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The Mexican Common Property Forestry Sector

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Abstract

This report summarizes preliminary findings of the *Mexican National Database and Community Survey Project* which examines linkages between institutional characteristics in Mexico's common property forestry sector and economic and environmental outcomes. Framing the Mexican agrarian community as a unit of analysis characterized by its history, individual members, resources, civic structure and property rights, we use institutional economic analysis to motivate project design and research on three aspects of Mexican community forestry governance: first, how communities have engaged forest resources to participate in forestry markets; second, how internal models of forestry management are reflect historical circumstances and practices, policy trends and managerial preferences that are independent of vertical integration levels; third, correlation among market participation, internal organization and performance outcomes such as conservation levels, wealth and income indicators and public and private goods investment. The project employs unique community-level survey data collected in Durango and Michoacan between 2005 and 2007 to summarize basic statistics to describe the sector from the point of view of the project's objectives. Preliminary results reveal an inverse relationship between integration into production chains and material wealth measures, no correlation between internal governance models and vertical integration, and significant regional variation in institutional characteristics. The emerging profile shows continually evolving and varied common property institutions and questions "one-size-fits-all" business models, pointing to the need for more specific understandings of the community forestry sector. The lessons learned can be applied to address the future role of "community" in Mexican economic and environmental policy, and, on a larger scale, the meaning of community forestry management in sustainable development strategies.

1 Purpose of Study

1.1 Why study Mexican common property forestry?

Mexican common property forestry refers to forest conservation and forestry production occurring in Mexico's *ejidal* and indigenous communities where forest land is held as common property. Three major concerns have motivated the current research on this sector. The first concern relates to its connection with the broader phenomenon of "community forestry" which has gained global importance in the last two decades for establishing rights to resources and sustainable development strategies (CIFOR 2009). The alarming rate of destruction of forests, the incidence of poor people living around or in forests who have often relied on forests economically (White and Martin 2002; Chomitz et al. 2007), and the recognition of local institutions as viable means of sustainable resource management are critical aspects in the study of community forestry (Menzies 2007; Schmink 2008). Low estimates place 22% of forests in the most forested developing countries under local communal reserve or ownership (White and Martin 2002), and this number may be growing (Khare 2009). Mexico is first worldwide in extent of commercially viable natural forest under communal property.[1] Clarifying local property rights to forest resources has further significance for climate change mitigation efforts. Scholars refer to common property regimes as arenas for the study of a broad spectrum of human behavior (Dietz et al. 2002; Klooster 2000). Demand for knowledge in this area is high as policymakers struggle with finding practical strategies to incorporate local stakeholders into long-term natural resource management goals.

The second concern is disentangling the nature of Mexican community forestry itself. The Mexican Revolution of 1910 led to a dramatic redistribution of land rights from the *hacienda* holdings to peasant groups or communities. The meaning of "community" is established in the Mexican Constitution of 1917, defining the legal basis, governing bodies, rulemaking procedures and membership criteria. Nevertheless, up until the seventies, the state claimed the right to timber extraction and leasing, or private firms made ad hoc agreements with community members to buy or extract timber (de la Peña 1950; Merino and Alatorre 1997). Resistance to these practices eventually led to a shift to community-determined management and commercialization. Policy trends have witnessed the recognition of community rights to exploit forest resources, the privatization of

[1] An oft-cited figure places the extent of Mexican forests (including tropical and temperate) in ejidal/indigenous lands as 80%. However, this figure is now considered to be an overestimate, though more updated estimates await further clarification. The number of communities with forest land is estimated as between 7000 to just over 9000. Wilshusen (2003) traces these figures back to the original sources and finds that confusion exists on the definition of forest, for example, whether the original estimates include closed canopy forests only or a broader definition that includes arid and semi-arid lands and wetlands (pages 132-33, note 36). Newer estimates place the estimates in the range of 30-60% (Antinori (2008), Juan Manuel Torres-Rojo, personal communication, April 14, 2008; David Bray, personal communication November 15, 2009). In general, however, it is recognized that Mexico is still first in extent of community timber production worldwide.

professional forestry services and most recently an emphasis on reducing deforestation.[2] Despite changes to agrarian law, outright ownership of forests is unlikely to change hands in the near future. The coincidence of poor rural populations and deforestation does not occur in Mexico in communities with forestry management activities. Many areas of Mexico's worst deforestation lie where no commercial forestry activity occurs or where no forest management plan is in place (Deininger and Minten 2002; Bray et al. 2003; Duran et al. 2005), suggesting both a conservationist and commercially productive role for community forestry. Yet, vast underinvestment and inefficient management and production remain as obstacles to further growth and improvement in this sector.

The third concern is the lack of empirical data on the community forestry sector's institutions, that is, systematic information on rules governing use of the resource, decisionmaking processes, stakeholders and governance as a whole despite its importance as a management model for natural resources. The World Bank's governance indicators project (Kaufmann et al. 2009) attests to the greater acceptance of institutional features in economic development; however, these indicators are rarely available at the local community level. Yet, scholars and practitioners using case studies have identified these indicators as key determinants of the success or failure in reaching performance objectives (Macqueen 2008; Chomitz et al. 2007). White and Martin (2002) is the first accounting of tenure control over the world's forests and includes definitions of communal rights in its property rights typology. The International Forestry Resources and Institutions (IFRI) project is filling this information gap by building a cross-spatial and over-time database of resources institutions (see http://www.sitemaker.umich.edu/ifri/home) (Ostrom and Nagendra 2006). Research specific to forestry and Mexico has yielded some of the first cross-sectional studies on community forestry institutions (Antinori and Rausser 2008; Perez-Cirera and Lovett 2006). However, a Ford Foundation report (Bray and Merino-Perez 2002) found that no firm data exists on the extension of forests management by communities nor types of management regimes across Mexico as a whole. Therefore, the full level and scope of community timber production and ecosystem management efforts are uncertain. Individual case studies (Merino and Alatorre 1997; Moros and Solano 1995) and the Antinori and Rausser (2008) study reveal the full range of capacities for downstream processing across communities, from selling stumpage to finished products hewn in community-owned sawmills which are not determined solely by technical production inputs like size of forest. Furthermore, at each level of processing capability are further variations: community-level organizations, subcommunity-level work groups, parcelized forests, and unions of communities organized to share costs of technical services and capital investments. Before policy formulations can be made, more in-depth work is required to understand the institutional basis of this sector.

The project frames Mexican community forestry management as a mode of governance distinct from the private firm or public bureau, where the Mexican agrarian community is a

[2]See Antinori and Garcia-Lopez (2008) for detailed account of changes in forest policy over last forty years and current laws.

unit of analysis characterized by its history, individual members, resources, civic structure and property. These are also viewed as continually evolving institutions, rather than static concepts, which are shaped by incentives to benefit from local resources. A fundamental concern is how different forms of collective action in timber production affect distribution of monetary and nonmonetary benefits among local and nonlocal stakeholders. A full range of decisions encompass how forests are managed. In the research design, we trace out decisions as they translate into activities and practices in forestry management, including decisions that are made mostly by internal members of the community and those that are influenced or guided mainly by external rules and regulations, such as for example, limits to the amount of harvesting that can occur legally in a given forest stand per year. In this way, the research bears much similarity to ostrom's work by explicating rules in use in common pool resource management. To analyze the collective production decisions , mostly but not exclusively around timber products, we draw on the transaction cost literature and related contract theory to understand how incentives are affected by accountability, uncertainty and monitoring mechanisms in the chain of production. These distinctions in decisionmaking processes and structures are characterized by different lines of questions within the survey instrument and then analyzed according to our theory and hypotheses.

1.2 Project history

The research grows out of a collaboration by Florida International University, Centro de Investigacion y Docencia Economica and the University of California-Berkeley to fill this gap in information. Phase One of the project began in 2003 to combine into one database all state permit files kept in the separate state offices of the *Secretaria de Medio Ambiente y Recursos Naturales* (SEMARNAT).[3] Phase Two activities began in 2005 to collect survey data from a sample of common property forest communities drawn from the Phase One data for more in-depth analysis. This report covers the activities and preliminary research findings of the Phase Two survey data effort.

1.3 Organization of report

This report summarizes the questions, objectives, methodology, basic results and future work of the community-level survey component of this project. Section 2 describes the underlying theoretical concepts guiding the the overall research project. Section 3 explains the survey instrument design and data sampling techniques. Section Four begins the summary of data from the surveys collected from 41 communities in two states in Mexico. As an extensive amount of information was collected, this report reports basic results to introduce information previously not collected or known and to identify critical areas of further research.

[3]See Antinori, Magana, Torres Rojo, Bray, and Segura (2004) for full description of the Phase One effort.

2 Research themes and analytical approach

Economic governance provides the organizing theme for this research project. Dixit (2009) defines, for the purpose of discussion, economic governance as the structure and functioning of legal and social institutions which support economic activity and economic transactions. Recent work in this area sends a clear signal that there is no automatic link between one form of governance and specific performance outcomes, like economic growth, development or environmental conservation. It is unsurprising that this applies not only on a macroeconomic scale (Rodrik 2004) where the governance indicators have been widely applied, but also on a microeconomic-political scale (Wunder 2001). The set of institutions within a system of "good governance" assures security of property rights, enforcement of contracts and collective action to produce public goods and constrain public "bads" (Dixit 2009). Such governance occurs as contracts, customs, norms and laws in both market and nonmarket economies rather than through single formal prescriptions, like privatization of private property. The policy forms described as "community forestry" include devolution, decentralization, state-sponsored community forestry management, indigenous local management recognition, co-management, formally recognized common property, among others. Nevertheless, it may be said that community forestry governance relies on systems of collective action often bound by formal and informal rules and customs, local and national political agendas and socioeconomic needs (Arnold 1999; Jodha 1992).[4]

To bring economic governance into a tractable analytical framework, our approach builds on earlier work on contractual hazards in Mexican community forestry (Antinori 2000; Antinori and Rausser 2008) and then expands the analysis using political-economic theory (Rausser, Swinnen and Zusman, in progress; Zusman 1992) to incorporate the role of internal and external actors in decisionmaking over forest resources. We follow Ostrom in considering that common-property based systems of natural resource management are a viable "third way" of management, in addition to governmental and private options (Ostrom 1990; Ostrom and Nagendra 2006). We address the challenge of parsing out what mechanisms of governance whether they follow more general principles of collective action and organization.

The focal questions for this research can be summarized as follows:

1. Under what conditions have communities chosen to participate in the market for

[4]Timber harvesting by or for local communities is prevalent worldwide in many different forms. Examples exist in Asia (e.g., Vietnam, Nepal, India, China), Africa (e.g., Cameroon, Zimbabwe, Senegal), Europe (e.g., Romania, Bulgaria, Germany) and Latin America (e.g., Guatemala, Honduras, Chile, Nicaragua) (Scherr et al. 2002; Ribot 2002; Ribot 1995; Abraham and Platteau 2003; Oyono 2004; Arnold 1999). In many cases, the local right to harvest has only recently been given in pursuing "devolutionary" policies or recognizing human rights. In other cases, the term community forestry is applied to households with woodlots for individual collection of firewood (e.g. China). The only other countries in which community-engaged timber harvesting exists on a scale comparable with Mexico is Guatemala and Bolivia (Benneker 2008). No matter the location or history of the sector, the capitalization of community forestry is highly uneven.

forest resources and at what level in the production chain?

2. How have they organized their production and contracting activities within the community governance structures?

3. How do governance characteristics, including both internal and external influences in the decisionmaking processes, affect the distribution of public and private benefits from forest activities, including environmental conservation practices, public goods investments, and direct economic benefits?

Each of the following subsections describes the background of Mexican community forestry and the analytical basis with respect to these three lines of inquiry. The first question brings us to the insights in economic theory on the importance of asset ownership and control, as each stage in the production chain requires investments in capital and managerial responsibilities. The second question calls for a consideration of decisionmaking processes in light of the growing literature on collective action and economic governance which characterizes these processes in terms of inclusiveness, representativeness, transparency, democratic accountability and regulatory quality, for example. Both internal decisionmaking processes and relationships with outside contractors would shape these characteristics. The third question then relates the institutional features represented by form of market participation, internal governance and external relationships to outcomes of interest, particularly economic, social and environmental impacts. The background details in each subsection describe the on the ground situations that clarify how the analytical strategies apply, as this topic - not to overstate the issue - is highly complex, interweaving broad national policy dynamics, historical establishment of rules and practices that persist today, and continual local innovation of community governance institutions.

2.1 Asset ownership and control

Despite its over twenty year history, numerous reports emphasize the underinvestment of the Mexican social forestry sector and suggest improvements in human and social capital, internal organization, and more recently, stronger links with the private sector to improve efficiency and environmental management (UNDP 2009; Forster et al. 2004). Our research approach relies on an analysis of the transaction costs of ownership and control to explain in part this situation.

Ownership and control over the assets used in production, like chainsaws, cranes, trucks, tractors and sawmills, has huge implications for the transaction costs of production wood products to achieve a range of objectives, including monetary and nonmonetary benefits. Much research on this problem is cast within the vertical integration paradigm (Globerman and Schwindt 1986; Leffler and Rucker 1991). Vertical integration represents the ability to benefit from residual flows through ownership of assets of production. Incentives are

therefore altered depending on whether the person making a decision on how to allocate assets is the owner or an outside manager. Control does not equal ownership. With greater uncertainty and inability to monitor managers adequately, vertical integration is preferable because it assures greater ability to manipulate the flow of assets over time through the threat of withdrawing an asset from the manager's control (Forbes and Lederman 2008). Ownership and control are therefore distinct concepts. Transaction cost factors determine when both ownership and direct managerial control are exercised to optimize community benefits. Antinori and Rausser (2008) provide evidence to support the claim that the multiple objectives in a high transaction cost environment such as Mexican social forestry are more easily balanced the further downstream a community integrates into the industry. This approach shares conceptual similarities to the "theory of access" (Ribot and Peluso 2003) which characterizes access as the capacity to benefit from things as opposed to a more narrow definition of access based on property rights alone. The capacity to benefit from things depends on transaction costs, knowledge, wealth and political influence. In our approach, a property right is only one aspect of access, while control is another.

Table 1 describes the classifications used.[5] Note that the classification depends on most processed wood product sold to allow consistent criteria for indicating ownership and control rights.

Table 1: Community Classifications by End Product Sold

No-sale	Communities with over 300 hectares of forestland suitable for commercial production but which do not participate in the industrial wood products markets.
Stumpage	An outside contractor pays for the right to harvest and extract timber on community land.
Roundwood	The community fells timber to be sold as roundwood either from the logging road (*en brecha*) or a collection point (*en patio*).
Sawnwood	The community transforms timber into lumber.

A continual sticking point in discussions of the Mexican community forestry sector is the extent to which internal organization, level of vertical integration and "success" are interchangeable. It is important not to confound vertical integration with certain outcomes. For example, it is possible to earn profits for example at any level of production

[5]In Antinori (2000) and Antinori and Rausser (2008), a fifth category for secondary processing (e.g. finished or semi-finished goods, like doors, furniture, palettes, tool handles, and dried and treated wood for export) is separated from the sawmill category because of the much higher capital inputs and technical expertise, setting these communities apart from other sawnwood communities. The governmental programs, *Programa de Conservacion y Manejo Forestal* (PROCYMAF) and *Programa de Desarrollo Forestal* (PRODEFOR) (both now combined under PROARBOL, and the World Bank use similar classifications to target funding activities to the perceived needs of communities at each level. These programs originally used only four levels of the classifications, eliminating the last category of secondary products and combining that with the sawnwood category. The recent follow-on to these programs has added the fifth.

(see http://are.berkeley.edu/ antinori/ConaforPresentEng.pdf). Furthermore, higher levels of community vertical integration do not correlate with nor predict environmental degradation (Antinori and Rausser 2007). On the contrary, communities with forest management plans do as well or better as Mexico's officially designated National Protected Areas in protecting forest cover (Duran et al. 2005; Bray et al. 2008). The Appendix records a variety of typologies created to examine the Mexican forestry sector, though more exist. An example of a typology that incorporates style of internal organization by Nahmad (2004) draws on characteristics of products sold, organizational capacity and participation in the production process. Vertical integration patterns map over configurations of internal organization and external relationships but not in a one-to-one pattern. This social, economic and "communitarian" taxonomy speaks to the institutional complexity of this sector. Which taxonomy is used is a function of a study's goals and purpose. This report parses out processing capacity, internal organization and performance as separate descriptors and examines their relationships separately.

2.2 Economic governance

The second fundamental question asks what governance mechanisms exist for community forestry in Mexico and, if possible, why they exist. The communities in the sample exhibit a dizzying array of institutional forms and external linkages. For example, communities at the same level of integration can have a variety of internal governance systems. The evidence echoes Rodrik (2004)'s statement that "institutional functions do not map into unique institutional forms." Mexican forestry communities are no exception. We hope to shed light on these various aspects of governance for a holistic view and with an eye towards shaping policy for rural development. Consequently, we go into some detail in this section because the institutional complexities and extent of overlapping decisionmaking processes are rarely recognized in any research to date on Mexican community forestry, details which could inform development of long-lasting solutions to management challenges.

Figure 1 shows actors and processes in forestry decisionmaking, though by no means captures all nuances of these relationships. Starting at the community level (Community 1), the basic community governance structure follows the format codified in Article 27 of the Mexican Constitution, so that all communities share the basic core governance elements. The *Comisariado de Bienes Comunales* (CBC) (or *Comisariado de Bienes Ejidales* (CBE) if the community is officially titled as an *ejido*) and the *Consejo de Vigilancia* (CV) are elected by the General Assembly consisting of officially recognized community members (one vote per member household). The vigilance officer oversees the integrity of the office of the CBC and the territory of the community, for example, organizing border patrols. These leaders are civic, political and economic agents of the community, at times reflecting centuries-old practices of the historical *caciques* (Terraciano 2000) and the traditional system of *cargos* whereby community members rotate civic duties among themselves. The CBC and CV's term is normally three years, after which a new

election is held. Though not shown, other elected offices besides the CBC and CV exist as well, depending on the needs of the community, such as a point person for the health clinic, transportation and community religious celebrations.

