤ **External Connectivity**

In order to assess external connectivity, interviewees were asked about interaction with external organizations and other communities. External connectivity is an important component of community capacity building because it demonstrates a community's ability to seek out external opportunities and solicit resources and information from external sources. This type of capacity is instrumental for PSA-H participants, as it enables them to engage with external ecosystem service buyers or access continued support for forest conservation after program enrollment.

In neither Yucatán nor Oaxaca did the majority of communities interact with external actors besides government agencies. In Oaxaca, a variety of government agencies were mentioned, leading Oaxacan intermediary interviewees to voice the opinion that *campesinos* are accustomed to, "extending their hand to the government." Yucatecan intermediaries claimed that PSA-H participation has changed the relationship between some beneficiary communities and the government by alleviating the distrust of government that had developed among rural populations in recent decades. As mentioned in the previous section, Yucatecan intermediaries also mentioned that participation in PSA-H made *ejidos* more likely to self-organize, which, aside from improving internal collaboration, also make them better equipped to access government or other external support.

In each state, interviewees provided two examples of external connections aside from interaction with the federal government. A point of contrast is that in Yucatán, those external relationships resulted from PSA-H participation, whereas external relationships in

Oaxaca existed prior to PSA-H enrollment. This difference between the states mirrors the trends we observed in internal collaboration and PSA-H participation. The Oaxacan examples of external relationships involved NGOs: in one case WWF had an office in the beneficiary community, and in another case an interviewee had worked with an NGO greenhouse project in a neighboring community. The two Yucatán examples involved community interaction with organizations that provided technical assistance for PSA-H implementation. In both cases, these examples were provided by *ejido* leaders, who may have been more likely to be aware of external collaboration because of their leadership role. Yucatecan intermediaries said that PSA-H had encouraged *ejidos* to start working with *técnicos* and regional associations for technical support-relationships that would not have developed independently of PSA-H.

Communities in both Oaxaca and Yucatán reported that they did not interact or communicate with neighboring communities. Yucatán *ejido* leaders do, however, meet bimonthly in Tekax to discuss agricultural needs and opportunities to solicit government support for agriculture. Approximately 60 *ejidos* from the Tekax area participate in these meetings, which are organized by an elected president. PSA-H is reportedly not discussed during these meetings. A Oaxacan intermediary mentioned that communities do collaborate with external organizations sporadically, but long-term collaboration is more unusual. Most Oaxacan intermediaries referenced collaborative efforts between communities, specifically UMAFORES- a CONAFOR program which coordinates monthly meetings to facilitate community coordination and information exchange. However, there seemed to be confusion regarding how many regions continue to hold UMAFORES meetings and what types of activities are addressed. Oaxacan intermediaries also described several collaborative community projects: a biological corridor for the endangered green macaw, UZACHI- the previously mentioned coalition of forestry based communities, and an organization called *Sistema Comunitaria por la Conservacion de Biodiversidad*, which engages approximately 13 communities in productive management projects. According to one intermediary, many communities become involved in PSA-H as a result of their participation in regional organizations like UMAFORES. However, UMAFORES were never

mentioned by community members in the interview sample, which indicates that intermediaries may have an unrealistic perception of community collaboration in the state.

The lack of interaction between Oaxacan communities, as expressed by community members, could be due to the extreme isolation of these communities- both geographically and linguistically. While Yucatán is quite flat, Oaxaca's very mountainous terrain complicates travel. Although indigenous languages are widely spoken in both states, in Yucatán the vast majority speak Maya, whereas 16 different languages are spoken in Oaxaca (Bernard, 1992). These geographic and linguistic characteristics may present greater barriers to inter-community interaction in Oaxaca compared to Yucatán.

A regional forum for communities to discuss their participation or desire to participate in PSA-H could be an extremely beneficial resource-sharing tool. Communities could exchange technical, contact, or programmatic information, which would assist them in complying with PSA-H and maximize program benefits. Such a forum could also help communities increase their joint capacity and clout in negotiating with local or state governments to improve forestry programs or resources. Additionally, improved technical skill, information sharing, and communication between communities would increase the potential for development of an actual ecosystem services market in which landowners engage with external buyers. While CONAFOR has made efforts to establish such connections, as evidenced by creation of UMAFORES, these efforts should be renewed.

A community's relationship with their hired *técnico* is a vital component of external connectivity. As the trained professionals responsible for collaborating with beneficiaries to create and carry out a forest management plan, *técnicos* are integral in PSA-H implementation. Through formal trainings and informal guidance, *técnicos* are responsible for disseminating information regarding forest health and management, PSA-H compliance, and the development of ecosystem service markets. Oaxacan community members more frequently expressed dissatisfaction regarding the services of their community's *técnico* than Yucatecan community members. Oaxacan *técnicos* reportedly visited their communities rarely, while in Yucatán many interviewees claimed that their *técnicos* visited

approximately once per month, or bimonthly. Furthermore, several Oaxacan intermediaries mentioned corruption related to *técnicos*. The main grievances were that *técnicos* are absent, do very poor jobs, or become defensive when reprimanded. This discrepancy in presence of *técnicos* between the two states may be due to the isolation of Oaxacan communities compared to Yucatán communities. Additionally, in both states, one beneficiary interviewee mentioned that their community did not employ a *técnico* because of the prohibitive expense, despite the fact that CONAFOR earmarks money for this purpose. This seems to be a deficiency in CONAFOR's implementation or design of the program.