Balancing the monetary and nonmonetary benefits achievable with common property forestland has been called the "permanent tension" within Mexican community forestry (Arzola et al. 1993). Foresters and other persons working to establish sound and sustainable forestry practices within communities have long realized the challenge of organizing a "sectoral economic activity" such as forestry from within the agrarian communities without being constrained by the agrarian administrative forms, which were not conceived for collective entrepreneurial activities (Herrera et al. 1995; Gordillo et al. 1998; Lopez-Arzola 2005). However, although they appear overtly similar across communities, the actual governance structure for managing forestry matters, that is the decisionmaking processes and structure, has been evolving to address the competing demands for the allocation of common property benefits.

Earlier work identifies at least three forms of internal organization for timber production. Table 2 summarizes the frequency of these three modes from two cross-sectional surveys, including the current survey. The first and by far the most common is the community-level form of production. The CBC is the point person in charge of forestry activities and would be the contact, for example for the professional forester and potential buyers. Communities organize timber production activities at the community level, that is, any contracting, sales, extraction and processing occur with decisionmakers who represent the entire community, usually the CBC. As communities participate more extensively in forestry activities, the General Assembly or CBC may appoint additional managers, such as logging foremen, sales manager or sawmill manager. Documenters (often one from the community and one from the buyer) measure and keep records of extracted volume. The rotation of key community officers poses noted difficulties in adopting long-term forestry management strategies. To overcome this obstacle, some communities have created permanent forestry councils or separated communal forestry activity into distinct legal entities apart from the traditional community structure itself (Antinori et al. 2006; Antinori 2000).

The second and third forms are the work groups and the individual modes of production. These organizational models have emerged based on historical practices in managing the forest, more recent federal policy changes and, given evidence in our survey, internal dissatisfaction with community-level organization. The 1992 reforms sanctioned subcommunity-level work groups (*grupos de trabajo*) although such organizational choices remain with the General Assembly. Work group leaders or individual parcel holders will contact outside buyers on their own and groups compete to get the best price. Work groups may form based on affiliations among family or friends and may represent other nonforestry-related interests, indicating a sub-coalition of interests within the community that may affect voting in the General Assembly. Work groups often have a leader elected or appointed from within the group. Individuals may in fact organize informally from year to year to conduct the extraction and sales efforts. These alternative forms of production do

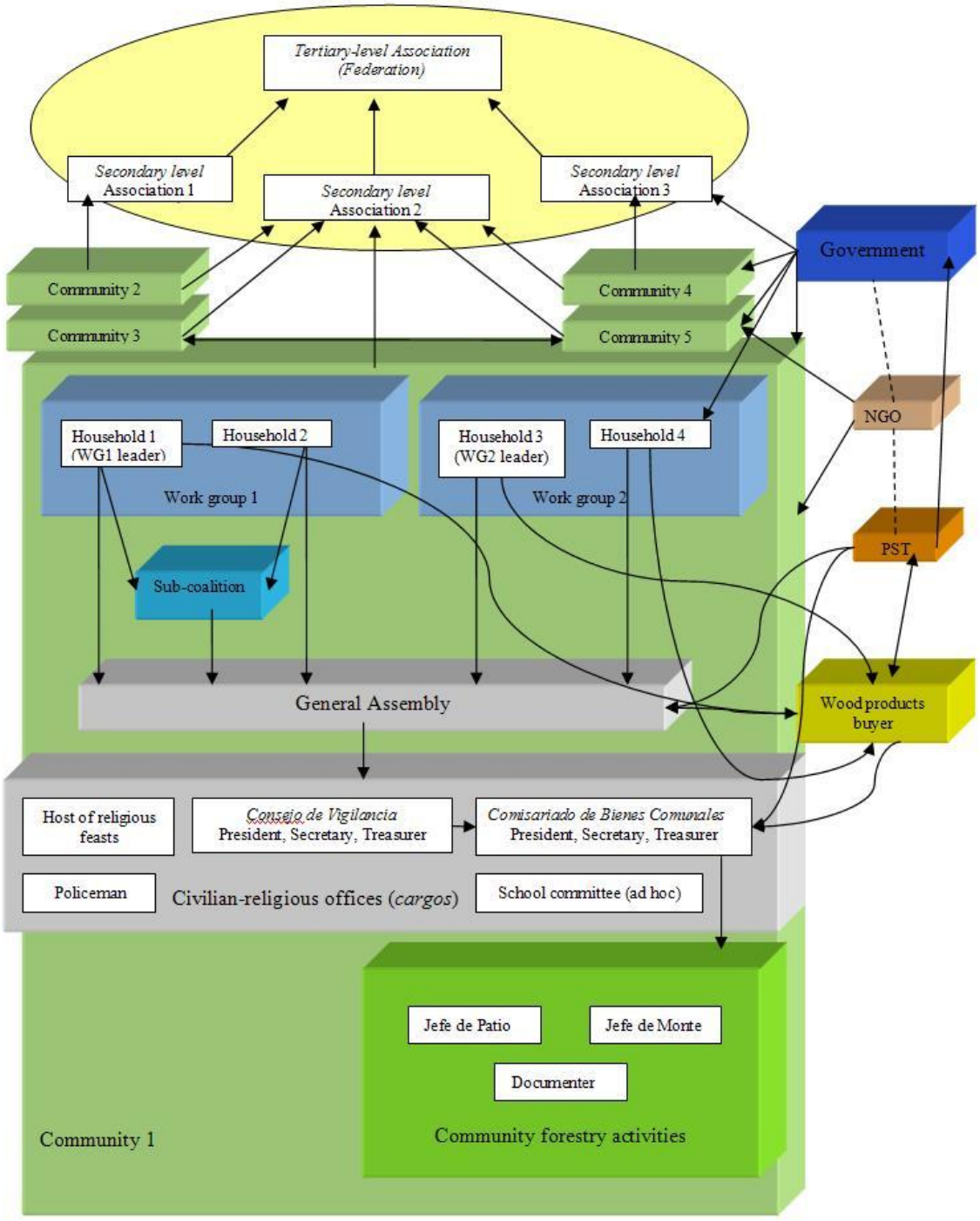

Figure 1: Institutional linkages in community forestry governance

Table 2: Internal Production Organization in Mexican Common Property Forestry

State and Data Source	Community	Work group	Individual	Survey Total
Durango (Survey data 2007)	21	4	3	28
Michoacan (Survey data 2007)	5	1	7	13
Oaxaca (Antinori 2000)	35	2	5	42

not map precisely to levels of vertical integration, so that specialization and delegation in production does not explain the reasons for one form of internal governance over another (Antinori 2000; Antinori and Fransen 2008; Wilshusen 2005; Taylor 2003).

It is critical to emphasize that forestry management plan in all cases, regardless of extraction and processing organization, is done at the community level, that is, there is one management plan per community (except in rare cases). In a typical scenario, the forester will assign the authorized volume to the community in any given year and delineate the areas where harvest is to occur. The manner of dividing up the volume among work groups or individuals is left to the internal workings of the community. Often, members hold a lottery (*rifa*) to assign areas of harvest, as the areas differ in accessibility and quality of timber, though everyone is assigned an equal volume. Once these areas are assigned, it is left to individuals or work groups to arrange harvest and sale of timber. Therefore, flow, and not stock, is divided at the extraction phase. Even under these alternative governance modes, the CBC and CV may maintain some decisionmaking role, as contacts with the government or PST, for example, or assuring the conduct of one community documenter or *Jefe de Monte* who assist all work group or individual forestry activities in the community.

Now we explain the external linkages to the community, starting with the federal government's role. The government has decisionmaking influence at the individual household, associational, non-forest communal and communal forest levels. Households can participate in many government programs (e.g. *Oportunidades, Procampo*) which offer additional sources of income including agricultural subsidies. All land in the community is held in common, but agricultural land is allocated to individuals who then have usufruct rights to cultivate individually. Forest and non-forest community-government linkages occur as functions of the agrarian system. Forests remain as common property. Technically, the Mexican government retains ownership of community land but recognizes *de jure* ownership of the land by the communities (UNDP 2009).[6] As a result, government officials or agrarian tribunals are ultimately engaged in land issues, like territorial disputes at the general, communal level. However, the agrarian reforms removed some rules for

[6]Although the Agrarian Reform of 1992 allows communities to privatize land holdings, an extremely small percentage of approximately 30,000 agrarian communities have chosen to do so (IBRD 2008). Reasons are unclear. One concern is that forest land would convert to state control and privatized individual plots would become taxable, perhaps discouraging the decommissioning of agrarian community status (Goldring (1998) and interview notes with key informants and community leaders).

government participation to give communities more autonomy (e.g. requirement that a government representative be present at General Assembly meetings). For community forestry, the government has considerable rules and policy in place, such as requirement of a forestry management plan for harvesting activities, required permits for harvesting certain timber and nontimber goods, documentation, standards for forestry professionals, and environmental programs as administered by CONAFOR.

Forestry associations (FAs) constitute another important external linkage for the Mexican forestry sector in terms of number of communities they represent and their role in the historical development of the sector. FAs form a cross-scale linkage among communities involved in forestry management and production as well as among communities and higher levels of state, national and international organizations.

Ideally, forestry associations capitalize on synergistic effects of group action. Services include cost sharing of forestry technical services, access to technical and management expertise, coordination to access financial resources from government programs, political action and voice, information sharing and community timber purchases and harvest coordination at premium prices. In many states, the community-based FAs have their origins in the social mobilization against the parastatals during the concessionaire era. The federal government also has a community linkage at this association level as well. The government has often created or supported forestry-related associations of communities (Gordillo et al. 1998) or channeled program resources through other forestry associations. Recently the government has mandated that communities form "silvicultural" associations regionally. The new associations, called *Unidades de Manejo Forestales* (UMAFORs), created under CONAFOR is a current example of government participation in a forestry-related decisionmaking platforms. These may be considered as an external linkage categorized as a FA or as a government administrative unit.

The professional forester (*prestador de servicios tecnicales*, or PST) is responsible for creating the management plan, marking trees and conducting other silvicultural treatments as needed throughout the year. A main service is ushering the proposed management plan through the permit process in SEMARNAT. Though PSTs generally try to stay out of the marketing and selection of downstream buyers, occasionally the PST will associate with a buyer or buy the community's wood products directly. Some PST services are provided through forestry associations (link not shown). Indeed, some FAs formed for the sole purpose of combining the costs of PSTs across a set of communities. In all cases though, the PST must form relationships with each community to develop management plans and fulfill their responsibilities.

The occurrence of nongovernmental organizations (NGOs) and services offered is extremely sporadic across Mexico, with some states well-represented by NGOs and other states where barely any operate. Their role may vary from offering environmental expertise, marketing services or developing production chains with timber and nontimber forest products. Their relationship with governmental administrative offices is ad hoc rather than systematic.

By comparing who makes what decisions and how they are authorized to make those decisions, we can form a basis for applying economic and organizational theory to link governance with outcomes. We not only consider how relationships play out in an entrepreneurial setting, for which there is a vast literature in the business and economic journals, but also dynamics particular to the political and social culture of the Mexican agrarian sector. Starting with the concepts of transparency and accountability as major factors in the governance literature, we explore how transparency and accountability is achieved in Mexican community forestry. Mechanisms providing transparency and accountability, we suppose, improve the effectiveness with which leaders and community members provide local benefits from community forestry operations. Where members have an active and influential voice, one would expect the group to have greater ability in reaching stated objectives, be it productivity, sustainable resource management or economic development (Hoddinott et al. 2001; Wittman 1995; Vitaliano 1983; Hirschman 1970; Manne 1965). Of particular concern for devolution of natural resource management is the problem of local elites, or "covert privatization" of resources (Klooster and Ambinakudige 2005; Fritzen 2007; Abraham and Platteau 2003). Political domination by local bosses can hijack state efforts to improve management through local decisionmaking (Johnson et al. 1999; Klooster 2000; Abraham and Platteau 2003). Studies specific to Mexico corroborate the importance of the General Assembly in this context (Merino and Alatorre 1997; EDUCA 2001; Klooster 2000; de Janvry et al. 2001). Community managers must elicit support from the local population. The relationship between community authorities as managers and the rest of the community population has been characterized by the use of the General Assembly (Klooster 2000) and by measures of local power inequality, such as illiteracy rate, disparity in assets and external connections (Perez-Cirera and Lovett 2006). Zusman (1992) further argues that the choice of rulemaking procedures reflects an optimal balance between the costs and benefits of having larger number of decisionmakers and the value of the decision being taken.

The survey asks community representatives to flesh out the relationships represented by Figure 1 in terms of their own community. Community representatives mapped their governance structure, including both *cargo* and non-*cargo* offices or personnel (both general and forestry-related), history and membership in forestry and non-forestry associations, community and residents' participation in government programs, and role of of nongovernmental organizations. The evolution of internal production organizations is captured within the main survey for community-level forestry production as the default option and in subject-specific annexes for work groups and individualized systems.

Furthermore, the survey traces key decisions affecting the distribution of resources in the community. Previous research identified key internal forestry decisions as granting wage or dividend advances, choice of buyer, choice of volumes to cut, and distribution of dividends. For each of these decisions, survey respondents were asked who makes these decisions, who authorized that person/s to make those decisions and the involvement, if any, of the General Assembly. These questions therefore capture the concepts of delegation of authority based on type of decisions made and the degree of oversight mechanisms in place

for those decisions in Mexican agrarian communities. Further characteristics we consider for monitoring mechanisms to hold decisionmakers accountable are characteristics of the General Assembly and General Assembly meetings, reporting, selection of leaders, group sanctions, social capital (trust and networks), and third party engagement for audits, access to information and oversight.

In addition, we collect data on sources of heterogeneity among the community populations, as these are often considered in the literature as explanatory variables for collective action outcomes (Dayton-Johnson 2000). These included members, the *ejidatarios* or *comuneros*, versus nonmembers, the *avecindados* or the *posesionarios*. Only official members can vote in the assembly and receive monetary benefits generated from the commons. Other interests were divided between young and old, where the younger generation preferred investments in labor-saving technology while the older generation preferred social investment (Fernandez). Interests also differ according to wealth status in the community, say between those who own businesses that need timber as an input into production, and the rest of the community. Questions to identify these and other groups are included in the survey.

2.3 Impacts of community forestry management

Our final major question is the impacts of the ownership and governance characteristics described in the previous two sections on benefit streams which forests can provide and translating those benefits into mensurable performance indicators for statistical analysis. To ground the analysis in economic theory, it is useful to view forests as providing private, public and common goods and services. The forest is a local common resource for members of the community because it is rival in use (one person's harvesting of forest products makes those products unavailable to the next person) but also nonexcludable among members of the community (because anyone in the community can use the forest). Furthermore, a community member usually must ask permission from the CBC to harvest timber or nontimber goods from the forest, so that we have a common pool resource management system not necessarily subject to the tragedy of the commons. The Mexican forest also has an element of private goods (rival and excludable) because a community can exclude nonmembers and anyone outside the community from using the forest. The forest is a pure public good both locally and globally when it generates ecosystem services of air, soil and water quality and existence value. Local public goods generate benefits for the community as a whole (e.g., revenues to support local infrastructure, local environmental services, job generation).

In this study, we consider benefits influenced by conscious choices by the community members in choosing specific allocations of funds and actions. For private benefits, the survey includes questions on the distribution of *repartos* or dividends that are paid to community members from timber proceeds, individual collection of timber and nontimber forest products, and other income generated by forestry activities. Local public or common

resource benefits captured in the survey consider economic and environmental investments back into the community. Details include the range and character of reinvestment back into forestry, local public goods, like schools and health clinics, and management or conservation practices. For pure environmental public goods, ecological indicators are drawn from the forest management plan and survey questions. Characteristics drawn from the management plan include extent and density of standing forest, size and age distribution of trees (for some communities), climate, slope, altitude, and erosion levels. Self-reported quality measures from the survey are indicators of changes in forest cover, biodiversity and water quality. Conservation practices include community members' "rule conformance" to protect and maintain the forest.[7] In the present study, practices include limits on hunting, conservation reserves, degree of illegal logging and clearing forest land for agriculture or pasture and fire preparedness activities.

To consider how a link between an institutional characteristic and a performance outcome might evolve, consider vertical integration and ecological indicators. Vertical integration by the community may lead to better performance on a given ecological indicator if the ecological indicator depends on adaptive, ecologically significant decisions more easily addressed by the community than by an outside independent private operator. The link may not be necessary, say, if one were able to separate the timber production activities from the activities which affect the ecological indicator, by easily monitoring or measuring the separation of activities (say, by restricting harvest areas) so that it would not matter if the community or an outside operator harvested the timber. The operative questions in this case are: over what do you exercise control and when is it necessary?

3 Survey Development

Survey development and data collection methodology is designed to support testing of theoretical research on common property and to answer basic empirical questions concerning Mexican community forestry.

3.1 Sampling

We used two sources of data as the population frame. First is a dataset compiled from the permit records maintained by the SEMARNAT state offices in ten of the most forested states in Mexico: Campeche, Chiapas, Chihuahua, Durango, Michoacan, Oaxaca, Puebla, Guerrero, Jalisco and Quintana Roo.[8] SEMARNAT is the government agency responsible for reviewing management plans and issuing permits for harvest for agrarian communities

[7] Empirical studies of rule conformance in natural resource management include Lam (1998), Bardhan (2000), Fujiie, Hayami, and Kikuchi (2002) and Gibson, Williams, and Ostrom (2005).

[8] Data is summarized in Antinori, Magana, Torres Rojo, Bray, and Segura (2004).

Table 3: Total Forest Hectares in Ten States

State	Total forested hectares with permits (SEMARNAT)	Total forested hectares without permits (NFI)	Total
CAMPECHE	978304	972519	1950824
	n=63	*n=253*	*n=316*
CHIAPAS	194499	1126535	1321035
	n=127	*n=1068*	*n=1195*
CHIHUAHUA	2668271	557180	3225451
	n=217	*n=106*	*n=323*
DURANGO	2407992	292922	2700914
	n=296	*n=102*	*n=398*
GUERRERO	670579	281612	952192
	n=120	*n=307*	*n=427*
JALISCO	419731	281219	700950
	n=151	*n=265*	*n=416*
MICHOACAN	257265	167000	424265
	n=245	*n=287*	*n=532*
OAXACA	568428	922876	1491304
	n=197	*n=523*	*n=720*
PUEBLA	76493	32466	108960
	n=143	*n=90*	*n=233*
QUINTANA ROO	580004	869897	1449902
	n=82	*n=176*	*n=258*
Total	8253141	5504230	13757370
	n=1641	*n=3177*	*n=4818*

and small private landholders. As this dataset does not include communities with forests but no history of permits, the second source of data is the 2000 National Forest Inventory (NFI) to identify communities with area classified as forest (*bosque*) but not included in the permit database.[9] The total in these ten states is 4818 verifiable communities with some 14 million hectares of forest (Table 3).

There is much theory and speculation that size of forest primarily or solely explains vertical integration into the forest industry and that vertical integration in turn explains environmental, social and economic outcomes. To test these hypotheses specifically, we construct a random stratified sample based on measures of forest size and vertical integration using the best available information possible. *Programa de Conservacion y Manejo Forestal* (PROCYMAF) and *Programa de Desarrollo Forestal* (PRODEFOR)

[9]The permit database has forested hectares information for 1710 observations with some missing data, so that the total is 1641. The permit database provided no information from the state of Oaxaca but is estimated using the Antinori (2000) database.

Table 4: Average Forest Cover for Survey Population, by Vertical Integration

VI level	Mean forest ha.	SD (linearized)	Mean forest/land ratio	N
No-sale	3377	351	0.51	1994
Stumpage	4820*	359	0.67*	483
Roundwood	6574*	592	0.67	309
Lumber	16944*	2396	0.72*	126
Total	4543	281	0.56	2912

Source: Phase 1 data.
* = sig. diff. from group above.

(both now combined under PROARBOL, both maintain information on vertical integration as types (*tipos*) of communities. While definitions slightly vary (see Appendix), both closely follow the concept of end product sold. The categories in this case follow a linear advancement along the main production chain: 1) those with commercially viable forest but no commercial timber sales, 2) those selling stumpage rights to standing timber, 3) those harvesting timber and selling roundwood, and 4) those harvesting and processing timber into sawnwood. For forest size, we used the number of forested hectares as recorded in the SEMARNAT and NFI data. The no-sale type, for our purposes, includes communities in the SEMARNAT permit database whose last permit ended five or more years prior to sampling in addition to communities in the NFI database with forest cover but no harvest permits evident in the SEMARNAT database. This combined set of observations includes 4886 communities.[10] Since our goal is to understand forestry institutions and outcomes in communities where commercial timber production is possible, we limited the population frame to communities with 300 hectares or more of forested hectares. This number is consistent with idea that a "commercially harvestable" forest would be one where a harvest was possible every five years or less, as judged by professional foresters on our team and consulting with other professional foresters. Eliminating communities with less than 300 forested hectares and those whose type is not recorded, we have a population frame of 2912 communities (Table 4). The difference between "forest" category and "commercially productive potential" became apparent during fieldwork and is further discussed below.

3.2 Survey sample

The sampling technique is a random sample stratified by size of forest and market participation (vertical integration) level. Vertical integration levels were known for some

[10]Some of this data is summarized in Bray and Merino-Perez (2007) where the totals and averages are slightly different due to different stages of data cleaning. The numbers in this report should be considered the most up-to-date.

Table 5: Sample, by Forest Size and Vertical Integration

Average ha. within strata	No-sale	Stumpage	Roundwood	Lumber	Total
0.50	428	8	1	0	437
50	292	23	16	1	332
100	522	38	40	1	601
239	364	56	30	5	455
400	394	43	16	4	457
608	304	88	30	6	428
1,000	371	69	42	3	485
1,677	332	64	49	12	457
3,016	278	87	69	22	456
6,645	184	101	89	83	457
Total	3469	577	382	137	4565

Source: Phase 1 data.

Table 6: Forest Size Stratification Ranges

	Category	
	No-sale	Stumpage and above
Forest Size Strata	Hectares	Hectares
Strata 1	100-556	300-850
Strata 2	556-1357	850-2000
Strata 3	1357-3077	2000-4500
Strata 4	3077-6186	4500-9250
Strata 5	6186+	9250+

Source: Phase 1 data.

degree of precision except for the no-sale category. Communities which had more than 300 hectares of potentially commercial forest but which had not harvested in the last five years were relatively easy to identify from the SEMARNAT permit database. However, identifying such communities which had never had a permit and thus were drawn from the NFI database was much more difficult, due to ambiguity in defining "forest" with the GIS data. Therefore, we combined the no-sale types from both databases but maintained the entire list to be available to enumerators in the field so that they could crosscheck their information in the field prior to visiting a community and replace an invalid observation with a valid observation as necessary.

For stratifying by forest size, we used Cochran's formula (Cochran 1963) to determine cutoff points for forest size levels from smaller to larger forests. The formula seeks groupings of similar number which minimizes variance of the variable of interest, in this case forest size, within each group. The no-sale communities from the NFI database have much smaller forest sizes on average than the no-sale group identified in the permit database, again indicating a disjunction either in measurement or in a qualitative feature of the NFI communities. Combining the two datasets and applying the stratification exercise to the entire sample results in the groupings in Table 5. The majority of the observations falling into the lower ranges (up to about 600 hectares) are from the NFI database, especially the no-sale types.

To create the population frame forests), we nevertheless combined the two sources of no-sale communities and stratified them separately from the stumpage and above communities. Running the stratification exercise using six levels of strata gives the most even set of groupings for the no-sale dataset on the one hand and the stumpage and above on the other hand. Eliminating the lowest strata for each group, we use the ranges shown in Table 6 to stratify the sample by forest size. The stratification of stumpage group and above naturally selects 300 hectares as a cutoff point, further justifying our selection of limiting the sample to communities with 300 hectares or above. The corresponding stratum for the no-sale communities is skewed to a smaller size, though only those with 300 hectares or more are used for sample selection.

We performed the same exercise for each of the ten states (except Oaxaca) and compared state against total distributions. Durango, Michoacan and Chihuahua had distributions that most closely matched the total sample set and had observations in the full range of cells. We chose Michoacan and Durango as the most representative and cost-feasible states to survey. Because the no-sale group would overwhelm our survey efforts if we strictly applied the distribution, we capped the stratified sample of no-sale communities to ten and then randomly selected a stratified sample of 31 from the commercially-engaged set to arrive at a total sample of 41 in Michoacan and Durango (Table 7). Before contacting a no-sale community for a possible survey interview, we consulted with local SEMARNAT forestry personnel. As expected, many did not meet our criteria and were switched out for no-sale communities in our list which did.[11] In sum, of the total 41 communities surveyed,

[11]During fieldwork, we came across an alternative way of determining whether a forest has "commercial

Table 7: Population Frame versus Survey Sample

	State								
	Durango			**Michoacan**			**Total**		
	Total	Sample	Col %	Total	Sample	Col %	No.	Col %	Cum %
Vertical integration									
No sale	136	4	14.3	143	3	23.1	7	17.1	17.1
Stumpage	140	10	35.7	120	6	46.2	16	39.0	56.1
Roundwood	68	9	32.1	15	3	23.1	12	29.3	85.4
Lumber	42	5	17.9	12	1	7.7	6	14.6	100.0
Total	290	28	100.0	147	13	100.0	41	100.0	

Source: Survey data

13 are from Michoacan and 28 from Durango. The data in this report refer to these 41.

3.3 Instrument development

The survey instrument is based on earlier work in Oaxaca, Mexico on mapping ownership and control of forestry production in communal timber areas (Antinori 2000; Antinori and Rausser 2008). The present survey maintains core questions from that work on the institutional development of community forestry and contracting with downstream buyers and adds questions about internal decisionmaking processes and governance.

3.4 Survey protocol

The procedure for administering a survey to a community included first seeking introductions to community authorities. They were presented with a introductory letter explaining briefly the project and contact information. The survey was to be conducted with at least three members of the community present, including the CBC. The survey is a community-level survey and is administered to the current CBC as the recognized head of the community responsible for such matters, though anyone from the community could respond to the questions during the survey. All answers are treated as confidential.

viability". Foresters use a rule of thumb, which may vary from state to state, that considers a management plan feasible if the area has a tree species density of at least 40 cubic meters on average. The average for pine for communities in the population frame is 64 cubic meters per hectare and 15 cubic meters per hectare for oak.

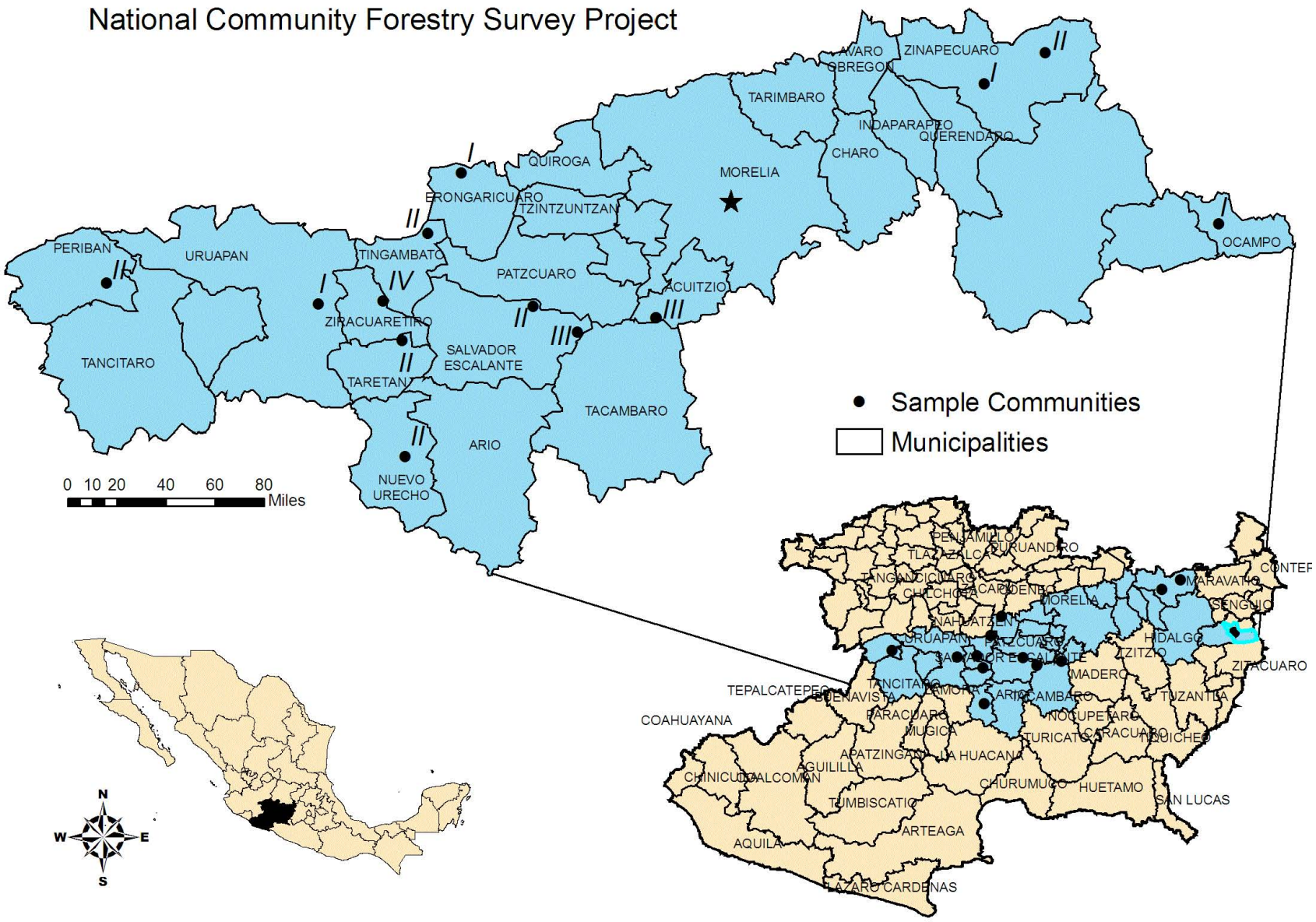

Figure 2: Michoacan sample communities by type

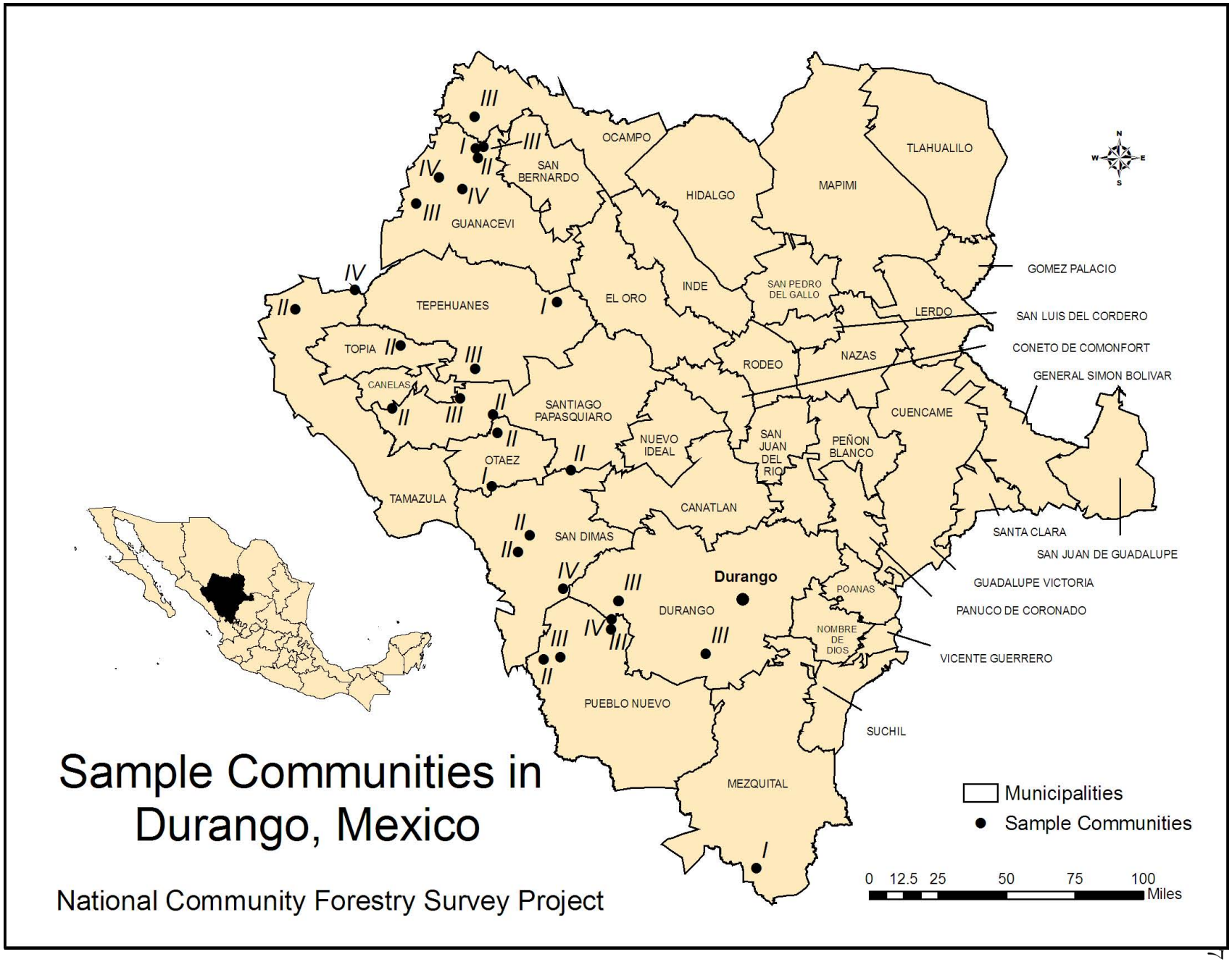

Figure 3: Durango sample communities by type

3.5 Pretests

A series of three pretests refined the survey instrument and protocol. The first pretest was conducted in three communities in Durango during November 2004, including a stumpage, roundwood and lumber community. This was followed by a survey training seminar among enumerators and research team members in Mexico City at the Survey Design Center at UNAM. The second round of pretests in two communities, a stumpage and roundwood community, was then held in Michoacan in late November/December 2004. The third and final pretest was conducted in Michoacan in August 2005 in two communities, a no-sale and lumber (which was later recategorized as a roundwood). At the end of this process, the team edited and produced a final draft of the survey instrument. This final pretest placed the length of time necessary to administer the survey as between three to four hours on average.