Without the strong support of *técnicos*, program participants are unlikely to build forest management skills, change their perception of forest value, or pursue the potential to sell ecosystem services after the program ends. Therefore, the role of the *técnico* is pivotal to PSA-H's ability to generate lasting conservation and poverty alleviation impacts. Although steps have been taken to increase the accountability of *técnicos*, PSA-H would benefit from additional rules governing the interaction between communities and their *técnicos*, particularly in isolated areas that might suffer from *técnico* neglect. Additionally, CONAFOR could screen potential *técnicos* more rigorously before including them in the list provided to program participants. Transparency and accountability issues in the community-*técnico* relationship could be alleviated if the program required a certain number of interactions between communities and their *técnicos*, and both parties were required to log the number of visits and submit a record to CONAFOR. In order for this approach to work, however, it would be necessary to first ensure that the *técnicos* are receiving a large enough payment to incentivize fulfillment of their responsibilities.

In neither state did communities demonstrate very strong external connectivity, and no distinctions could be drawn between beneficiary and non-beneficiary communities. While the ability of PSA-H participation to generate external collaboration remains unclear, efforts to increase external connectivity would likely improve the implementation and outcomes of the program by increasing access to technical expertise, and improving information sharing between communities. In Yucatán, two intermediaries mentioned a

lack of forestry schools, forest technicians, and engineers in the region as a barrier to program success. Based on this information, it is possible that the lack of external connectivity among *ejidos* reflects a lack of available technical skill in the region as opposed to a lack of community capacity of to seek out external resources.

In conclusion, based on the PSA-H payment use and distribution methods, internal collaboration dynamics, and external connectivity of participating communities as demonstrated in our interview sample, the program does not appear to be alleviating poverty or generating sufficient community capacity to alleviate poverty over time. Payments are typically received and spent at the household level without being invested in income generating activities or community assets. Internal collaboration did seem to improve in the smaller Yucatecan communities, but only in the context of PSA-H participation, which suggests that internal collaboration might not persist beyond program enrollment. Furthermore, internal organization of communities appeared to be deficient in regards to *vigilancia* activities because instances of illegal activity occurred in many communities and responsibilities did not seem to be clearly designated in several cases, particularly in Oaxaca. Finally, participating communities demonstrated little and inconsistent external connectivity and dissatisfaction with *técnico* services was expressed. This lack of external connectivity undermines the likelihood for technical forestry skill building and the potential for communities to sell ecosystem services in the future.

In order to overcome these shortcomings and increase the program's ability to alleviate poverty in a sustainable manner, PSA-H design should incorporate certain changes. The program should assist communities in developing locally appropriate financial planning strategies and leverage payments in a way that will better enable the community to generate revenue over time. This assistance would require a high degree of community participation and a deep understanding on the part of the CONAFOR personnel of community economic potential and limitations. The program should also assist communities in strengthening internal organization in terms of designating responsibilities and keeping records for money management and PSA-H compliance activities. Additionally, PSA-H should provide more oversight of the *técnico*-community relationship and ensure

that adequate forestry skill building and transfer of knowledge is occurring. The program should also help communities to foster external relationships with other communities, professional organizations, or potential ecosystem service buyers. Incorporating these objectives and requirements into the PSA-H program will enhance the program's ability to generate community capacity and alleviate poverty among participants.

#### **IV. Conclusions**

Our results show an incongruity between the forest valuation methods employed by PSA-H designers and PSA-H participants on the ground. By using the national average opportunity cost of conversion to agriculture to calculate PSA-H payments, PSA-H design does not include benefits of standing forest that factor into participants' land use decisions.

However, our results indicate that participants tend to value the forest in terms of intrinsic value, products, and services instead of land use conversion. In order to more accurately capture forest value, PSA-H payment calculation should be adjusted to more closely match valuation on the ground. An altered payment scheme would ideally include forest products, and be region-specific in order to capture diverse forest uses. If land conversion is to be considered in payment calculations, conversion to timber harvesting would be more pertinent, because it was occasionally mentioned by program participants. Incorporation of these characteristics into PSA-H design would more efficiently incentivize conservation.

PSA-H designers' original goal was for program participants to find ecosystem service buyers after their five-year program participation. However, perspectives from PSA-H participants and intermediaries indicate that participants are unprepared or unable to enter ES markets. PSA-H seems to have a positive impact on understanding of ecosystem service concepts, as evidenced by the greater awareness of forest benefits and ecosystem services displayed by program beneficiaries. Although ecosystem service understanding is the first step towards engaging in ES markets, the second necessary step does not seem to be in place: understanding of ES markets. The vast majority of interviewees did not perceive the potential for non-governmental buyers of their services, and many barriers to market development were identified. If training from CONAFOR and *técnicos* emphasized



ecosystem service markets, program participants would be better equipped to engage with buyers after their PSA-H tenure. Furthermore, CONAFOR should expend effort towards encouraging market development- weak or non-existent markets currently prevent PSA-H participants from finding buyers. Incorporating these two recommendations would help program participants meet the PSA-H design goal of entry into ES markets.