3.6 Use of previously collected data

In addition to the survey instrument collecting original data, we also supplemented community-level information with INEGI 1990 and 2000 Census data on population, demographics, employment, education and standard of living. The measures on material goods, housing materials and cooking fuel have frequently been used as poverty or income indicators and we will employ them in a similar manner. To supplement resource data, we collected measures on topography, general vegetation coverage, altitude, annual average rainfall and temperature. Finally, foresters for each of the communities provided data on levels of actual harvest volume, in contrast to the data on authorized volume available from the SEMARNAT database.

3.7 Follow-up verification

All the data was checked by the enumerators and then by another reviewer to identify and clarify any inconsistencies or missing information in the survey. As necessary, follow-up visits were made wherever possible, or phone calls directly to community members who were present at the survey interview or to other informants to verify the information.

A formalized effort was made to determine the quality of the survey responses with follow-up case studies conducted by a masters student at the University of California. Four communities were chosen from the survey sample based on internal organization for production, so that community-level, work groups and individually-organized forestry operations were represented. The case studies served various purposes. First was to review the original survey with community residents and authorities for approximately a week, thus allowing ample time for reviewing the original survey responses from several perspectives and giving a barometer of how well the original survey responses, often

collected in a one-day visit, reflected "reality" as seen after a longer stay and wider discussions. Second was to amplify our information on how motivations and impacts varied regarding the allocation of forestry benefits under the different organizational types. The interviews targeted a heterogeneous set of community residents (e.g., official members, nonmembers, men, women, young, old) who might be affected by frest managment decisions in various ways.

The follow-up case studies verified that much of the original survey data was correct. One exception was that one community classified as a work group community actually represents a historical anomaly where the state combined several separate villages into one indigenous community for purposes of titling as an agrarian community. Each village, now called *barrio*, has a separately identifiable forest and makes its own decisions about harvesting, so this community's organizational mode is reclassified as "other". The major contribution of the case studies (reported in Fransen (2008) and Antinori and Fransen (2008)) are the detailed conversations and contextual analysis that elucidate the dynamics of the institutional innovations represented in the larger survey sample.

4 Profile Data

4.1 Community characteristics

The following basic characteristics provide an overall profile of the community and generate indicators frequently used to test hypotheses concerning governance and collective action. The first subsection on land settlement captures the length of time the current community population has been in the area. Land and forest size gives information on resource availability. Proximity to population centers suggests measures of the degree of general market integration of the community, possible transport costs and opportunity costs of employment. The subsection on sources of income extend the data in this regard. The demographics subsection details characteristics of the population. The remaining sections summarize secondary data on literacy and education to create various measures of well-being. Many measures of poverty alleviation and well-being exist and go beyond material wealth, such as security and cultural identity (Alkire 2007). Our survey is limited to a combination of literacy, education, material wealth and social network information as indicators of poverty alleviation and well-being, recognizing that these indicators capture only facets of economic and social development.

4.1.1 Settlement

Post-colonial legal sanctification of Mexican agrarian communities came much later than the actual settlements. *Comunidades indigenas* and *ejidos* are two official categories of

communities which fall under current agrarian law, the law that applies specifically to this sector of society. Members of *comunidades* have provided proof that they existed as a settlement prior to the revolution. Therefore, many *comunidades* have indigenous origins and are often called *comunidades indigenas*. Members of *ejidos* have come together to petition for a title to a specified land area, though this group of people may not have been living in the same locale for any length of time. Our sample includes nine *comunidades* and 32 *ejidos*. Twenty percent of the total number have populated their current location for more than 100 years. The formal titling process for recognition as *ejido* or *comunidad* began slowly after the revolution and picked up its pace in the thirties (Barnes 2009). The mean year for receiving formal status and land titles as an agrarian community is 1959, with little difference for *ejidos* and *comunidades*.

4.1.2 Land and forest area

The forestry permits provide us with data on land areas and forested areas. In our sample, the no-sale and lumber groups have the largest land areas; however, average forestland increases with vertical integration (Table 8). The difference in average forest hectares is not statistically significant between any of the groups in this sample, in contrast to the same test applied to the full permit database covering ten states (n=2912)[12] which shows a significant difference in average forested hectares between each group (Table 4). Therefore, we cannot reject the relationship between scale effects and vertical integration in larger samples.

Durango has a larger land area and forested land area per community on average than the Michoacan communities but the forest to total land ratio patterns are distinct with increasing vertical integration. Overall, the increases between the no-sale and the stumpage communities and the stumpage and roundwood communities tested significant, but not between the roundwood and lumber communities. This pattern of significance is repeated with the Durango communities only. In Michoacan, the differences between the no-sale and stumpage communities and the stumpage and roundwood communities is statistically insignificant, while the difference between the roundwood and the (one) lumber community is significant. Therefore, for the majority of the sample, the forest to total land area does not correlate strongly with the switch from extraction activities to sawmilling, a result at odds with expectation that a much larger scale forest is needed to sustain own milling operations. Using the population frame data (n=2912), the forest-land ratio differences are significant between the no-sale and the stumpage group (1% level) and the roundwood and the lumber communities (10% level), but not between the stumpage and roundwood communities (Table 4). Therefore, future work on the predictors for greater value-added activities should look into further details of the forest size and value-added relationship and consider regional differences.

[12]Test includes communities with over 300 hectares and type identifiable.

Table 8: Land and Forest Area

	Total area (ha.)	Forest area (ha.)	Forest/land ratio
		Durango	
No sale (n=3)	17654	2612	0.22
Stumpage (n=11)	8686	5881	0.66*
Roundwood (n=9)	8570	7980	0.86*
Lumber (n=5)	15679	13676	0.86
Total (n=28)	10894	7661	0.71
		Michoacan	
No sale (n=3)	2197	1483	0.58
Stumpage (n=6)	3352	1743	0.65
Roundwood (n=3)	778	568	0.78
Lumber (n=1)	3524	1950	0.55*
Total (n=13)	2505	1428	0.66
		Total	
No sale (n=6)	9926	2048	0.40
Stumpage (n=17)	6803	4330	0.66*
Roundwood (n=12)	6622	6128	0.84*
Lumber (n=6)	13820	11722	0.81
Total (n=41)	8234	5636	0.70

Source: Survey data.
* = sig. diff. from group above.

4.1.3 Demographics

Demographic data captures measures of heterogeneity and and population size that may affect measures of social cohesion and a group's overall ability to coordinate collective action. Although population size has ambiguous affects on deforestation (Angelsen and Kaimowitz 1999), it is one of the most widely used indicators. Olson's hypothesis is that collective action becomes more difficult as population size becomes "too large". For these reasons, population size and other demographic data are important measures. Both the survey instrument and INEGI data provided the data on population size. Where there were large discrepancies between the two sources, the data is not included in the summary table.[13]

The no-sale communities have the largest average population size, followed by the stumpage group. The lowest population size is the roundwood group. The result corresponds to Olson's hypothesis that larger size discourages collective action (Table 9). However, noting that the stumpage group has the closest proximity on average to population centers, other factors may be in play (Table 10). Proximity to population centers offers employment and therefore raises opportunity costs and lowers several transaction costs such as search, information and transportation. Previous study found evidence suggesting that proximity lowers specificity of investments in timber, thus raising the probability of outside contracting for production services (Antinori and Rausser 2008). Further analysis will shed light on the relative importance of these effects.

Some support for the idea of social cohesion as a unifying force is given by the percentage of families whose household head is an official community member *ejidatario* or *comunero* where the no-sale group has the lowest average. The nonmember families include *posesionarios* and *avecindados*, many of whom are related to community members.[14] However, all communities have 60% or more of their official members as residents, with the lumber group and, surprisingly, the no-sale group, reporting the highest average percentages.

We have wide variations between the two states in population patterns. Using available data from INEGI, Duranguense communities have much smaller population sizes than Michoacan communities. Notably, overall population sizes are shrinking in the Durango communities, with only the stumpage group showing positive population growth. Michoacan has a positive average growth rate except for the two roundwood communities (one observation dropped for lack of population data). *Ejidatarios/comuneros* also make up less of the local resident population in Durango than in Michoacan (data not shown).

[13] INEGI 2000 population data organizes information by localities rather than communities. Therefore, we noted all localities within a community during the survey process and then added the count data for each community. Data reported in percentages were then recalculated using these new totals.

[14] Posesionarios live in the community with a plot for the house and an agricultural parcel. They are typically children of *ejidatarios* but lack voting rights in the General Assembly. *Avecindados* live in the community with a plot only for the house and do not have voting rights.

Table 9: Population and Population Change

	Mean, 2000			**Change 1990-2000 (%)**		
	Durango	Michoacan	Total	Durango	Michoacan	Total
No-sale	395	2019	1207	-12	52	20
Stumpage	217	2368	889	9	21	13
Roundwood	181	368	214	-32	-16	-29
Lumber	243	3571	798	-26	20	-18
Total	229	2018	734	-13	23	-3

Source: INEGI

The lower section of Table 10 presents results according to whether the community has residents who speak the local indigenous language (e.g. Purepecha, Tarahumara, Huichol, Tepehuano). The presence of indigenous language speakers does not distinguish whether a community is titled as an *ejido* or an indigenous community comunidad, as our statistical test of this relationship resulted in an insignificant statistic. This fact may underscore the great dispersal of indigenous language speakers across Mexico and also quirks of titling, where the denomination of ejido or comunidad was pursued based on other considerations.[15] About half of the communities have indigenous language speakers. The actual percentages within each community as reported are relatively small, about 2%, and decrease with advancement along the timber production chain, with the no-sale group having 6% indigenous language speakers on average. Yet, the indigenous language-speaking are (statistically) significantly larger in population size and have *less* members as a percent of their overall population while the percentages of members actually residing in the community are relatively the same. The results may indicate that communities with indigenous language speakers represent older settlements which tend to have children of the official members residing in the village as well, as compared to the non-native speaking communities.

Other comparisons of differences by indigenous language speakers also give results contrary to much prevailing perceptions. The proximity to centers of population (500 residents or more) is not significantly different, so that presence of native language speakers does not correspond to remoteness. Furthermore, there is no significant correlation between native language speaking capabilities and vertical integration, so that the basis of collective action for forestry activities goes beyond the cultural bonds of language as measured.

[15]Informants anecdotally told us that titling procedures for *ejido* status were less onerous than for *comunidades indigenas*.

Table 10: Population Characteristics (average)

	Hrs. to pop. center	Avg. total residents	Forest ha. per member	Members (% residents)	Resident members (% members)
Vertical integration					
No-sale	0.90	1207	36	50%	77%
Stumpage	0.48	889	72	76%	62%
Roundwood	0.68	214	101	70%	68%
Lumber	0.93	798	98	70%	72%
Indigenous speaking					
No (n=22)	0.79	203*	89	77%*	63%
Yes (n=19)	0.57	1049*	78	63%*	68%

Source: Survey data, INEGI.

*difference sig. at 10% or better.

4.1.4 Proximity to population centers

Two types of indicators approximate distance to population centers: 1) hours to state capital (including transportation means necessary) and 2) hours to any other population center of 500 people or more. There is a nonlinear pattern for distance to population centers, with the no-sale and the lumber groups the farthest, followed by the roundwood and, finally, the stumpage group on average closest to population centers. The pattern is slightly switched for distance to the capital city, with the lumber and no-sale groups farthest and the stumpage and roundwood groups closest. The result is consistent with an interpretation that greater distance from population centers increases the contractual hazards of timber marketing as well as decreases opportunity costs for those farther away. For those able to commercialize their forest, these factors argue for own production (Antinori and Rausser 2008).

4.1.5 Sources of income

Table 11 displays sources of income from local or regional sources, where the responses are given as percent of families regularly receiving income from that source in the last year before the survey was administered. Sixty percent or more of families in communities with forestry operations receive income from forestry. In the communities with forestry operations, private businesses which buy community wood. Among the forestry production categories, the lumber group has significantly smaller percentage of families who engage in this type of business, presumably because that business is dominated at a collective level.

The stumpage group shows the greatest frequency of private income from businesses, both forestry and non-forestry, which are located either within the community or in another town (Columns 2, 3 and 4), possibly indicating higher opportunity costs of forestry than the other three groups.

Agriculture and livestock are the other main sources of income, with no significant differences across vertical integration groups. However, stumpage community members most often receive income from agriculture while the no-sale community families most often receive income from livestock. The latter finding may be worth closer analysis, as livestock grazing may be associated with deforested areas. Closer proximity to town centers (500 inhabitants or more) tends to be associated with more families engaged in agriculture, though the correlation coefficient is rather low ($\rho = -0.27$).

Nontimber forest products rarely generate income in this sample. The roundwood communities report no families receiving income from nontimber products while stumpage community families most often receive nontimber forest product income. The presence of stores in the community, as separate from other types of local business, is most frequent in the lumber and no-sale group. This data has been used as an indicator of a general level of local income in a community. Finally, the no-sale community commuters are statistically significantly larger than those who commute to work from the forestry production communities.

4.1.6 Literacy Rates

The INEGI literacy indicators include the percent of 6-14 year-olds who can read and write Spanish and the percent of persons 15 and over who are "literate". For the former, Table 12 shows that the percentages from the Census 2000 data start from a high base of 78% across the four types of communities. Changes between 1990 and 2000 are positive for the stumpage and lumber groups but negative for the no-sale and roundwood groups. Literacy rates in 2000 among 15+ year-olds are 83% and above across groups, though improvements since 1990 are the lowest for the no-sale and roundwood groups. Therefore, in general, the no-sale and the roundwood groups have the lowest performance indicators for literacy in this sample.

4.1.7 Material Well-Being

INEGI Census data and survey questions provide well being measures in terms of basic human needs, like housing and access to health facilities, and wealth such as livestock and consumption goods. Poverty, for example, has been frequently measured by the percent of families who use fuelwood as a primary cooking fuel. In this section, we show the average trends and correlations among these measures and vertical integration, as vertical

Table 11: Sources of Income (Mean Percent of Households)

	Forestry	**Priv-For**	**Priv-Ext**	**Priv-Int**	**NTFP**	**Agri**	**Livestock**	**Stores**	**Commute**	**Other**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
No-sale (n=6)	0.00	0.00	1.00	0.37	0.33	16.67	35.10	5.17	49.17	0.55
Stumpage (n=17)	62.97	6.34	4.86	0.50	8.77	30.67	23.21	4.60	8.97	5.50
Roundwood (n=12)	77.52	3.58	0.34	0.26	0.00	11.35	29.93	4.55	18.29	0.00
Lumber (n=6)	79.00	0.40	1.20	0.40	1.40	10.80	21.00	6.20	16.17	0.00
Total (n=41)	60.23	3.83	2.52	0.40	3.93	20.25	26.65	4.88	18.64	2.47

Source: Survey data

Table 12: Literacy Rates, 1990-2000 (Mean share of population)

	6-14 yr. olds 2000	Change 1990-2000	15+ yr. olds 2000	Change 1990-2000
No-sale	0.82	-0.05	0.83	0.06
Stumpage	0.84	0.41	0.85	0.17
Roundwood	0.78	-0.01	0.85	0.06
Lumber	0.84	0.04	0.89	0.08
Total	0.82	0.16	0.86	0.11

Source: INEGI 1990, 2000

integration may contribute to local economic development through investments, profit-sharing and jobs.

However, the data in this regard give an ambiguous picture of market participation's contribution. Table 13 shows a select set of measures focused on household utilities and cooking fuel. While not all mean differences across groups are statistically significant (the break between stumpage and roundwood is significant for drainage), a general decline is apparent with increasing vertical integration in most measures. The last column represents an aggregated measure (average share of households with electricity, water, drainage or gas as primary cooking fuel) in which a statistically significant break occurs between the stumpage and roundwood group. Those communities based on agriculture (i.e. more families reporting agriculture as a regular income source) are associated with less poverty (using cooking fuel as a poverty indicator, $\rho = -0.51$ for firewood).

By state, the difference is especially strong in Michoacan where the percent of households using gas stoves as a primary fuel drops significantly (and reciprocally the percent who use fuelwood as primary cooking fuel rises) between the stumpage and roundwood groups. Otherwise, the confidence intervals are too large to register statistically significant results, though there are sharp drops in measures moving up the vertical integration chain. The same wellbeing measure calculated for the Oaxaca sample of timber-producing communities shows an opposite, increasing trend in material wealth with vertical integration. Why do reverse patterns appear in the northern states? Is vertical integration in Oaxaca contributing to greater local infrastructure development? Possibilities such as difference in character of vertical integration and market relationships across regions will be further explored.