Contrary to the PSA-H design assumption that providing payments to poor communities to conserve their forest will alleviate poverty, the perceptions of stakeholders on the ground demonstrate that poverty alleviation is more complex than the simple transfer of payments. Participants exhibited a lack of a savings or investment culture, varying degrees of internal collaboration, and limited external connectivity to organizations or other communities. These aspects of community capacity should be improved in order for the program to generate more lasting socioeconomic impacts. If financial planning strategies are developed, internal organization and management are strengthened, and communities more frequently and consistently engaged with external actors, then program participants will be better equipped to utilize payments in a way that generates returns and to interact in future ecosystem service market transactions. These insights gleaned from stakeholders' experiences with the PSA-H in practice should be incorporated into PSA-H design.

As demonstrated by our analysis of forest valuation, ES market potential, and poverty alleviation, there are discrepancies between PSA-H in practice and PSA-H design. This disconnect points to deficiencies in PSA-H design and implementation that could be improved to better meet forest conservation and poverty alleviation goals. Comparing Oaxaca and Yucatán—states with disparate socioeconomic and environmental conditions—underscores the need for consideration of regional variation and pre-existing conditions in design and implementation of the program. While the specific characteristics impacting PSA-H design and implementation are different in each region, we believe our findings to be generalizable throughout the country because they address integral components of PSA-H design that are applicable to all states and the differences we found only serve to suggest ways in which PES initiatives can be implemented across variable landscapes. As PES programs continue to expand globally, these considerations should be

incorporated into design and implementation. If these concerns are addressed, PES programs will more effectively and sustainably achieve the dual goals of forest conservation and poverty alleviation.

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## Literature Cited

- Alix, J., Janvry, A. D., & Sadoulet, E. (2003). Payments for Environmental Services : To whom, where and how much ? *Simulation*, 1-27.
- Alix-Garcia, J. (2009). *International Initiative for Impact Evaluation (3ie)- Grant Application Form. Update.*
- Alix-Garcia, J., de Janvry, A., Sadoulet, E., & Torres, J. M. (2005). *An Assessment of Mexico's Payment for Environmental Services Program. Alix-Garcia, Jennifer de Janvry, Alain Sadoulet, Elisabeth* (Vol. 18). doi:10.3126/banko.v18i1.2159
- Anta, S., Mondragon, F., & Lavin, D. (2006). El Manejo de los Recursos Naturales y el Pago de Servicios Ambientales Hidrologicos en la Chinantla Alta, Oaxca: El Caso de Corenchi, A. C. *Gestion de Cuencas y Servicios Ambientales* (pp. 203-220).
- Antinori, C., & Bray, D. B. (2005). Community forest enterprises as entrepreneurial Firms: Economic and institutional perspectives from Mexico. *World Development*, 33(9), 1529-1543. doi:10.1016/j.worlddev.2004.10.011
- Antinori, C., & Rausser, G. (2007). Collective choice and community forestry management in Mexico: An empirical analysis. *Journal of Development Studies*, 43(3), 512-536. doi:10.1080/00220380701204471
- Arriagada, R. A., Ferraro, P. J., Sills, E. O., Pattanayak, S. K., & Cordero-sancho, S. (2012). Do Payments for Environmental Services Affect Forest Cover ? A Farm-Level Evaluation from Costa Rica. *Land Economics*, 382-399.
- Asbjornsen, H. (2004). Synergistic responses of oak, pine and shrub seedlings to edge environments and drought in a fragmented tropical highland oak forest, Oaxaca, Mexico. *Forest Ecology and Management*, 192(2-3), 313-334. doi:10.1016/j.foreco.2004.01.035
- Barnes, G. (2009). The evolution and resilience of community-based land tenure in rural Mexico. *Land Use Policy*, 26(2), 393-400. doi:10.1016/j.landusepol.2008.05.007
- Barrera-Bassols, N., & Toledo, V. M. (2005). Ethnoecology of the Yucatec Maya: Symbolism, Knowledge and Management of Natural Resources. *Journal of Latin American Geography*, 4(1), 9-41.
- Bernard, H. R. (1992). Preserving Language Diversity. *Society*, 51(1).
- Bezaury, J. A. (2007). Organized Coffee Producers: Mitigating Negative Impacts of Outmigration in Oaxaca, Mexico. *Mountain Research and Development*, 27(2), 109-113. doi:10.1659/mrd.0905