The survey provides binary responses on other public services. Little statistically significant variation across groups exists in having schools, internet, libraries, mail service and health clinics, though some frequencies decrease with vertical integration. We have a number of survey measures on household wealth in terms of livestock and materials goods, like cars, telephones and house size. Rather than report individual measures, we look for

Table 13: Household Utilities, 2000 (Mean share of population)

	Electricity	Water	Drainage	Gas Stoves	Combined
			Total (n=37)		
None	0.83	0.74	0.47	0.36	0.60
Stumpage	0.71	0.72	0.30	0.18	0.48
Roundwood	0.47	0.64	0.10	0.05	0.31
Lumber	0.66	0.34	0.10	0.06	0.29
Total	0.65	0.65	0.24	0.16	0.42
			Durango (n=25)		
None	0.73	0.72	0.54	0.29	0.57
Stumpage	0.59	0.67	0.11	0.01	0.35
Roundwood	0.29	0.55	0.06	0.02	0.23
Lumber	0.58	0.23	0.09	0.01	0.23
Total	0.51	0.57	0.14	0.05	0.32
			Michoacan (n=12)		
None	0.94	0.75	0.40	0.44	0.63
Stumpage	0.96	0.81	0.68	0.52	0.74
Roundwood	0.95	0.88	0.19	0.13	0.54
Lumber	0.96	0.77	0.14	0.26	0.53
Total	0.95	0.81	0.44	0.38	0.65
			Oaxaca (n=43)		
Stumpage	0.90	0.68	0.14	0.07	0.45
Roundwood	0.92	0.76	0.18	0.09	0.49
Lumber	0.93	0.72	0.40	0.25	0.57
Total	0.91	0.72	0.24	0.14	0.50

Sources: Survey data, INEGI 2000, Antinori (2000).

patterns using principal component analysis and find that factors formed around having the following sets of assets: 1) sheep, 0-3 cows and 0-3 pigs, 2) over 50 cows and over 50 chickens, and 3) car, cell phone, and a house with two levels and running water. The factors are scored to create an index of household wealth measures for each community. There is a strong correlation between the "material goods" factor and INEGI data on percent of families using fuelwood, gas stoves and degree of economic marginalization for that municipality. The same factor correlates negatively (ρ = -0.70) with fuelwood use, positively with gas stove use ($\rho = 0.71$) and negatively with higher degrees of marginalization (ρ = -0.21), as would be expected, showing some consistency between survey and secondary, government-collected data. Furthermore, the material goods factor decreases as vertical integration increases. Those communities with more families involved in agriculture correlate positively ($\rho = 0.38$) with material goods but (surprisingly) negatively with the first livestock factor ($\rho = -0.31$) and zero correlation with the second livestock factor, again associating agriculture with a wealth factor. The comparison with forest hectares per member is the mirror image to this, as it varies negatively with the first, small but diverse livestock factor ($\rho = 0.43$) and negatively with the material goods factor ($\rho = -0.32$), reflecting earlier correlations discussed above. Durango scores more poorly in material goods, with a negative average scorings (principal components scorings can take positive and negative values), while only the roundwood and lumber groups have a negative average in Michoacan.

4.2 Development of Community Forestry Institutions

For the communities which commercialize their forestland by selling stumpage, roundwood or more processed material, the survey mapped institutional evolution and internal governance structure. Below is a brief historical overview of forestry activity in all the communities in the sample and, for communities which are currently selling their timber resources in some form, a description of their internal organization for forestry management and production.

4.2.1 Market integration

The survey covers generally the last 50 years, based on recall of the community members present at the survey interview. This includes a representation of both concessioned and non-concessioned forests. Of the communities which currently commercialize their timber resources, about half in each category of stumpage, roundwood and lumber have been part of a concessioned area in the past, starting in 1950 and onward (with one community reporting a concession which initiated in 1917). In addition, a little over half of all the communities in the sample (24 out of 41), including the no-sale group, have worked with private firms in the past. The earliest date is 1940, though occasionally community

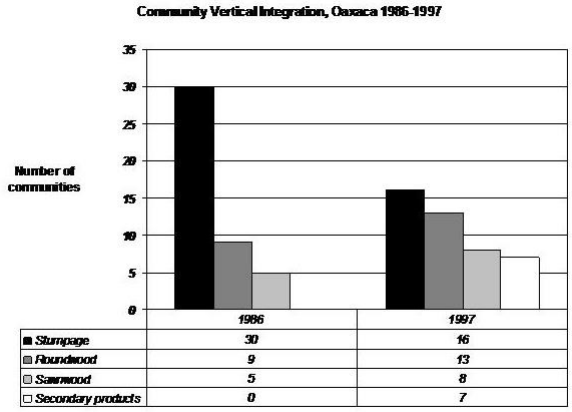

Figure 4: Oaxacan community-market participation, 1987-1997

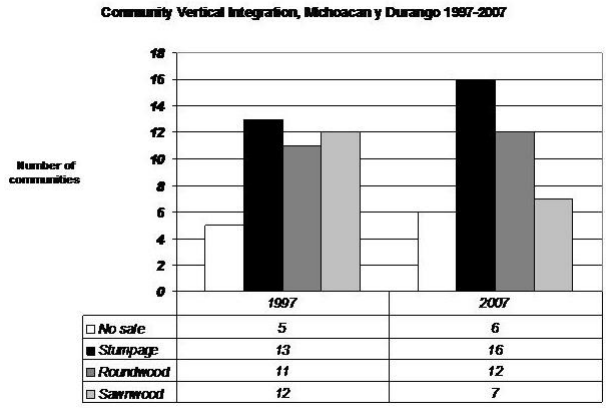

Figure 5: Sample community-market participation, 1997-2007

interviewees indicated that forestry activities had occurred even earlier but could not recall specific time periods.

The figures compare how the survey sample communities have changed their market participation over time, first with the Oaxaca dataset and then with the Durango/Michoacan dataset for comparison. Granted that the time periods covered are different, the comparison is still interesting. The Oaxaca communities show the vertical integration profile by end product sold for the 42 community observations in 1987 and then again in 1997. The striking feature is that many forward integrated. The comparison with the Durango and Michoacan communities, despite the time period differences of 1997 to 2007, give a remarkably different pattern where there is much more de-integration. Many lumber communities de-integrated in the time period, so that the number of no-sale, stumpage and roundwood increased.

Our previous analysis of the Oaxaca data used the incomplete contracts framework to explain vertical integration in Oaxaca communities in 1997. As a formalization of transaction cost theory, with some distinctions, we tested variables related to transaction costs to explain the communities' vertical integration. These variables included measures of asset specificity, uncertainty and complexity of production processes as they relate to timber and nontimber goods, and conditions which would lover the costs of collective action. The concept of uncertainty is interpreted to include control over jobs, monitoring, multiple forest uses, and diversification possibilities. The result is that a base level of forest endowment, while important, is not enough for a decision to integrate. Organizational capacity supported by a general consensus among community members about the value of forestry operations is also a significant element.

The same test is recreated in a preliminary fashion with the Durango and Michoacan sample, and has strikingly different results. Similar variables applied to the new dataset are generally not explanatory. An ordered logit regression to explain levels of stumpage, roundwood and lumber (no-sale communities not included to maintain comparison with the Oaxaca study) on the sample of the 35 communities from Durango and Michoacan revealed no explanatory variables, including forest size and social capital indicators used in the Oaxaca study. Only when we separated out the Durango communities (n=25) did one variable become marginally significant. The roads variable representing pre-existing infrastructure for harvesting (prior to community decision and expectation to participate in the market) is significant and positive for the Durango communities, at the 10% level, indicating a capital constraint rather than a need for asset specific investments in Oaxaca.

What does this mean for the analysis and what conclusions can we draw from this, albeit preliminary, analysis? We cannot say that we over-fitted the model in Oaxaca, as the variables are chosen based on conventional transaction cost and production economics theoretical predictions. Certainly, further research is warranted. One interpretation to be explored further notes how political relationships and institutional structures evolved in forestry is vastly different from one region to another. It is possible that social and organizational capital remain important but must have a different quantitative measure to reflect the different ways community institutions have evolved, which is a qualitative characteristic. Social and organizational capital may be measured differently across regions. One implication is that the transaction costs of timber production, processing and exchange may have been lowered by community forestry institutions or policy in the north such that communities do not find it worthwhile to forward integrate to control the non-contractible benefits of production. If transaction costs are low, vertical integration does not matter in capturing benefits. This interpretation seems unlikely in the complex environment in which forestry operate in Mexico. Therefore, follow-up research will carefully examine the terms of trade for communities in the north versus the south.

The evolution of community market integration since the concession era also shows that even for one community, the end product sold fluctuates, and not always in a forward, greater value-added manner. Table 14 shows communities' movement up and down the

production chain over time. Some of the more integrated communities started their introduction into the timber market by a sequential progression of selling stumpage and then eventually integrating forward, while other more integrated communities have de-integrated for a period of time and then sold a more downstream product. The top part of the table indicates how many of the more integrated types have followed a sequential integration along the timber production chain. Most of the roundwood communities had never sold stumpage in the past but started off their own forestry activity by extracting the timber themselves and selling roundwood. In contrast, the majority of lumber communities report selling stumpage and roundwood in the past. Taking a more detailed look at our historical data reveals interesting overlaps of production activities and strategies employed by the communities in accessing timber markets. Four of the twelve roundwood communities at some point concurrently sold both stumpage and roundwood in the past, while only one still sells both stumpage and roundwood in the same cycle. Otherwise, all the other roundwood communities jumped right into selling logs when they began participating in the market. For the lumber communities, three of the five who sold stumpage in the past continue to sell stumpage concurrently with their lumber sales. Only two of the six lumber communities did not sell stumpage concurrently and stopped selling stumpage when they began to sell lumber. Comparing sales of roundwood and lumber, half of the lumber communities sold roundwood before selling lumber; five of the six at some point sold roundwood concurrently with lumber; and half still sell roundwood along with lumber. Reasons could be that the community lumber operations do not have the capacity (physical or managerial) to process all the volume or classes of timber produced from the common forestland. Further analysis will yield more conclusive evidence.

The lower part of the table shows cases of the opposite movement, that is, going from a more forwardly integrated to a less forwardly integrated step in the timber production chain. At least five of the no-sale group have sold stumpage in the past, showing that they may be occasional timber sellers, possibly because their forestland is not large enough to support timber sales every year. Fourteen of the no-sale to roundwood communities have had sawmills in the past which they no longer operate. Reasons for the switch in level of operations vary widely but the most frequent responses are issues with management capacity, re-organization, and having enough timber that year to sell or process. One informant explained how the switch in end product sold year to year fits into a livelihood strategy. Referring to one community with a sawmill and machinery for secondary products, the community has frequently switched from selling stumpage one year and selling processing material another depending on the need for cash. The processed material presumably yield about the same profits as selling stumpage, so that the decision depended on the need for an *anticipo* or the advance payment that stumpage buyers will offer but not buyers of processed material. If the *anticipo* is not needed that year by community members, they will incur the upfront costs of salaries and other costs and process the timber. We suspect that this strategy is used by other communities.

Table 14: Integration and De-integration History

	No-sale (6)	Stumpage (17)	Roundwood (12)	Lumber (6)
Forwardly integrated				
Sold stumpage in past	-	-	5	5
Sold roundwood in past	-	-	-	5
De-integration				
Sold stumpage in past (and now don't)	5	-	-	-
Sold roundwood in past (and now don't)	2	4	-	-
Sold lumber in past (and now don't)	1	6	7	-
Sold secondary products in past (and now don't)	0	3	2	1

Source: Survey data

4.2.2 Internal organization for timber production

Table 15 shows variation in production models across states. Levels of production organization found in the survey sample are community, work group and individual. While community-level production organization is most common overall, work groups are statistically more prevalent in Durango, while individual informal parcelization has a stronger presence in Michoacan. Although the frequency of division decreases with greater vertical integration, there is no significant systematic variation. It is possible to encounter any variety of internal organizational mode for any given end product sold. Mean forest size decreases as we move from community level, work group, then individualized systems, but the differences are significant only between the individualized systems and the other two systems. Except for a historically anomalous work group (see below), mean formation date of work groups occurred after the 1992 Reform while most individual arrangements formed prior to the 1992 Reform. Much of the subcommunity level forms of internal production organization are correlated with reports of "bad administration" (*maldesempeño*) in the past by the community administrators responsible for managing or overseeing the forestry operations. The reasons given, in order of frequency, for subdivision of production activities internally, for work groups, are errors in administration, lack of confidence in administration, internal conflict, and costs. The reasons in order of frequency for individualizing the production activities are historical pattern of individual access to forests (e.g. for resin), internal conflicts, costs and errors in administration. Therefore, work groups seems to be more the production mode of choice when the CBC or general manager does not fulfill their forestry duties to satisfaction. The specific survey modules for work groups and individual modes of production revealed the following summary points. Discontent with community administration motivates many to change organizational mode for forestry. Half have chosen to manage forest by the individualized

system based on historical patterns of usage. Five out of eight "individualized" communities have followed that mode of production since before 1992 for forestry purposes. If a community chooses to split production activities, it is more likely to choose an individualized parcel system if it had this system in the past for other non-commercial timber forest products (e.g., resin). Otherwise, its chooses work groups. Finally, work groups are chosen more if the split is due to maladministration.

To pursue the theme of internal accountability, all communities were asked what measures were taken in cases of *"maldesempeño"*, or, in hypothetical cases where no specific management errors were stated, what measures would be taken if the situation arose, most said the individuals renounce their post. Fines are also used. Only in the hypothetical cases did community respondents mention state or federal agencies for sanctioning. The "other" responses include withholding *repartos* until the debt was paid, or for a period of time, not giving the person work, verbal reprimand, and in one case specifically, sub-division of the production activities.

The tendency to split is consistent with Fama and Jensen (1983)'s concept of separation of ownership and control, where the reorganization is an internal institutional response to making community managers more responsive to the community members. Splitting into subcommunity-level groups makes the flow of funds more transparent by taking it out of the community authorities' hands, and putting commercial exchanges and production more directly into community members' hands.

The degree of formalization of these subgroups varies across communities, as would be expected. Some work groups form along family lines, by convenience or simply around who people think can get the best terms of trade. Consequently, group size can change each year. Under individual harvesting, individuals are responsible for harvest and business arrangements. Groups or individuals hire amongst the community for extraction. For example, one community with "individual" organization employed a total of ten chainsaw operators for about 50 community members in the last completed harvest prior to the survey. Sales proceeds go directly to each group member net of direct costs paid by group leaders or to individuals. A few cases claim to have permanent parcels based on historical, individual access patterns for resin production, or a distinct constitutional history. *Colonias* for example were formed in the fifties by federal policies to encourage land settlement and cattle ranching. In these cases, each founding member was allotted 50 hectares, regardless of whether the land was agricultural or forest. In addition, our sample includes one community formally created from five previously distinct communities. Each original community, now called *barrio*, still considers itself more or less separate from the unified body so that each decides the manner of timber activities despite one overall forest management plan.

The existence of these other forms poses a challenge to cross-scale linkages, say with foresters who must spend additional time coordinating with community members, and second-level organizations which seek representation from the community. While frequency of membership in forestry associations (FA) is fairly evenly distributed among each

Table 15: Internal Organization Systems

	Community N=26	Work group N=5	Individual N=10
State			
Durango	21	4	3
Michoacan	5	1	7
χ^2 prob. = 0.01			
Mean formation date	1980	1998	1978
VI level			
No-sale	4	0	2
Stumpage	11	1	5
Roundwood	6	3	3
Lumber	5	1	0
χ^2 prob. = 0.47			
Mean forest hectares	7033	5854	2031
chisq not sig b/w com and wg			
chisq sig b/w com and individ			
chisq sig b/w wg and individ			
FA membership	21	5	6
Joined FA after current org. type	6	5	2
χ^2 prob. = 0.002			
Past *"maldesempeño"*	8	4	7
χ^2 prob. = 0.01			

Source: Survey data

organizational mode, all the work group communities formed work groups *after* joining the association. The work group form, as opposed to the individual mode, has been problematical in sending community representatives to association meetings (Taylor 2003). Most (80%) of both community-and individual-level harvesting production mode were in place prior to joining the FA. This shows that individual forms of production do not compete with the usual governance of common property activities in the communities, whereas work groups introduce additional layering of decisionmaking that is not completely hierarchical to community-level governance.

4.2.3 Management

Overall, few communities have elaborated their governance system beyond the core agrarian governance structure as defined in the Constitution to accommodate additional forestry activities. The number of committees increases with vertical integration, showing more division of labor; however, this distinction fades when we consider that most positions are dually held by the CBC or JV, reducing the effective number of positions in the community (statistically significant variation goes from 1% to 10% confidence level). This structure is a practical choice by the communities but highlights the need for training and outreach to cover business and ecological management skills. About 45% of the communities compensate the CBC and JV for their time. For all communities, the CBC and JV serve for 3 years.

Organizational structures can also include both internal and external actors to gain additional expertise or act as oversight. Three (a no-sale, stumpage and a lumber community) have a council of advisors apart from the regular cargo positions. The Consejo Forestal (CF), where they exist, follow the agrarian structure. They serve 3 years and receive no payments. Only two, a stumpage and a lumber type, have *caracterizados*, that is, respected members of the community, who act as overall advisors or counsels in community forestry matters. In neither case are they paid, and they have a more or less indefinite post. These are outside the formal agrarian structure and arise from earlier systems of governance.

For the forestry activities, all the communities have designated *Jefes de Monte* (JM) whose function is primarily to oversee extraction. In all survey communities, the JMs are members of the community appointed by the CBC or CV and overseen by the CV or STF. The duration of their post varies from 1-3 years or for an indefinite period. About five were unpaid positions, while the rest (nine) are paid either by the community or in one case by the buyer.

The documenter, responsible for measuring wood volume extracted and transported, has more variation in supervision and pay. All but one are members of the community and appointed, for 1-3 years or for an indefinite period. They are supervised by the CBC, CV, STF, contractor, or *parcelero* or a combination of those. They obtained the post by

appointment by the community assembly, *parcelero*, work group, or contractor, and paid by the community, buyer, work group or *parcelero*.

4.2.4 Decisionmaking

As illustrated in Figure 1, many levels and scales of governance shape forestry decisions. The administrative levels of governance are local, regional, national and supranational while the rulemaking levels are constitutional, collective choice, and operational (Ostrom 1990). The constitutional level sets the rules for the collective choice level, which in turn sets the rules for the operational level.[16] For our purposes, relevant rules which have been constitutionally set at the national level are the agrarian structure itself which defines membership, voting and responsibilities of elected officials. Resource use policies set at the national level are, most importantly, the template for the forestry management plan and the harvest permitting process. Local collective choices occur in the General Assembly where operational decisions may be delegated to elected or appointed officials like the CBC. Additionally, regional forestry associations may participate in forestry decisionmaking, such as prices for material or labor.