- Blackman, A., Albers, H., & Crooks, L. (2005). *Deforestation and Shade Coffee in Oaxaca, Mexico*.
- Bray, D. B., & Merino-Pérez, L. (2002). The Rise of Community Forestry in Mexico: History , Concepts , and Lessons Learned from Twenty-Five Years of Community Timber Production.
- Bray, D., Perez, L., 2004. Community Forests of Mexico: Achievements and Chal- lenges. Sierra Madre, Mexico City.
- CONEVAL. (2011). *Medición de la pobreza*. Retrieved from [http://internet.coneval.gob.mx/informes/Pobreza/Pobreza\\_municipal/Presentacion/Pobreza\\_municipios.pdf](http://internet.coneval.gob.mx/informes/Pobreza/Pobreza_municipal/Presentacion/Pobreza_municipios.pdf)
- Corbera, E., & Brown, K. (2008). Building Institutions to Trade Ecosystem Services: Marketing Forest Carbon in Mexico. *World Development*, 36(10), 1956-1979. Elsevier Ltd. doi:10.1016/j.worlddev.2007.09.010
- Corbera, E., Soberanis, C., & Brown, K. (2009). Institutional dimensions of Payments for Ecosystem Services: An analysis of Mexico's carbon forestry programme. *Ecological Economics*, 68(3), 743-761. Elsevier B.V. doi:10.1016/j.ecolecon.2008.06.008
- Costanza, R., D'Arge, R., Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., et al. (1997). The value of the world's ecosystem services and natural capital. *Nature*, 387(6630), 253-260.
- Creswell, J. W. and Plano, V. L. (2007). *Designing and Conducting Mixed Methods Research* (pp. 1-19). Thousand Oaks, California: Sage Publications:
- Delgado Wise, R. (2003). Critical Dimensions of Mexico-U . S . Migration under the Aegis of Neoliberal Globalism. *International Migration Conference in the Americas: Emerging Issues Conference*.
- Durand, J., & Massey, D. S. (2012). Mexican Migration to the United States: A Critical Review, 27(2), 3-42.
- Eastmond, A., Robert, Manuel L. (2000). Henequen and the challenge of sustainable development in Yucatan, Mexico. *Biotechnology and Development Monitor*, (41), 11-15.
- Ernst, J. A., Monroe, M. C., Simmons, B. (2009). Evaluating Your Environmental Education Programs: A Workbook for Practitioners. *North American Association for Environmental Education*.
- Esquivel, G., Lederman, D., Messmacher, M., & Villoro, R. (2002). *Why NAFTA Did Not Reach the South. Education*.

- Faust, B. B. (2001). Maya environmental successes and failures in the Yucatan Peninsula. *Evaluation*, 4, 153-169.
- Ferraro, P. J. (2001). Global Habitat Protection: Limitations of Development Interventions and a Role for Conservation Performance Payments. *Conservation Biology*, 15(4), 990-1000. doi:10.1046/j.1523-1739.2001.015004990.x
- Ferraro, P. J., & Simpson, R. D. (2002). The Cost-Effectiveness of Conservation Payments. *Land Economics*, 78(3), 339. doi:10.2307/3146894
- Flores, R. T. (1999). *The Differential Impact of International Integration on Local Economies: How are Lagging Mexican Regions Performing?* Centro de Investigación y Docencia Económicas.
- García-Frapolli, E., Ramos-Fernández, G., Galicia, E., & Serrano, A. (2009). Land Use Policy The complex reality of biodiversity conservation through Natural Protected Area policy : Three cases from the Yucatan Peninsula , Mexico. *Landscape and Urban Planning*, 26, 715-722. doi:10.1016/j.landusepol.2008.09.008
- Gobierno del Estado de Oaxaca. (2010). EXPOSICIÓN “ECOSISTEMAS DE OAXACA” «. *Niza*. Retrieved February 25, 2012, from <http://ecologiaoaxaca.wordpress.com/2010/07/22/exposicion-%E2%80%9Cecosistemas-de-oaxaca%E2%80%9D/>
- Gobierno del Estado de Oaxaca. (2011). Plan Estatal de Desarrollo de Oaxaca: 2011-2016. Retrieved from <http://www.planestataldedesarrollo.oaxaca.gob.mx/>
- Gobierno del Estado de Yucatán. (2007). Plan Estatal de Desarrollo 2007 – 2012. Retrieved from <http://www.Yucatán.gob.mx/gobierno/PED/>.
- González-Iturbe, J. (2002). Tropical dry forest recovery after long term Henequen (sisal, *Agave fourcroydes* Lem.) plantation in northern Yucatan, Mexico. *Forest Ecology and Management*, 167(1-3), 67-82. Retrieved from [http://dx.doi.org/10.1016/S0378-1127\(01\)00689-2](http://dx.doi.org/10.1016/S0378-1127(01)00689-2)
- Gravel, N. (2007). Mexican Smallholders Adrift: The Urgent Need for a New Social Contract in Rural Mexico. *Journal of Latin American Geography*. doi:10.1353/lag.2007.0039
- Hébert, M., & Gabriel, M. (2007). Community Forestry and the Paradoxes of Citizenship in Mexico: The Cases of Oaxaca and Guerrero. *Library*.
- Instituto Nacional de Estadística y Geografía (México) (2011). Anuario de estadísticas por entidad federativa 2011. Retrieved from [http://www.inegi.org.mx/prod\\_serv/contenidos/espanol/bvinegi/productos/integracion/pais/aepef/2011/aepef2011.pdf](http://www.inegi.org.mx/prod_serv/contenidos/espanol/bvinegi/productos/integracion/pais/aepef/2011/aepef2011.pdf)