What do the internal organizational modes of production which we label as community, work group and individualized mean in terms of who makes decisions? What role do external agents play, and for what decisions? To answer these questions, the survey has a detailed component which traces the decisionmaking process for several key decisions in forestry management. These decisions are the choice of buyer, exchange price, wage or *reparto* advances[17] and volume harvested. The decisionmaking "processes" refer to who makes the decisions, who authorized that person(s) or body to make those decisions, and what forms of oversight exist over those decisionmakers.

We followed the decisionmaking authority for a set of important decisions related to forestry operations made in each community. In many cases our internal organization modes correspond to a distinct decisionmaking pattern, although there are mixtures. The patterns do not correspond to vertical integration level except for the profit distribution decision. Again, vertical integration typologies mask great internal variation in organization and management. Only the harvest decision lack correlation with internal organization and vertical integration, being mainly a technical decision laid out by the *prestador de servicios tecnicos* (PST). If we look at these decisions in detail, we see overlapping decisionmaking authority within each mode as well as across each mode. Let's take the profit allocation decision as an example. Even though differences exist across modes, there is still an element of the GA and CBC present, showing that community-level authority still plays a hierarchical, oversight role in many instances (Table 16).

[16] Other work (Ostrom 2005) includes a fourth level called the meta-constitutional level, which sets the rules for the constitutional level.

[17] In cases where *repartos* or dividends are not distributed, we asked about the occurrence of wage advances for employed members of the community.

Table 16: Who is Authorized to Make the Profit Allocation Decision?

Production level	Who decides	Percent of responses
Community	General Assembly	62%
	CBC	33%
Work groups	General Assembly	60%
	WG leader	40%
	WG assembly	40%
Parcels	CBC	50%
	Parcel holder	50%
	General Assembly	25%

Source: Survey data.

Table 17: Vertical Integration v. Internal Organization Decisionmaking

	Is the relationship statistically significant?	
Decision	By internal orgn.?	By VI level?
Profit allocation	Yes	Yes
Trade price	Yes	No
Wage/reparto advance	Yes	No
Harvest volume	No	No
Choice of buyer	Yes	No

Source: Survey data.

The results reveal extensive cross-scale interactions among government agencies, foresters and buyers, associations and local community members, both officials and general members. One interesting finding is that decisionmaking patterns are distinguished not by vertical integration level but by organizational mode according to whether forestry activities are organized at the community or sub-community level (Table 17). Consistent with economic organizational theory (Fama and Jensen 1983), decisionmaking powers follow the governance structure. Take for example the question of who is authorized to make decisions about the distribution of revenues from forestry sales. Most of the communities which fully manage and operate collectively report that the General Assembly (GA) makes this decision. In those which operate in a parcelized fashion or in work groups, the flow of funds is handled by the work group leaders or the individual parcel holders. Neither does the CBC become involved in this decision, though he is in a several community-level operations. However, this mode of organization implies a collective choice and an operational choice. The GA initially approved the decision to allow production at the sub-community level, implicitly allowing the change in decisionmaking responsibilities which goes with that particular production model. One may also say that the GA constitutionally had the choice to make a collective decision to change their internal practices.

Likewise, the GA and CBC have the responsibility of negotiating a sales price with buyers in collectively-managed communities while parcel holders or group leaders make the decision in these divided communities. Yet, even in communities with divided production processes, there is a variation in decisionmakers. The work group communities vary their responses among the CBC, PST, work group chief (*Jefe de Grupo*), and the work group assembly (*Asamblea de Grupo*) as actors in authorizing sale prices. In the individual parcel cases, the GA is also noted with frequency. Even though these subgroups are responsible for harvesting their allotments, some of these subgroups still coordinate as a community in agreeing to prices or in making agreements with buyers.

Advances on wages or *repartos* are part of the livelihood strategy associated with community forestry (Wilshusen 2003). The CBC, rather than the GA, is more often responsible for authorizing advances in collectively managed communities, though the GA was the second most frequent response. In several instances, interviewees explained that the CBC has to clear or report the advance in GA meetings. Among the five work group communities, both the *Jefe de Grupo* and the CBC are mentioned as decisionmakers for this decision. Finally, *parceleros* deal directly with buyers to arrange advances. In one example of the interaction, the buyer might discuss a request for an advance with the CBC, presumably to gain more information on the individual and make the accounting consistent. The buyer then deducts the advance at the end of the payment cycle from any *repartos* or wages (say, in stumpage communities) owed to that individual.

Most communities regardless of internal management system said that the PST is responsible for authorizing harvest levels, as per state mandated rules and the requirement of a management plan. However, some communities noted that the GA (or work group

leader or *parcelero*) also has a role in authorizing the harvest, either in approving the plan or adjusting the harvest to less than the total allowable cut.

In collectively-managed operations, the General Assembly is most often the locus of choosing a buyer. Buyers make a proposal and the GA votes whether to accept the bid. The CBC is noted in a few cases along with the GA as decisionmakers. During interviews, community authorities often responded to this question in terms of final decisionmaking which does not preclude the role of the CBC or another actor, like the PST, in bringing the buyer to the GA forum. In work groups, the work group leader is directly responsible for choosing a buyer, while the individual parcel holders choose under the temporary parcel system. The PST is least involved in this phase, and many PSTs in follow-up interviews confirmed that they are mostly not part of this process.

A question is whether any one decisionmaking model provides more accountability and more equal distribution of benefits. This question is explored in the section below on distribution of benefits. In addition, Antinori and Fransen (2008) indicate that economic and environmental impacts in these "decentralized" communities are not systematically worse. The impact depends on the performance measure in question (Fransen 2008; Antinori and Fransen 2008). Theory suggests that as long as decisionmaking powers are balanced by a form of control mechanisms over the decisionmakers, decisions that are responsive to membership needs can be made. Production at the work group or individual level does not completely relieve the subgroup from community responsibilities. Almost all of the individually organized production operations pay some form of retribution to the community. In work groups it is less clear, though a portion may be allotted on a regular basis to the local school. Preliminary empirical tests reveal lack of strong correlations between organizational forms and outcomes. Further research will clarify results.

The community members are generally protective of their claim to forest resources. The most common answers to whether people monitor their peers taking resources from the forest are "always" and "often". Most said that it would be probable or very probable that someone would denounce another if they observed a rule violation. Table 18 shows that there is some tendency for more integrated and community-organized production communities to report amongst themselves. In cases where they said that someone would probably not report a violation, the reasons given were fear of doing so or an expected empty response where nothing would happen.

4.2.5 Associations and NGOs

Relative to other regions in Mexico (for example, Oaxaca), few nongovernmental organizations (NGOs) operate in this sample (only 2 out of the 41), despite these state's importance to forestry resources. Michoacan is home to the Monarch Reserve and other ecological attractions, while Durango is one of the top timber producing states in Mexico.

On the other hand, forestry associations (FAs) have a rich history in Mexico and have

Table 18: Peer Monitoring

	Monitoring					Reporting Probability				
VI level	Always	Often	Sometimes	Rarely	Never	Very	Good	50-50	Unlikely	Not
No-sale	1	2	1	1	0	0	3	1	0	1
Stumpage	4	6	2	2	3	8	4	1	2	2
Roundwood	6	4	0	1	0	8	1	0	2	0
Lumber	3	0	2	1	0	0	4	0	1	1
Internal organization										
Community	8	9	5	4	0	12	9	2	1	2
Work group	3	1	0	0	1	3	0	0	2	0
Individual	3	2	0	1	2	1	3	0	2	2
Forestry association										
Nonmember	5	3	1	1	1	3	4	0	2	2
Member	9	9	4	4	2	13	8	2	3	2
Total	14	12	5	5	3	16	12	2	5	4

Source: Survey data

played a major role in shaping the community forestry sector. The associations in the sample include technical associations to share forestry services, political associations, production cooperatives and the *Unidades de Manejo Forestales* (UMAFORs) recently created by CONAFOR. Antinori and Garcia-Lopez (2008) provide a detailed analysis and historical background of these associations using the survey data. Here we note the main points.

Affiliation with a forest association is predominant across the sample. Out of 41, 32 belonged to some type of union of forest *ejidos*, with membership probability rising with vertical integration (Table 19). Durango counts with significantly more instances of associations membership than Michoacan.

Since the historical motivations leading to the creation of forestry associations includes complex relationships between the state and the agrarian sector, a continuing line of analysis is how political movements differed across regions and the impact on services offered by FAs.[18] Of the 32 FAs identified in the current sample, thirteen are products of community effort as opposed to top-down formation (Table 20). These bottoms-up organizations show no significant difference in frequency across states. Historical associational networks matter as well. All of those who reported being members of a past forestry association dedicated to counteracting detrimental parastatal practices are now members of a forestry association. In addition, such history is significantly related to being in a bottoms-up organization now.

We tested the impact of association membership against various environmental and economic indicators. The differences are somewhat less than expected, though the analysis is preliminary. For example, those who are members in an association that provides marketing services do not always receive a price premium for their product. Those in an association providing environmental training or services do not necessarily exhibit "better" forestry management practices. However, association membership has a positive impact on reinvestment in forestry and some public goods (Antinori and Garcia-Lopez 2008). In addition to these impacts, further study includes an assessment of how association membership is integrated into the community decisionmaking processes.

4.3 Production

The survey covered many details of production, including harvest levels authorized and cut by species, labor and capital and forestry services. We present only a snapshot of the data.

[18]For example, in the Oaxaca study, less than half of the sample (13 out of 44) communities belonged to a forestry association, where membership significantly increases with vertical integration.

Table 19: Forestry Association Membership

	Nonmembers n=9	Members n=32	Total n=41
Avg. forest ha.	1123	6946	5636
SE	(262)	(1358)	(1124)
Parastatal-era assoc.*	0	13	13
chi^2 prob. = 0.02			

Source: Survey data

Table 20: Origin of Forestry Association

	Association Membership n=32	Bottom-up n=13	Top down n=19
State			
Durango	26 (93%)	12	14
Michoacan	6 (46%	1	5
chi^2 prob. = 0.001			
VI level			
No-sale	2 (33%)		
Stumpage	14 (82%)		
Roundwood	10 (83%)		
Lumber	6 (100%)		
chi^2 prob. = 0.03			
Parastatal-era FA membership	13	8	5
chi^2 prob. = 0.01			

Source: Survey data

4.3.1 Volume

In an earlier phase of the project, the permit data from the ten states showed a declining trend in authorized volume for pine species, the most important of commercial species in Mexico. Figure 6 displays the average volume against the total number of permits to community territories. The decline is steady since 1991. In the same period, the number of permits have increased, reaching a peak in 2001, and then decreased. Even if we consider that more permits may have been issued after we collected the data around 2005, the decline in average authorized pine volume is still apparent. One possibility is that initially large communities apply for a permit, while communities with smaller forest resources organize more slowly.

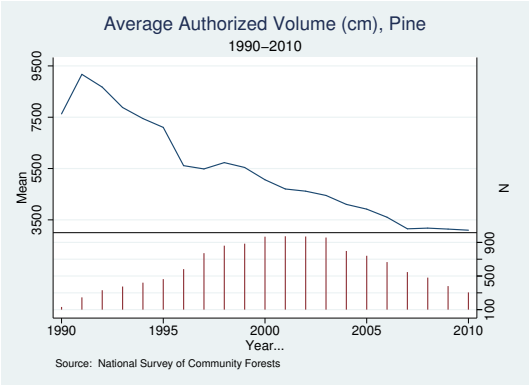

Figure 6: Timber authorizations, 1990-2010 (m^3s of pine)

How do the sample communities compare with the overall trend? Table 21 shows authorized volumes from the permit database for the years 2000 and 2005. Few communities in the database had matching data for both years, so the percent changes show changes in overall group averages.[19] The 41 sample communities reflect the trends for the rest of the communities in their state by vertical integration group, except for the Durango stumpage communities which had a slight increase in authorized volume on average in contrast to the decrease among the sample stumpage communities, and the large overall increase for Michoacan lumber communities in contrast to the one sample observation for this group. Otherwise, the sample communities reflect the decreasing trend in authorized volumes.

Comparing the authorized versus the actually harvested levels in the sample, all averages are somewhat less than the authorized levels except for the roundwood group in Michoacan. If we focus on group averages (where more than one observation point is available), we find that Durango on average comes closer to harvesting 100% of its authorized volume each year than Michoacan. All the Durango averages are above 90% of the authorized amount.

[19]The Phase 1 typological classification is maintained for the sample communities for consistency even if the community was later classified as a different type.

Table 21: Average Authorized Pine (m^3) for Durango and Michoacan: All v. Sample Communities

	Durango			Michoacan		
	Stumpage	Roundwood	Lumber	Stumpage	Roundwood	Lumber
2000-All						
N	73	60	29	85	14	9
Mean	4638	4769	18326	1708	1779	9994
sd	5031	4318	23810	1464	1870	20663
2005-All						
N	46	39	24	69	13	7
Mean	4824	3865	16930	1084	1681	13601
Sd	3950	2700	22005	1187	1646	24199
Change	4%	-20%	-35%	-36%	-6%	36%
2000-sample						
N	8	10	6	3	3	2
Mean	4913	3331	11886	3072	938	608
sd	4048	4095	9209	1652	324	308
2005-sample						
N	7	6	5	3	3	1
Mean	3341	2069	10198	1531	862	329
Sd	2936	1253	8172	1176	377	–
Change	-32%	-38%	-14%	-50%	-8%	-46%

Source: Phase 1 permit data.

As a group, the roundwood harvest the highest percentage of allowable cut than the other groups. Where the volume actually cut was less than 100% of the allowable level, communities across groups tended to state lack of demand and lack of commercial wood - implying that not all of their harvestable wood was commercially desirable - as reasons. The stumpage group tend to state lack of demand, while the lumber group gave both reasons. In considering trends in harvest levels, most communities thought they would only be able to harvest less timber in the future, consistent with the declining production trend.

4.3.2 Prices

The price at which products are exchanged are an agreement between the buyers and sellers. Considering that various governance characteristics might improve the bargaining power of the communities, we compare the deviation from the mean price for the product sold. For example, we might expect more highly integrated communities to have more market information and flexibility in contracting and therefore to have better prices for their products. Likewise, communities selling their timber by subgroups may be expected to receive better prices if the division sought to improve management operations and achieve more flexibility in contracting. A measure was created by calculating the difference between either the community's stumpage or roundwood price per cubic meter and the average for that category of product. The more integrated communities and the communities that produce by subgroup levels have higher averages, that is, price premiums. However, we found that among this dataset, the variances in prices are so wide that the differences in means between integration levels or form of organization are not statistically significant. Other factors must also be considered in explaining price differences, such as location and specific contract agreements.

4.3.3 Employment

One of the benefits cited for community forestry is access to local employment opportunities. Indeed, one of the sticking points causing resistance to parastatals was the practice of hiring more experienced workers from distant locations outside the community rather than hiring and training locally for all except the most basic of tasks. Our data on employment refers to the last harvest season before the survey to ground the responses in actual occurrences. Table 22 shows total employment by occupation. Technical work refers to taking inventories, clearing brush to prevent fires and other silvicultural treatments, and marking trees for the next harvest. The sum excludes the professional forester, which is generally one professional per community. Reforestation refers to workers hired to replant trees and tend to nurseries. This category is the largest as various government programs mandate and fund reforestation in communities. Large groups are sometimes organized to carry out re-planting projects. While some of this work is paid, it should be noted that a community might organize a particular reforestation effort as a *tequio/faena*, or community

Table 22: Total Employment by Occupation

Occupation	Sum (n=41)
Technical	578
Reforestation	947
Logging	793
Milling	264
Total	2582

service project, which is unpaid but counts towards members fulfilling their duties to the community. Logging refers to loggers, their assistants, transport of timber, road work to maintain or create logging roads. Finally, milling, the smallest category, refers to work in sawmills and with other equipment to produce secondary products. The data does not include the managerial team, either as specified under the *Usos y Costumbres* practices (e.g. the CBC and JV) or those selected to manage forestry activities (e.g. *JM, Jefe de Patio, Jefe de Aserradero*).

Figure 7 compares average local as compared to total employment across vertical integration levels and forest size. Surprisingly, the no-sale group has as much employment on average as does the stumpage group, and all employment is local, whereas the stumpage group has the largest gap between average local and total employment. Outside contractors tend to hire from outside the community more often, explaining this gap. The roundwood group hires almost all workers from the local population, while the lumber group, with then highest average local and total workers, has a lower percentage of local workers on average, possibly due to the increased specialization and expertise required on some machinery.

By size of forest, the smallest size strata has the largest average local and total, due to the large reforestation efforts in this group. Beyond this strata, employment on average increases with size of the forest.

4.3.4 Financing forestry activities

Only seven of the forty-one communities sampled received credit from commercial banks or government rural development banks ata anytime in the past. Where credit was obtained, funds were applied mainly to working capital and machinery. For example, one community received credit to purchase a crane (*grua*), two received credit to purchase sawmill equipment, and one for "other" type of machinery. Of these seven, some have received credit more than once. Low reliance on credit markets is consistent with the Oaxaca study, where only three communities used bank credit in the five years previous to the survey (in 2000) and all credit funds were applied to physical equipment (Antinori 2000).