- INEGI (2012). Perspectiva Estadística Yucatán Retrieved from [http://www.inegi.org.mx/prod\\_serv/contenidos/espanol/biblioteca/Default.asp?accion=2&upc=702825000970](http://www.inegi.org.mx/prod_serv/contenidos/espanol/biblioteca/Default.asp?accion=2&upc=702825000970)
- Info Rural. (2008). México tiene el mayor programa de servicios ambientales del mundo Banco Mundial Noticias Medio Ambiente Info Rural Noticias Agrarias Info Rural. Retrieved April 10, 2012, from <http://www.inforural.com.mx/spip.php?article36440>
- Joseph, G. (1982). *Revolution from without: Yucatan, Mexico, and the US 1880-1924*. Durham, NC: Duke University Press Book.
- Kerr, J. (2002). Watershed Development, Environmental Services, and Poverty Alleviation in India. *World Development*, 30(8), 1387-1400. doi:10.1016/S0305-750X(02)00042-6
- Klooster, D., & Masera, O. (2000). Community forest management in Mexico : carbon mitigation and biodiversity conservation through rural development. *Global Environmental Change*, 10.
- Kosoy, N., Corbera, E., & Brown, K. (2008). Participation in payments for ecosystem services: Case studies from the Lacandon rainforest, Mexico. *Geoforum*, 39(6), 2073-2083. Elsevier Ltd. doi:10.1016/j.geoforum.2008.08.007
- Lewis, J. M. (2005). Strategies for Survival : Migration and Fair Trade- by. *International Migration*, (June).
- McAfee, K., & Shapiro, E. N. (2010a). Payments for Ecosystem Services in Mexico: Nature, Neoliberalism, Social Movements, and the State. *Annals of the Association of American Geographers*, 100 (3), 579-599. doi:10.1080/00045601003794833
- McAfee, K., & Shapiro, E. N. (2010b). Payments for Ecosystem Services in Mexico: Nature, Neoliberalism, Social Movements, and the State. *Annals of the Association of American Geographers*, 100(3), 579-599. doi:10.1080/00045601003794833
- Merino Perez, Leticia, Patricia Gerez Fernandez, and Sergio Madrid Zubiran 2000 "Políticas, instituciones comunitarias y uso de los recursos comunes en Mexico. In *Sociedad, derecho y medio ambiente*, edited by M. Bafielos, 57-144. Mexico, D.F.: Universidad Autónoma Metropolitana, SEMARNAP, PROFEPA, CONACYT, SEP.
- Mills, N., & Porras, I. (2002). *Silver Bullet or fools' gold? A global review of markets for forest services and their impact on the poor. A global review of markets for forest environmental*. London. Retrieved from <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Silver+bullet+or+fools'+gold+?#7>

- Muñoz-Piña, C., Guevara, A., Torres, J., & Brana, J. (2008). Paying for the hydrological services of Mexico's forests: Analysis, negotiations and results. *Ecological Economics*, 65(4), 725-736. doi:10.1016/j.ecolecon.2007.07.031
- Oficina Estatal de Información para el Desarrollo Rural Sustentable. (2005). *Tarjeta Estatal de Información Estadística Básica: Estado 20- Oaxaca*.
- Pagiola, S., Arcenas, A., & Platais, G. (2005). Can Payments for Environmental Services Help Reduce Poverty? An Exploration of the Issues and the Evidence to Date from Latin America. *World Development*, 33(2), 237-253. doi:10.1016/j.worlddev.2004.07.011
- Pagiola, S., J. Bishop, and N. Landell-Mills. 2002. Selling forest environmental services: Market-based mechanisms for conservation and development. London, UK: Earthscan.
- Radel, C., Schmook, B., & Chowdhury, R. R. (2010). Agricultural livelihood transition in the southern Yucatán region: diverging paths and their accompanying land changes. *Regional Environmental Change*, 10(3), 205-218. doi:10.1007/s10113-010-0113-9.
- Robson, J., & Berkes, F. (2011). How Does Out-Migration Affect Community Institutions? A Study of Two Indigenous Municipalities in Oaxaca, Mexico. *Human Ecology*, 39(2), 179-190. doi:10.1007/s10745-010-9371-x
- Robson, J. P. (2007). Local approaches to biodiversity conservation : lessons from Oaxaca , southern Mexico. *International Journal of Sustainable Development*, 10(0), 276-286.
- Robson, J. P., & Berkes, F. (2011). Exploring some of the myths of land use change: Can rural to urban migration drive declines in biodiversity? *Global Environmental Change*, 21(3), 844-854. Elsevier Ltd. doi:10.1016/j.gloenvcha.2011.04.009
- Schmook, B., & Radel, C. (2008). International Labor Migration from a Tropical Development Frontier: Globalizing Households and an Incipient Forest Transition. *Human Ecology*, 36(6), 891-908. doi:10.1007/s10745-008-9207-0
- SEDETUR (2006). Indicadores Tursticos: Afluencia Turistica al Estado. Secretaria de Turismo de Quintana Roo, Mexico. Retrieved from <http://sedetur.qroo.gob.mx/estadisticas/2005/marzo.php>
- SEMARNAT (2006). Conoce el Cuadro de Resultados 2002-2006. Retrieved from <http://cruzadabosquesagua.semarnat.gob.mx>
- SEMARNAT. (2010). *El Ambiente en Numeros*. Retrieved from [http://www.semarnat.gob.mx/informacionambiental/documents/sniarn/pdf/el\\_ambiente\\_numero\\_2010.pdf](http://www.semarnat.gob.mx/informacionambiental/documents/sniarn/pdf/el_ambiente_numero_2010.pdf)