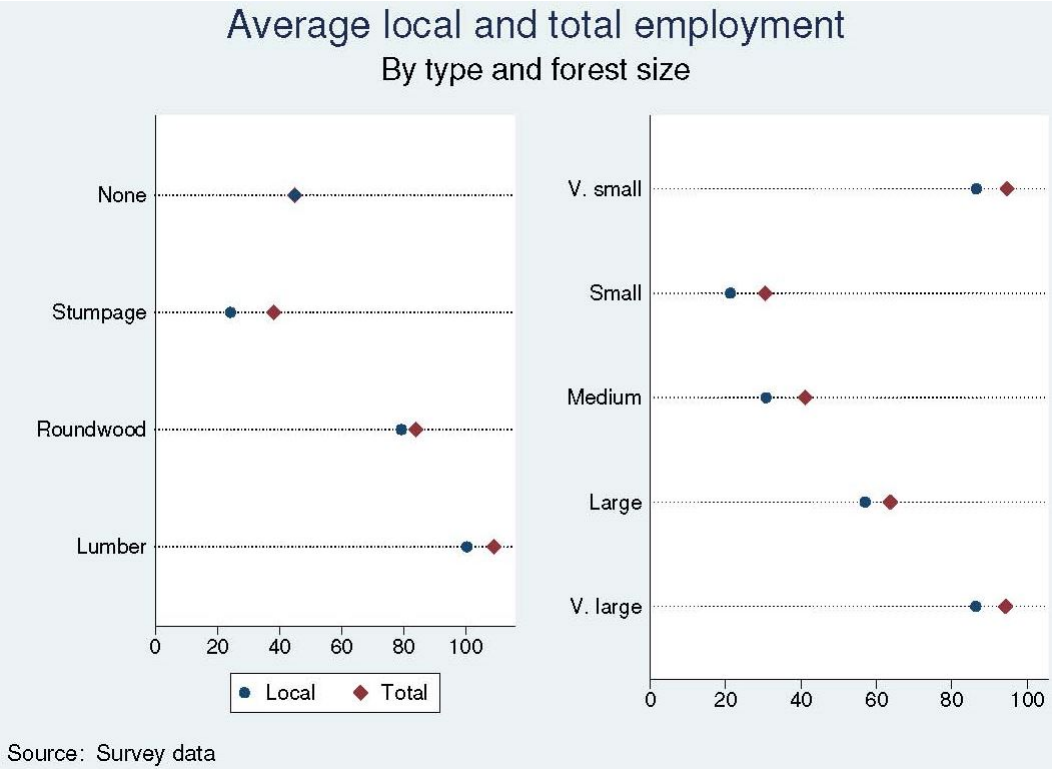

Figure 7: Total employment by forest size and vertical integration

For technical services, 32 out of 33 responses said the community paid for all or part of the management plan, with 18 responses receiving assistance from SEMARNAT or CONAFOR. On average, communities pay 65% of the cost of the management plan.

Government programs have tended to emphasize public goods and human capital and less physical or working capital needs of production. The main forestry-related programs and their main focus are listed in Table 23. Most programs are administered by CONAFOR.[20] The major programs in the past, PRODEFOR and PROCYMAF, plus PRONARE and PRODEPLAN, were reorganized under a single program known as PROARBOL in 2008. However, each individual program had been active in the time leading up to the surveys, and of course, in the past. PRODEFOR funded about 6500 projects among the permit holders captured in the Phase 1 database for ten Mexican states. About 4000 of those projects are for management, mainly thinnings, fire prevention, and management plans.[21] Consequently, all except five communities in the Durango/Michoacan sample have received assistance from a government program for primarily reforestation, fire prevention and other management activities. Only three cited government assistance in acquiring machinery for secondary processing.

[20]Sedesol, Sedena, Sagar, SEP and Semarnat are involved in PRONARE.

[21]One community may account for more than one project, so less than 6500 different communities have received funding.

Table 23: Forestry Programs at Time of Survey

Program	Objective
PRONARE	reforestation
PROCYMAF	institutional capacity, technical assistance, funding for management plans
PRODEPLAN	plantation promotion
PRODEFOR	conservation, restoration and modernization of industrial activities, technical support
PSAH	Payment for environmental services

4.4 Measuring institutional impacts

In this subsection, we consider outcomes of interest - economic, social and environmental impacts - that are affected by the collective decisionmaking processes of communities as a group, residents of the community and outside actors. The purpose is to develop quantitative measures and analyze patterns as outcomes of quantitative and qualitative characteristics of the institutions under study, that is, the community forestry institutions and the polices which implicate them. We continue to report statistics across community type, internal organization and association membership as factors of broad interest to policymakers and researchers. When able, we report preliminary empirical tests of the relationship between the institutional characteristics and the outcomes of interest. General hypotheses that tend to arise in the literature and which we base our preliminary tests are:

- Greater vertical integration by the community leads to greater reinvestment into forestry, more local public goods and better forestry management for conservation purposes.
- Division of communities, even within production organization, leads to a decline in these same outcomes.
- Membership in forestry associations (FAs) increases the frequency and level of these same measures.

Finally, we introduce a refinement of the institutional analysis according to size of stakeholder group:

- For important decisions that have broad impact, the decisionmaking forum is more likely to be the General Assembly. If not, then the outcomes as measured are less "desirable" from a societal point of view.

The following sections provide information for some insight into whether these expectations maintain in the data.

4.4.1 Investments in forest activities

Investments in forestry can have ambiguous individual effects depending on a person's relationship to the community and the operations themselves. Workers through their wages are more likely to benefit from reinvestments if the investment assures the continued viability and employment capacity of forestry activities, unless the investment is labor-saving. We venture to assume that in community forestry operations, the investments in capital mainly allow the same or more labor to be hired. Nonworker community members maintain access to benefits through reinvestment when the investments assure the continued operation and dividends (when disbursed). The benefit in this case may be longer term and more uncertain, as the choice to disburse and the amount of dividends is decided upon yearly.

Survey questions asked whether any investments back into forestry operations had occurred in the last five years. Expenses characterized as reinvestment into forestry operations include management plans, roads, trucks, cranes, tractors, secondary processing equipment, and investments in diversified activities. Table 24 summarizes the results in terms of how many communities stated that they had made these investments in the last five years prior to the survey. The most frequent investments are in roads. Road investment tended to occur on a yearly basis. The result coincides with the need to maintain and build roads each year, as heavy rains and usage have eroded existing roads and new stands need to be accessed. The second most frequent investment is the management plan. Communities contribute to the plan, which is necessary to obtain harvesting permits. Across vertical integration levels, roundwood and lumber groups invested more often in secondary processing and tractors, trucks and cranes. Across production organizational mode, the distinction between community and work group modes is much less than the distinction with the individualized mode. That is, while community-level operations have more frequency of investments in more categories than work-group communities, the difference is not that great. For roads, all models seem comparable. The communities which are members of inter-community forestry associations, however, consistently invested more across all the categories of investment. In the last column, a dummy variable indicates whether investment in any category occurred in the last five years. This dummy is positively (pairwise) correlated with vertical integration and membership in a forestry association but negatively correlated with sub-community-level management, due mainly to individualized systems. Finally, overall, no investments in market studies, scientific inventory equipment or management studies occurred, suggesting possible areas for improving services to communities.

Table 25 shows where tendencies appeared stronger or were significant by a χ^2-statistic (testing for statistically significant associations across columns and rows in a table). We show correlation coefficients greater than $\rho = 0.20$ across the institutional groupings and/or their χ^2 where significant at a level better than 10%. Under these tests, more vertically integrated communities do tend to invest more often in management plans, roads, secondary processing and in general. Communities which organize production through

Table 24: Frequency of Forestry Investments

	Share of communities						
	Forest Study	Plan	Roads	Transport	Secondary	Diversify	Any investment
Vertical Integration							
No-sale	0.14	0.14	0.14	0.14	0.00	0.00	0.43
Stumpage	0.00	0.38	0.31	0.00	0.06	0.19	0.62
Roundwood	0.08	0.50	0.58	0.08	0.17	0.25	0.92
Lumber	0.17	0.00	0.67	0.33	0.50	0.17	0.83
Internal Organization							
Community	0.12	0.38	0.46	0.15	0.19	0.19	0.81
Work Group	0.00	0.40	0.40	0.00	0.20	0.20	0.80
Individualized	0.00	0.10	0.30	0.00	0.00	0.10	0.40
Forestry associations							
Nonmembers	0.00	0.25	0.25	0.00	0.00	0.00	0.50
Members	0.10	0.34	0.48	0.14	0.21	0.24	0.79
Total	0.07	0.32	0.41	0.10	0.15	0.17	0.71

Source: Survey data

Table 25: Forest Reinvestment - Statistical Correlations

	Correlation coefficient (ρ)	$\chi 2$ Prob.
Vertical Integration	Plan: –	.04
(levels=1-4)	Roads: .41	.06
	Secondary: .41	.04
	Any: .37	.06
Internal org.	Transport: -.25	–
(division=1)	Any: -.29	.06
Forestry associations	Secondary: .26	.09
(membership=1)	Diversify: .29	.06
	Any: .29	.06

Source: Survey data.

sub-community groups invest less in transport equipment and overall. However, this tendency is due to the individualized mode, as the tendency disappears when tested against work group communities only. Those in forestry associations have some tendencies to invest more in secondary processing, diversified forestry activities, and overall.

4.4.2 Local public goods

Reinvestment in local public goods differs from reinvestment in forestry because access to local public goods is more directly open to all residents of the community, not only members or those engaged in timber production. Therefore, it represents another aspect of development as a forestry activity outcome. As with reinvestment into forestry, a set of survey questions explored the frequency and nature of public goods investments by communities in the last five years and the source of the funds. Table 26 summarizes the frequency of investments as communities advance in vertical integration, by internal organization and by FA membership (top, middle and bottom sections of table, respectively).

Across public goods, the greatest frequency of public investments went to schools, followed by churches, *fiestas*/ceremonies, and medical services or supplies (e.g. clinics), all core community functionings. The no-sale communities funded these investments mainly by nonforestry communal funds. In the other vertical integration groups, public goods are funded mainly by forestry revenues. It is a widespread custom to have the school count as an *ejido/comunero* member in the division of *repartos* each year, so that the school receives the equivalent of an individual member when forestry profits are disbursed. The no-sale group tends not to invest churches, potable water or civic buildings; the stumpage group tends to invest more often in medical supplies or services (as percentage of group); the roundwoods more frequently invested in churches and fiestas; and the lumber group more often invests in potable water and churches relative to other groups. By internal production

Table 26: Frequency of Local Public Goods Investments

	Count								
	School	Water	Civic bldg.	Church	Fiesta	Medical	Grants	Pension	Other
Vertical integration									
No-sale	2	0	0	0	1	1	0	0	2
Stumpage	8	1	1	4	3	4	0	0	6
Roundwood	11	0	1	4	3	1	0	0	2
Lumber	5	2	1	3	1	1	0	0	0
Total	26	3	3	11	8	7	0	0	10
Internal organization									
Community	18	2	2	9	8	7	0	0	8
Work group	4	1	1	1	0	0	0	0	1
Individual	4	0	0	1	0	0	0	0	1
Total	26	3	3	11	8	7	0	0	10
Invest every year?									
Community	13	0	0	6	8	3	1	0	1
Work group	3	0	0	0	0	0	0	0	0
Individual	3	0	0	0	0	0	0	0	0
Total	19	0	0	6	8	3	1	0	1
Forestry Associations									
Non-members	4	0	0	3	2	2	0	0	4
Members	22	3	3	8	6	5	0	0	6
Total	26	3	3	11	8	7	0	0	10

Source: Survey data

organization, public goods investments for the sub-community organized operations are more restricted to schools and to some extent church. That is, public investment is more limited to traditional contributions to church and school. Those in a forestry association more frequently invest in public goods across all the public goods categories.

To determine which relationships have statistical significance, Table 27 illustrates tendencies with a correlation coefficient $\rho > 0.20$ and/or a χ^2 probability better than 10%. More vertically integrated communities statistically invest more often in schools and potable water, while those FA member communities more often invest in schools in a statistically significant way. Note that most public goods investments are funded by forestry revenues, despite FA membership, though grants may have eased ability to spend on public goods. For sub-community internal production modes, there are less fiestas/ceremonies and medical supplies. A variable was constructed to record the range of investments across the categories of public goods, with higher values indicating a broader range of investments. The calculations shows that the range of public goods investment is positively correlated with vertical integration and negatively correlated with subcommunity

Table 27: Local Public Goods - Statistical Correlations

	Correlation coefficient (ρ)	$\chi 2$ Prob.
Vertical integration	Schools: .42	.02
	Potable water: .23	.05
	Church: .31	–
	Range: .21	–
Internal org.	Church: -.23	–
(division=1)	Fiestas: -.37	.02
	Medical: –	.03
	Range: -.39	–
Forestry associations		
(membership=1)	Schools: .40	.01

Source: Survey data.

organization, though no significance by FA membership.

4.4.3 Profit-sharing

The dividends (*repartos*) paid out to community members may be one of few other source of income aside from government programs. Therefore, it is a critical factor in community life. All except three community-level organized communities report the practice of paying out dividends to individual members. All work groups paid out such dividends. The responses are somewhat ambiguous for the ten individually-parceled communities, as the term *reparto* is mostly associated with disbursal of collective funds, whereas the individual parcel type of production sometimes bypasses the collective process and individuals are paid directly. However, three definitively said they disbursed profits through the GA, CBC or otherwise, while one said they did not disburse profits, even though the decision is held at the GA level.

Dividends vary across communities and within communities between years, depending on the harvest year. In our sample, the dividends ranged from 1197-58,000 pesos. Those with forestry activities who report paying dividends do so each year. By vertical integration type, on average each member in a stumpage community receives 10,000 pesos; roundwood, 30,000 pesos; and lumber, 21,000 pesos. By internal organization type, the community-organized on average received 19,000 pesos in the last pay-out, the work-group-organized received 16,000 pesos and the individually-organized received 30,000 pesos.

4.4.4 Protection of forest resources

A series of self-reported measures of environmental impacts includes practices widely believed to degrade environmental quality indicators and environmental quality conditions, such as measures taken to reduce erosion, soil and water contamination, to protect habitat, changes in water quality and forest cover, and conservation practices. Here we summarize a small subset of the survey data. In many cases, we were able to supplement or corroborate responses by third-party informants or indicators from the forestry management plan to crosscheck our results. Ongoing work will further "sync" this information with survey results.

We first review a basic set of conservation practices which represent actions over which individuals and communities have a degree of control through the choices they make and which have direct impact on forest cover and quality of habitat. The practices are governed by the community or supported by both community and government conservation decisions. For example, clandestine timber harvesting refers to collection of wood products in certain areas and beyond a certain volume without a permit sanctioned by the government office. Yet, this activity has also been historically monitored by local community authorities and general residents themselves. Fire preparedness refers to ability to respond to fires. As most communities have experienced fire danger over the years, the ability depends on willingness to respond to fires anywhere in the community and efforts coordinated by local residents or federal authorities (Antinori and Rausser 2007).

Table 28 displays patterns in the propensity to follow a set of conservation practices by institutional or organizational characteristics. While the frequency of clandestine wood collection - either for fuelwood or timber - declines with vertical integration, the differences according to χ^2 tests are not significant at convectional levels. However, the degree or severity of the illegal collection activities, is significantly more in the less integrated communities. Furthermore, the incidence of illegal harvesting increases significantly with more atomized organization of timber production and lack of membership in a forestry association, though the severity of illegal collecting does not vary significantly with these groupings. Most respondents described the source of the contraband harvesting as external, such as encroachment from a neighboring community, rather than internal actors. For all the other categories of conservation practices in the table, no major differences existed except for clearing forests by internal production mode. The individualized production communities have significantly greater clearing of forests than the work group or community-level organizational models. For fire preparedness, most communities stated that their practices had worked fairly well to excellent. Additional data reveal that fire brigades and inspection tours are the most common forms of fire prevention, and some areas are monitored by SEMARNAT or inter-community fire towers. Also, communities hold *faenas*, or voluntary civic duty among community members, for fire prevention (dig trenches, clear buffer zones, etc) between 1.1 and 2 times a year on average.

Questions on changes in water quality, forest cover and abundance of wildlife produced a

Table 28: Conservation Practices

	Clandestine timber harvesting					**Illegal NTFP**	**Clearing**	**Fire Prep.**
	% yes	Origin (Count)			Degree (Mean)	% yes	(Mean)	(Mean)
VI level		Internal	External	Both	0=low 3=high		0=low 4=high	1=low 5=excellent
No-sale	67%	0	3	1	*2.00	33%	0.67	4.00
Stumpage	29%	1	2	2	*0.76	24%	0.71	3.67
Roundwood	25%	0	1	2	*0.42	27%	0.17	4.00
Lumber	17%	0	1	0	*0.17	17%	1.33	3.83
Internal organization								
Community	*19%	0	4	1	0.50	23%	*0.46	3.90
Work group	*40%	0	0	2	0.80	60%	*0.40	4.00
Individual	*60%	1	3	2	1.40	11%	*1.20	3.57
Forestry association								
Nonmembers	*50%	1	3	2	1.33	8%	0.67	3.88
Members	*24%	0	4	3	0.52	32%	0.62	3.84
Total	32%	1	7	5	0.76	25%	0.63	3.85

Source: Survey data
* = sig. diff. over group.

range of answers among the sample.[22] Neither vertical integration or production model had any affect on these ecosystem indicators (Table 29). However, those communities in forestry associations significantly more often reported improvement in both forest cover over the last 10 years and wildlife abundance (over the last 5 years), as displayed in Figure 8. Future research will explore the kinds of programs these communities participated in and the connection to the perceived changes in the ecosystem.