- Secretaria de Medio Ambiente y Recursos Naturales. (2011). *Reglas de Operacion del Programa ProArbol 2012*.
- Servicios Ambientales de Oaxaca. (2012). Retrieved February 25, 2012, from <http://www.sao.org.mx/>
- Shapiro, E. N. (2010). *To Revalue the Rural? Transformation of the Mexican Federal Payments for Ecosystem Services Programs from Neoliberal Notion to Development Dogma*. University of California, Berkeley.
- UNDP. (2010). *Informe sobre Desarrollo Humano de los Pueblos Indígenas en México*. Retrieved from [http://hdr.undp.org/en/reports/national/latinamericathecaribbean/mexico/Mexico\\_NHDR\\_2010.pdf](http://hdr.undp.org/en/reports/national/latinamericathecaribbean/mexico/Mexico_NHDR_2010.pdf)
- Umlas, E. (1998). ENVIRONMENTAL NETWORKING IN MEXICO : The Comité Nacional para la Defensa de los Chimalapas. *Review Literature And Arts Of The Americas*, 33(3), 161-189.
- Vanwey, L. K., Tucker, C. M., & McConnell, E. D. (2004). MIGRATION, AND REMITTANCES IN OAXACA. Eileen Diaz McConnell, University of Illinois, Urbana-Champaign, 40(1), 83-107.
- Ventura-Aquino, Y., Rendón, B., Rebollar, S., & Hernández, G. (2008). Use and conservation of forest resources in the municipality of San Agustín Loxicha, Sierra Madre del Sur, Oaxaca, Mexico. *Agroforestry Systems*, 73(3), 167-180. doi:10.1007/s10457-008-9107-8
- Walker, M., Roberts, S., Jonesiii, J., & Frohling, O. (2008). Neoliberal development through technical assistance: Constructing communities of entrepreneurial subjects in Oaxaca, Mexico. *Geoforum*, 39(1), 527-542. doi:10.1016/j.geoforum.2007.10.009
- Wunder, S. (2007). The efficiency of payments for environmental services in tropical conservation. *Conservation biology : the journal of the Society for Conservation Biology*, 21(1), 48-58. doi:10.1111/j.1523-1739.2006.00559.x
- Wunder, S., Engel, S., & Pagiola, S. (2008). Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries. *Ecological Economics*, 65(4), 834-852. doi:10.1016/j.ecolecon.2008.03.010
- Yin, R. K. (1994). *Case Study Research Design and Methods, Second Edition* (pp. 1-17). Thousand Oaks, California: Sage Publications.



## Appendices

### i. Appendix A: Interview Guides

Three interview guides were developed for each stakeholder group included in the interview sample: private property owners, community members, and intermediaries involved in program implementation.

#### Private Property Owner Interview Guide

1. Do you think your forest is healthy?
  - a. How do you know it is/isn't healthy?
  - b. What type of forest is it?
2. Do you have a role in forest management?
  - a. What is your role? (If no response, prompt with: reforestation, vigilance, harvesting, cleaning)
3. Do you do forest inventories to evaluate the characteristics of your forest, such as measurements of the forest content and cover?
4. Is there vigilance of your forest against prohibited activities, such as tree-stealing or hunting of animals?
  - a. Who does the vigilance?
  - b. Is the vigilance effective?
5. Who would you ask if you had a question about how to improve the management of the forest?
6. What are the benefits of the forest to you?
7. What benefits does the conservation of your forest offer to people in other parts of the world?
8. If you had to calculate the total value of your forest, how would you do it?  
(If no response, prompt with the following series of questions)
  - a. Do you harvest wood from the forest? Why or why not?
  - b. Do you harvest non-timber forest products?
  - c. Do you use services provided by the forest?
9. What is the relationship between the forest and the quantity or quality of water?
10. Are there problems with the quantity or quality of water in this region?
  - a. What type of problems?
  - b. What can you do to alleviate these problems?

- c. Do you believe there will be problems with the quantity or quality of water in the future?
11. If the government did not pay you to conserve the forest, is there anyone else who would pay you?
    - a. Who would pay you? (If no response, prompt with: communities, municipalities, businesses, governments of other countries?)
    - b. Why do you think they would pay?
  12. How do you use the money that CONAFOR gives for PSA-H? (If no response, prompt with: for forest management, for agriculture, for household expenses, to maintain the forest without management?)
  13. Do you participate in any community activities or organizations in the location of your property (If no response, prompt with: social activities, activities of conservation or of forest management)
    - a. If so, did you participate in this activity or organization before your land was enrolled in the PSA-H program of CONAFOR?
  14. Do you work with any external organizations or associations related to forest management?
    - a. If so, did you work with this organization before your land was enrolled in the PSA-H program of CONAFOR?
  15. What do you believe will be the principal activity of your children when they are older? (If no response, prompt with: agriculture, forestry, ranching, another profession)

### Community Member Interview Guide

1. Do you think your forest is healthy?
  - a. How do you know it is/isn't healthy?
  - b. What type of forest is it?
2. Do you have a role in forest management?
  - a. What is your role? (If no response, prompt with: reforestation, vigilance, harvesting, cleaning)
3. Does the community do forest inventories to evaluate the characteristics of your forest, such as measurements of the forest content and cover?
4. Would you say the majority or the minority of community members are aware of the program PSA-H?

5. Is there vigilance of your forest against prohibited activities, such as tree-stealing or hunting of animals?
  - a. Who does the vigilance?
  - b. Is the vigilance effective?
6. Who would you ask if you had a question about how to improve the management of the forest?
7. What are the benefits of the forest to you and your community?
8. What benefits does the conservation of your forest offer to people in other parts of the world?
9. If you had to calculate the total value of your forest, how would you do it?  
(If no response, prompt with the following series of questions)
  - a. Do you harvest wood from the forest? Why or why not?
  - b. Do you harvest non-timber forest products?
  - c. Do you use services provided by the forest?
10. What is the relationship between the forest and the quantity or quality of water?
11. Are there problems with the quantity or quality of water in this region?
  - a. What type of problems?
  - b. What can you do to alleviate these problems?
  - c. Do you believe there will be problems with the quantity or quality of water in the future?
12. If the government did not pay you to conserve the forest, is there anyone else who would pay you?
  - a. Who would pay you? (If no response, prompt with: communities, municipalities, businesses, governments of other countries?)
  - b. Why do you think they would pay?
13. Do the people in this community perceive that the assembly is just and inclusive?
  - a. How are the PSA-H payments distributed between community members?
  - b. What would be the best way to distribute the PSA payments? (if no response, prompt with: for community projects, to individual people, for the management of the forest, for agriculture)
14. How do you use the money that CONAFOR gives for PSA-H? (If no response, prompt with: for forest management, for agriculture, for household expenses, to maintain the forest without management?)
15. Can you tell me an example of a situation recently in which the community had to work together to achieve a common objective?
  - a. What committees or local organization had a role in realizing this effort?

- b. Did you participate in this activity or organization before your lands were enrolled in the PSA-H program of CONAFOR?
- 16. Do you work with any external organizations or associations related to forest management?
  - a. If so, did you work with this organization before your land was enrolled in the PSA-H program of CONAFOR?
- 17. Does the community communicate much with other communities?
- 18. What do you believe will be the principal activity of your children when they are older? (If no response, prompt with: agriculture, forestry, ranching, another profession)

### Intermediary Interview Guide

1. Before the program PSA of CONAFOR began, what were some other forestry programs or projects that this region was implementing?
2. How have other forestry projects or programs in this region changed as a result of the implementation of PSA?
3. What are the ecological characteristics specific to Oaxaca/Yucatán that have had an impact on the implementation and success of PSA-H?
4. Is the majority of agricultural production for auto consumption, or are there many businesses or communities that generate income from agriculture?
  - a. Could you tell me the history of irrigation systems here? Have there been any government efforts to implement more irrigation systems?
5. What are the social characteristics specific to Oaxaca/Yucatán that have had an impact on the implementation and success of PSA-H?
6. What are the economic characteristics specific to Oaxaca/Yucatán that have had an impact on the implementation and success of PSA-H?
7. What do you believe are the principal reasons communities or private properties decide to participate in PSA-H?
8. What characteristics distinguish the communities that have had success in creating capacity in their community to manage the lands enrolled in PSA-H?
9. What role do community institutions—like the assembly, committees, and governing body—have in the implementation of PSA-H?

10. Do you think that since the implementation of PSA-H, there have been perceptible changes in the management and health of enrolled forests?
11. Do the communities that participate in PSA-H do inventories to evaluate the characteristics of their forest, such as measurements of the content and cover of their forest?
  - a. Is there anyone who does this work?
12. What do you believe will happen to the majority of the participating forests when the program ends?
13. Do you think the majority of the community members know PSA-H?
  - a. Why or why not?
14. Do the communities in this region work with external organizations for information or help with the implementation of programs like PSA-H?
15. Is there communication or collaboration between communities in this region?
  - a. How do they communicate? Do they have reunions, or communicate in an informal manner?
  - b. How many times each year do they meet?
  - c. What do they discuss during these reunions?
  - d. Do they do projects or activities together?
16. Could you tell me how PSA-H has changed since it began in 2003?
17. What do you believe should be the criteria to select the participants in the program?  
(If no response, prompt with: poverty alleviation, pure conservation, large parcels, priority ecosystems)
18. Do you think the majority of the children of community members in this region will work in agriculture, forestry, ranching; or other professions when they are older?

## ii. Appendix B: Node Description for NVivo Coding

Transcribed interviews were analyzed using QSR NVivo9- a qualitative data analysis software. Coding schemes were developed for both intermediary and community/private property interviews in order to analyze the data for themes of interest to the study. Each code is listed below with a description of the information included.

### *Intermediary Codes*

#### Beneficiary

- **Beneficiary characteristics that result in successful PSA implementation:** The private or community PSA beneficiary characteristics that may contribute to successful implementation or positive outcomes of PSA.
- **External collaboration:** Discussion of organizations or individuals outside the beneficiary community with whom the community interacts or works. This may include the government or NGOs.
  - **Other communities:** Any mention of projects, meetings, or general communication with other communities.
- **Internal coordination:** Evidence of the community working together on projects or community efforts, including PSA. Includes discussion of community workdays, community committees, and the general assembly.
- **Internal conflict:** Discussion of disagreements among community members or conflict in regards to PSA participation
- **Reasons for beneficiary participation:** The motives for private or community beneficiaries of PSA to choose to participate in the program.

Characteristics of the interviewee: Information pertaining to the interviewee's demographics, relationship with PSA, place of employment and amount of time spent in their work position.

#### Forests

- **Forest inventories:** Addresses whether PSA forests are inventoried for forest composition and measurements, and who undertakes this work. Also includes mention of forest studies conducted by scientific institutions.
- **Forest management practices:** Any mention of forest management activities carried out by the property owner or community.

#### Funds

- **PSA payment distribution:** Describes how payments are distributed among households and other expenditures within beneficiary communities.
- **Poverty alleviation:** The interviewee's perspective on PSA's role or efficacy in alleviating poverty in beneficiary communities.