Table 29: Changes in Environmental Quality

	Forest cover 1 = much less 4 = much greater	**Water quality** 1 = very high 4 = very low	**Species abundance** 1 = much greater 4 = disappeared
Vertical integration			
No-sale	2.83	2.67	2.67
Stumpage	2.76	2.65	2.65
Roundwood	3.25	2.42	1.92
Lumber	3.00	2.67	2.17
Internal organization			
Community	2.96	2.62	2.35
Work group	3.00	2.20	2.20
Individual	2.90	2.70	2.50
Forestry association			
Nonmembers	2.67	2.58	2.83
Members	3.07	2.59	2.17
Total	2.95	2.59	2.37

Source: Survey data

As a method of preliminary exploratory analysis, we ran regressions of all the performance indicators discussed above on the internal organization descriptors and a set of other variables. These other variables are distance to a population center of over 500 persons, fuelwood dependence as a poverty indicator, percent of community members in the local population, and local population density. The variable for internal organization is measured two ways, first as a binary variable equal to one if the community organizes production by either work groups of individualized systems, zero otherwise; the second as a binary variable equal to one if internal organization is individualized. A principal components technique combines and scores the measures in Table 28 to create a single variable that takes positive and negative values for conservation practices, with positive values indicating "better" practices.[23] For many performance indicators, internal

[22]Forest cover used a four-point scale indicating less than half of forest cover 10 years ago, somewhat less, equal, more; water quality scoring indicated high, medium, low, very low; and species abundance was scored for greater, same, less, disappeared.

[23]Regression were also run on the individual variables of conservation practices.

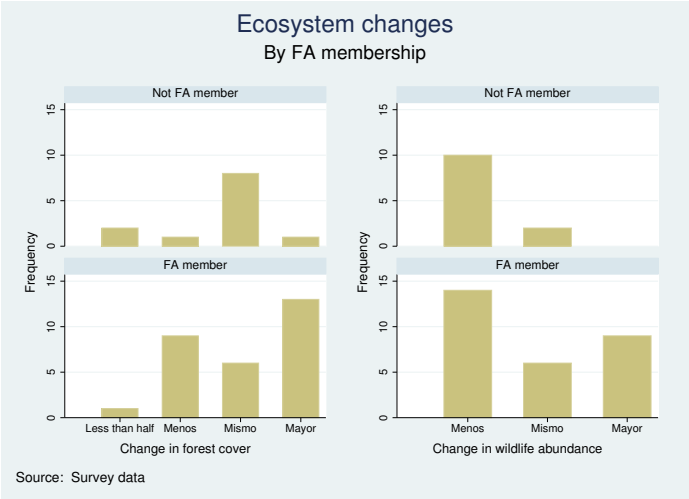

Figure 8: Ecosystem changes by association membership

organization had no effect. Table 30 shows regression results where the internal production type does have an effect at the 10% level or better. First, there is a narrower *range* of investments in public goods (Column 1) driven by the individualized communities (Column 2). This is only impact related to public goods which we found so far, including testing for each separate public good (e.g. schools, churches) (e.g. column 3). There was no internal organization impact on range of reinvestments in forestry (column 4), but subcommunity groups are less likely to diversify forest uses, a result also driven by the individualized groups (Column 6). No organizational impact on conservation practices was found (column 7). Further research will refine these models to clarify these statistical associations.

One of the working hypotheses suggests that decisions which have a broad impact on a set of stakeholders will be taken in forums where a broader set of stakeholders are directly involved in the decisionmaking. Furthermore, where this matching of decision impact with decisionmaking cost occurs, we would expect to see greater long-term investments in public, forestry and environmental goods. Assuming that allocation of forestry profits (revenues after all costs have been paid) is one such decision having a broad impact on community members, we test whether performance indicators are higher when the General Assembly is involved in the profit-distribution decision, as described in Table 16. From regressions of the performance measures, Table 31 shows where using the GA for profit decisionmaking has a significantly positive effect on performance measures. Namely, schools are more likely to receive investment, the range of forestry reinvestment is likely to be broader, and conservation practices may be of higher quality, though this last effect is only borderline significant.

Table 30: Impact of Subcommunity Organization

	(1) PG-Range OLS	(2) PG-range OLS	(3) Schools Probit	(4) Range-rein. OLS	(5) Diversify Probit	(6) Diversify Probit	(7) CP OLS
Sub-c div.	-0.14*		-0.45	-0.12	-1.15+		-0.37
	(-2.71)		(-0.55)	(-1.07)	(-1.95)		(-1.42)
Distance	-0.02	-0.01	-0.23	-0.08	-0.76+	-0.78+	0.05
	(-0.68)	(-0.63)	(-0.56)	(-1.55)	(-1.71)	(-1.76)	(0.41)
Fuelwood depend.	0.21+	0.22+	6.92*	1.37*	0.42	0.43	2.01*
	(1.85)	(1.90)	(2.52)	(5.37)	(0.37)	(0.36)	(3.63)
Member density	0.00	0.19	-10.84+	0.18	4.19	6.94	
	(0.01)	(0.44)	(-1.79)	(0.19)	(1.01)	(1.47)	
Individualized		-0.17*				-1.88*	
		(-2.98)				(-2.12)	
Pop. density							-0.31
							(-1.45)
Constant	0.10	0.08	-3.99+	-0.29	-0.26	-0.39	-1.37*
	(0.86)	(0.73)	(-1.95)	(-1.19)	(-0.24)	(-0.35)	(-2.63)
N	35	35	35	35	35	35	28
Adj. R-sq	0.23	0.26		0.56			0.60
Pseudo R-sq			0.66		0.20	0.26	

t-statistics in parentheses: + p<0.10, * p<0.05

Table 31: Impact of Using GA for π-Distribution

	(1) Schools Probit	(2) Range-rein. OLS	(3) Cons. prac. OLS
GA forum	1.29*	0.22+	0.44
	(2.74)	(1.92)	(1.68)
Distance		-0.06	0.12
		(-1.22)	(0.99)
Fuelwood		1.11*	1.99*
		(5.12)	(3.87)
Member density		-0.37+	-1.05*
		(-1.87)	(-2.61)
Constant	-0.10	-0.20	-1.76*
	(-0.41)	(-1.25)	(-4.71)
N	41	36	28
Adj. R-sq		0.61	0.65
Pseudo R-sq	0.16		

t-statistics in parentheses: + p<0.10, * p<0.05

5 Conclusions

5.1 Purpose of study

The purpose of this study is to summarize data from the National Forestry Survey Project in Mexico and provide a snapshot of the the conditions characterizing Mexican forest communities using a randomly stratified sample of forest communities in Durango and Michoacan. Data sources are responses from a unique community-level survey instrument designed for the project and secondary government data. Forty-one communities were interviewed for the study, as well as the corresponding forestry professionals and government agents serving these communities.

The general theme of our research is to analyze how economic governance affects socio-economic and environmental indicators. Transaction cost economics and the collective action literature relating to common property natural resources provide the framework for more specific analysis. The description presents strictly data associations in the form of correlations, differences in means, χ^2 tests and exploratory econometric analysis as a preliminary assessment of trends and patterns across communities.

5.2 Summary of findings

5.2.1 General

- Significant regional variations exist in population size and trends, household wealth, internal organization and forestry networks. Population growth is lower, with a particularly marked decrease in Durango from 1990 to 2000, where populations of each community tend to be smaller in general than in Michoacan.
- For basic community characteristics, as vertical integration increases, population sizes within each community tend to decrease, with greater percentage of members as part of the population.
- Among the communities harvesting timber, more integrated communities tend to be further from town or market centers and conventional standard of living indicators from the Census 2000 data decrease.
- Communities show a strong presence of indigenous culture, where about 50% have residents who speak the local indigenous language. These communities tend to be larger on average than those without indigenous speakers.

5.2.2 Production

- *Volume* Authorized volumes are declining over the time period 1990-2010 and many communities are harvesting 100% of their authorized volume. The roundwood communities most often complete their annual harvests with 100% of their authorized volume. *Uncertainty in finding:* whether the downward trend is real or reflects administrative gaps in reporting for more recent years.

- *Prices* More vertically integrated communities and communities organizing production by work groups or individuals with larger forests earn a price premium as compared to other communities selling the same product. However, the large variation in prices and small numbers within each group leave differences statistically insignificant.

- *Employment* Despite having no commercial activity, the no-sale group employs a relatively large number of persons throughout the year, most likely on an irregular basis, for reforestation and conservation efforts. Most communities hire a large percentage of their workforce locally. The stumpage group has the largest gap in local and nonlocal employment. Employment increases with vertical integration and size of the forest.

5.2.3 Institutional analysis

The institutional analysis draws on the common property, transaction cost and contract theory literature and was designed around three broad focal questions concerning Mexican community forestry. Through the descriptive statistics, we explore how benefits are associated with institutions. The main findings under each question are below.

1. **Under what conditions have communities chosen to participate in the market for forest resources and at what level in the production chain?**

    - Variables explaining vertical integration in the south (from a study on Oaxaca) do not explain vertical integration in Durango and Michoacan. These variables include forest size and social measures on a similarly sized sample using similar regression techniques. Forest size is not enough to explain vertical integration and particular types of institutional evolution, particular to each region, may have implications for transaction costs for communities in each region.
    - Communities in Durango and Michoacan fluctuate over time in end product sold, rather than exhibiting linear progression of investments forward. There has been several circumstances of de-integration instead of forward integrating across communities in the same time period (1997 and 2007).

- Communities often sell timber at various stages of processing, e.g. roundwood communities also sell stumpage, and lumber communities sell stumpage and roundwood.
- Livelihood strategies are apparent in the use of wage advances and choice of vertical integration. The choice of vertical integration level can change within a community from year to year while equipment remains idle if a less processed good is sold.

2. **How have they organized their production and contracting activities within the community governance structures?**

   - Decisionmaking responsibilities follow not a pattern of vertical integration but patterns of internal governance, showing variation of governance possible within each vertical integration level. So vertical integration is not a static or fixed type of institution but can be managed in many ways.
   - Sub-community level production, where it occurs, tends to take the form of work groups in Durango and individualized production in Michoacan.
   - Individualized production organization is more likely to have started prior to the 1992 Agrarian Reform as part of a historical pattern of forest usage which is not always related to timber production.
   - Both vertical integration levels and forest size are negatively correlated with the sub-community level models of production organization.
   - The other production organization models, i.e. work groups and individuals, are most likely an institutional choice arising from management needs. Both statistical tests and informant interviews link the internal division to some form of unsatisfactory management of forestry activities.
   - The forums chosen for making key decisions in forestry management, from a preliminary point of view, support Zusman's hypothesis that decisions with greater marginal impact on individual will be made by a larger set of persons or more demanding (i.e. costlier) choice rule. For example, the profit allocation decision patterns still have a General Assembly role despite internal organizational model or vertical integration level.
   - NGOs as external players are scarce in this sample.
   - Durango has a strong presence of forestry associations as political and economic forces relative to Michoacan and Oaxaca. While communities with long histories of forestry are both in bottoms-up and top-down inter-community organizations, communities with shorter forestry histories are being incorporated into mainly top-down organizations.

3. **How do governance characteristics, including both internal and external influences in the decisionmaking processes, affect the distribution of**

public and private benefits from forest activities, including environmental conservation practices, public goods investments, and direct economic benefits?

- Outcomes by internal organization are mixed. While there is some negative impact associated with the work group and individual production modes, the impacts were not uniformly negative across all our performance measures for the non-community-level operations.
- Forestry reinvestment increases with vertical integration and forestry association membership, while it decreases with individualized modes of production. Types of investment differ across categories as well. Road maintenance is frequent across the board, but investment is less varied with lower integration, division or lack of FA membership. If the community subdivides its production activities, it is less likely to diversify forestry activities away from timber production.
- The impact on local public goods depends on the type of public goods. Investment in schools and potable water increases with vertical integration. Investment in schools increases with FA membership. Sub-community organization of production leads to a narrower range of public goods investments (more concentrated in schools, for example). Further analysis will check for pre-existing preferences associated with both division and outcomes.
- For the year in which the survey took place, the roundwood communities had the highest per person dividends (*repartos*) paid to community members. Community-organized production had higher *repartos* than the work group communities, but the individualized production communities had the most per person, evidently at the expense of other investments.
- Environmental outcomes showed little variation over vertical integration levels. The work group and individualized production model communities had more clandestine harvesting of timber while the individualized communities also tended to clear land intended for forestland. Membership in forestry associations relates to seeing an increase in forest cover over the ten years prior to the survey. Otherwise, outcomes show no consistent variation and future research will refine these results.

To summarize this institutional component, we found mixed patterns consistent with the view that institutions are endogenous, that is, they depend on other factors and further details are necessary to understand how benefits are generated. The institutions themselves may represent an optimal choice given constraints communities face. Increasing vertical integration, for example, does not guarantee certain forestry management outcomes but reflects an economically and/or socially feasible choice given the characteristics of each community and its trading environment. Furthermore, internal organization modes may not inherently map to specific outcomes but reflect a cost-minimizing, or optimizing with

constraints, decision - where costs and constraints are interpreted here in a broad sense to include social, political and economic considerations. This view allows for the possibility that "good" forestry is achievable across a variety of institutional settings within the agrarian community forestry sector. How that is achieved may depend on both internal factors explored here as well as external factors such as the contractual environment and political context. An institutional approach would look at the distribution of assigned authority, controls on parties contracting to forest products exchanges, ability of stakeholders to make corrective measures for their leadership and other governance characteristics that affect the allocation of benefits flowing from the forest resource. With this view, we aim to shed light on the questions of how community forestry remains viable and persistent as an economic sector.

5.2.4 Questions for future research

- If the different governance structures of communal and sub-communal levels of production organization can exist, what institutional (formal or informal) characteristics do they share that allows them viability? Are there other forms of institutional change which are possible in the current system? How can further options be created?
- What role do forestry associations play in supporting the economic, social and environmental objectives for forestry management?
- What are sources of constraints on investments in this sector? Is it government policy, internal governance structure, bargaining power vis a vis the private sector or a combination of all?
- How can programs be designed to accommodate the different community characteristics, including population and well-being factors as well as internal organization.
- With authorized volumes declining over time for many communities, and many communities harvesting most of their authorized levels of harvest, where will gains in productivity come from?
- What explains the increase versus decrease in well-being indicators with vertical integration in different regions of Mexico and how does this pattern relate to livelihood strategies? While the data show that forestry plays an important role in the livelihood strategies of these communities, further details are needed on the tradeoffs at the individual level and the community level in balancing management decisions.

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A Comparison of Typologies

Table 32: World Bank Typology

Type 1	Communities/ejidos with no forest management or extraction activities or plans
Type 2	Communities/ejidos that sell standing timber (rentistas).
Type 3	Communities/ejidos with forest enterprises who sell harvested wood but have no other processing capacity.
Type 4	Communities/ejidos that process as well as harvest their own wood.

Source: IBRD (1997).

Table 33: PROCYMAF II Typology

Type 1	Potential producers: Owners or holders of forest land, which currently have no actions for planning, use, conservation and management of forest ecosystems, and that lack of forest management or sufficient means to defray the implementation.
Type 2	Producers who sell stumpage: The owners or holders of land subject to timber harvesting, in which it is done by a thrid party under contract of buy-sale without the owner being involved in any stage of use.
Type 3	Forest raw material producers: The owners or holders of forest lands that have allowed for use and that are directly involved in some stage of production chian, either in the cut and cut leaning on the road, in timber or in the colleciotn or cut and dried of nontimber products, as well as the transportation and sale of raw forest products to the collection centers and/or primary processing.
Type 4	Producers with primary processing capacity and marketing: Producers of raw forest materials that have infrastructure for primary processing to obtain sawn timber, packaged product or industrialized and directly market their products.
Type 5	Producers with secondary processing capacity and marketing: Producers of raw forest materials that have infrastructure for secondary processing for getting industrialized finished products, that direclty commericalize their products or through productive partnerships such as integration and production companies.

Source: Tovar (2009).

Table 34: Ownership and Control Typology

Type 1	Communities with commercially harvestable forestland but which do not participate in timber market
Type 2	Communities which contract with outside operators to extract timber material. Labor is paid by the outside contractor. Machinery is usually brought in by outside contractor.
Type 3	Communities which contract services to extract timber and sell material as roundwood. Labor is usually hired from within the community but workers from outside the community may be contracted. Chainsaws may be owned by the individual workers or the community.
Type 4	Communities which contract services to extract and sell sawnwood. Usually the sawmill is owned by the community but the sawmill may also be owned in common with other communities or rented.
Type 5	Communities which contract services to sell sawnwood and transformed secondary or finished wood products, like tool handles, furniture, doors, and moldings. Usually, milling and processing machinery is owned by the community but may be owned in common with other communities or rented.

Source: Antinori (2000).

Table 35: Internal Organization and Management Typology

Description	% as of 1993
Comunidades y ejidos que han consolidado una organizació interna fuerte y han logrado mantener o incrementar el ritmo de crecimiento del recursos forestales	4.0 %
Comunidades y ejidos que no han logrado consolidar su organizació interna y no han podido mantener la calidad de su recurso forestal	27.5 %
Comunidades y ejidos con problemas internos fuertes y significativa degradación de sus recursos forestales	68.5 %

Source: Madrid (1993).

Table 36: Organizational Capacity Typology

Successful and well-organized communities	Organized for the extraction of wood and transformation of intermediate industrial products and which make formal use of the forest.
Limited success and organization	sell roundwood, sawnwood and refined wood, with collection points in the communities or nearby urban centers. They have a medium or large sawmill, machinery for tool handles and a crate-making capacity.
Technical problems and medium level of organization	Have small and less efficient sawmill and sell *tablas* (rough hewn logs) on the community site.
Intermediaries for raw material and less organized	Sell roundwood; may also collect and sell fuelwood and nontimber forest products; constructs and maintains roads.
Rentistas and without organization	Do not have resources or experience as other communities; contract clauses set by buyers; sell stumpage at less than market value; little technical knowledge or market knowledge and no funds to invest in equipment.
Out of formal market	Extract only for informal markets - domestic use and regional markets; no relation with formal industrial forestry.

Source: Nahmad (2004).