### PSA impacts

- **Beneficiary capacity building & social impacts:** Any mention of ways in which community institutions or community-members' skills and knowledge have been strengthened as a result of PSA implementation.
- **Environmental impacts:** Perceived positive or negative impacts to the natural environment and ecosystems as a direct result of PSA implementation.
- **Economic impacts:** Perceived impacts of PSA payments on income or economic opportunity or activities, either at the household or community level. This may include discussion of community projects undertaken using program funds, additional household income, or improved community organization and capacity.
- **Future land use and long-term PSA impact:** Impressions of how beneficiaries will proceed with management of enrolled lands once their 5-year participation in PSA has concluded- whether they will continue conserving the land, or use it for a productive purpose. Additionally, any lasting changes that may occur in a community as a result of their participation, e.g. changes in community rules or community member attitudes.
- **Impacts on other conservation or government programs:** Input as to whether CONAFOR's PSA program has influenced or encouraged other conservation efforts since its initiation in 2003.

### PSA operations

- **Changes in PSA over time:** Explanation of any changes in PSA since its initiation in 2003, such as program rules and requirements, participant selection, funding sources, payments, or number of participants.
- **Selection process:** Description of the methods and criteria used to select PSA beneficiaries from the applicant pool, including considerations of the ecosystem, social structures, and poverty.
- **Tecnicos:** Any comments regarding tecnicos- the third-party professionals who work with beneficiaries to create a Plan de Mejores Practicas and undertake forest management activities.
- **PSA awareness:** Comments pertaining to how well-known PSA is among members of beneficiary communities.
- **PSA problems and suggestions:** Any faults or deficiencies noted in program operation and implementation, and suggested improvements.
- **PSA rules:** Discussion of the requirements for PSA eligibility and program rules.

### Regional characteristics

- **Conservation history and projects:** Description of any conservation or environmental-focused projects in the region or country. This includes efforts initiated by the government, NGOs, or private companies.

- **Social characteristics:** Description of social characteristics of the respective region that may influence PSA implementation or outcome, including community and family structure.
- **Environmental characteristics:** Description of environmental characteristics in the respective region, including topography, forest type, climate, etc.
- **Child activity:** Perception of preferences and decisions made by the youth of the respective region, including goals, occupation, education, and migration.
- **Economic characteristics:** Description of economic characteristic in the respective region that may influence PSA implementation, including industry, poverty levels, and job opportunities.

### *Community and private property codes*

#### Community institutions

- **Vigilancia practices:** Discussion of vigilance or security measures taken by the beneficiary, including the activities vigilance is intended to prevent, whose role it is to undertake vigilance, and whether it is effective.
- **Migration:** Any discussion of community members or beneficiaries moving out of their community, either on a permanent or temporary basis.
- **Internal coordination:** Evidence of the community working together on projects or community efforts, including PSA. Includes discussion of community workdays, the general assembly and community committees.
- **Child activity:** Perception of preferences and decisions made by the youth of the respective region, including occupation, education, and migration.

#### External connections

- **Information sources:** Any organizations or individuals consulted as information sources for forest and conservation-related topics.
- **External collaboration:** Discussion of organizations or individuals outside the beneficiary community with whom the community interacts or works. This may include the government or NGOs.
  - **Other communities:** Any mention of projects, meetings, or general communication with other communities.

#### Forest health & type

- **Forest Health Indicators:** Forest characteristics that indicate to the interviewee whether or not the forest is in a healthy state.
- **Forest Management Practices:** Any forest management activities that the interviewee or his/her community participate in, such as: reforestation, firebreaks, making forest paths, cleaning the forest, monitoring for illegal activity, etc.



- **Forest type:** How the interviewee describes the forest type present in the community.

Forest and water relationship: Discussion of whether there is a relationship between forest cover and water quality and quantity, and if so, the nature of this relationship.

Forest value and benefits

- **Community benefits of forest:** Any comments made by interviewees about the benefits they derive from the forest, which may include income, food sources, ecosystem services.
- **External forest benefits:** Perceived benefits that the beneficiary's forest provides to people in the rest of the world, external to the community.
- **Forest value:** Responses to the interview question regarding assigning a value to the forest, and how the interviewee might do so.
- **Forest products:** Any physical products the interviewee derives from the forest, such as fruits or vegetables, firewood, timber, or coffee.
- **Understanding of ecosystem services:** Evidence of beneficiary comprehension of the concept of ecosystem services- that the forest and natural environment provide services which they use, and for which they could potentially receive payment.

PSA

- **Conservation Payments:** References to the possibility of entities other than the Mexican government (such as private companies, international governments, or neighboring municipalities) paying the landowner or community for the services they are providing by conserving their forest.
- **PSA Awareness:** Comments pertaining to how well-known PSA is within beneficiary communities.
- **PSA Payments & Distribution:** Includes discussion of how beneficiaries use PSA payments in their homes, how PSA payments are distributed between households, and other expenditures within a beneficiary community.
- **PSA Problems & Recommendations:** Any faults or deficiencies noted in program operation and implementation, and suggested improvements to the program.

Water Issues: Discussion of whether or not water quantity or quality issues exist in the interviewee's community, whether they anticipate water issues in the future, and if these issues can be ameliorated.