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JUAN M. TORRES, DAVID B. BRAY Y OCTAVIO S. MAGAÑA

The Role of Scale in Mexican Community Forest Management

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Abstract

Several studies around the globe show that Community Forest Management throughout an improved institutional design inside communities can help to reduce deforestation rate, improve forest management practices and produce a greater flow of goods and services for both communities and society. This study is an attempt to analyze the effect of scale in community forest management, defined as the quantity and quality of forest resources, in variables such as vertical integration of the forest enterprise, performance of the firm, intensity of forest extraction, sustainability of the firm and welfare of the entire forest community. The analysis is done from an inventory of characteristics of forest communities in the 10 most important forestry states in the country. Results show that Forest Community Enterprises indeed depend on the quantity and quality of resources to survive, to vertically integrate and to produce an inflow of benefits inside the community enough to improve welfare. Analysis also shows that Community Forest Management applied at low scale might provide incentives for a greater forest liquidation of surplus forest which might turn on higher land use change.

Keywords: firm development, poverty alleviation, forest community enterprise, harvest rates.

Resumen

Varios estudios alrededor del mundo muestran que el manejo forestal comunitario basado en un mejorado diseño institucional de las comunidades agrarias puede ayudar a reducir la deforestación, mejorar las prácticas de manejo y producir un mayor flujo de bienes y servicios tanto para las comunidades como para la sociedad. Este estudio es un intento por analizar el efecto de la escala, definida como la cantidad y calidad de recursos forestales, en el manejo forestal comunitario. Se revisa el efecto en variables como integración vertical, desempeño de la empresa, intensidad de la extracción, sostenibilidad de la empresa y bienestar de la comunidad en su conjunto. El análisis se deriva de un inventario de características de comunidades forestales en los 10 estados de producción forestal más importantes del país. Los resultados muestran que las empresas forestales comunitarias dependen, para su sobrevivencia, integración vertical y producir un flujo de beneficios para la comunidad, de la cantidad y calidad de los recursos con que cuentan. El análisis también muestra que el manejo forestal comunitario aplicado a una escala baja podría incentivar una mayor *liquidación de los excedentes de recursos forestales, lo que podría ocasionar un mayor cambio de uso del suelo.*

Palabras clave: desarrollo de la empresa, alivio a la pobreza, empresa forestal comunitaria, tasas de cosecha.

Introduction

Community Forest Management (CFM) may be defined as forest management where the decision making process is partial or totally controlled by a local community that has full property rights to the stock of the forest to be managed. Community control of forests under a variety of institutional arrangements, some of which constitute "emergent" forms of common property management (Arnold, 1998), has been argued to be an effective way to conserve forest resources. However, the wide variety of institutional arrangements and biophysical characteristics of communities and their forests have made it difficult to generalize, and outcomes that suggest that community management is not always sustainable or effective in mitigating poverty are common (Wunder, 2001; Alix-García *et al.*, 2005). Hence the CFM strategy must be more deeply studied in order to identify the ecological, social and economic impacts resulting and the factors that condition the variety of outcomes.

As has been pointed out, CFM differs from traditional forest management not only in the decision making process but also in the diversity of social, economic and biological objectives employed in forest management (Purnomo *et al*., 2004; Antinori and Bray, 2005). Despite these differences, CFM must demonstrate that can achieve minimum standards of sustainability and health of forest resources, as well as some level of profitability or welfare for the community if it will survive as an option. Hence CFM must incorporate not only the appropriate forest management techniques but also the appropriate organization, leadership and incentives mechanisms (*e.g*. profit distribution or investments in the community) to reach management goals (Keller *et al*., 2000).

CFM requires both appropriate silvicultural practices and the reconciliation of diverse and sometimes conflicting interests within the community such as, the alignment of community governance structures with an efficient decision making process of forest operation, the definition of an appropriate incentive mechanism for community participation not only in forest related tasks but also in conservation of forest lands and promotion of linked activities according to the property rights distribution, as well as the blending of diverse levels of formal and informal institutions (Nygren, 2005; Klooster, 2000). This institutional complexity makes CFM a problem considerably more difficult than the forest management performed by state agencies or the private sector (Antinori and Bray, 2005) where efficiency of forest operations is largely dependent on the technology and the scale of production.

This paper deals with one of the latter traditional constraints of forest management, namely the scale of production. This variable is crucial for the subject of economies of scale and scope in traditional forest management.

However, it is not clear its effect on ensuring the two main objectives of CFM, namely, poverty mitigation and forest land conservation. The study of the optimal scale of forest operations under different technologies has been a traditional research topic. Simultaneous optimization of forest growth potential, road construction or maintenance, and harvesting and transportation have become more possible for foresters in the field with the use of new technologies. Nevertheless, most of these analyses usually assume no administrative constraints and do not take into account other objectives in decisions on road infrastructure, selection of harvesting technology, and institutional constraints on decision-making that might delay, modify, or stop economically optimal harvesting decisions, all factors that are common in CFM. Inclusion of these additional constraints and variables has three problems: i) many variables might be difficult to quantify, ii) many constraints might be temporal and dependent on numerous social and economic factors, and iii) such problems can be very difficult to resolve. In this paper we will characterize CFM activities in Mexico, analyze some of the typical constraints on production, and through some indicators identify the effect of scale on the community's welfare and performance of the community forest enterprise.

Results show that scale is associated with the level of vertical integration that the forest community reaches. It is also associated with the intensity of the use of forest resources and on the environmental friendliness of the management strategy adopted. However, it does not appear to be associated with community's welfare. The paper has been divided as follows: the following section characterizes CFM in Mexico by using data from a national survey of community-managed forests in Mexico (Antinori *et al.* ms). The paper emphasizes basic elements of CFM and discusses to what extent some physical and technical variables might be relevant to ensure sustainability and development of the Community Forest Enterprise (CFE) and to what extent the presence of these firms and their scale might be related to community's welfare.

Characterizing Forest Communities

CFM occurs in many regions where forest lands have been traditionally used by indigenous people, especially in the developing world (Klooster and Ambinakudige, 2005). CFM has a long tradition in countries such as Austria, Italy and France where common property forests have been managed through contracts for centuries (Casari and Plott, 2001; Casari, 2002; Herbst, 2004). However, the developing world offers cases of CFM where the management is conducted by poor communities, in the majority of cases, in the absence of explicit contracts but with internal rules and traditional governance structures. Examples in the Peten of Guatemala (Gretzinger 1998), Peru, Brazil, (Loayza-Villegas and Chota-Valera 1996; d'Oliveira *et al.,* 1998), Bolivia (Cronkleton, 2002), Honduras (Nygren, 2005), many African (Campbell and Shackleton, 2001) and Asian (Aumeeruddy and Sansonnens. 1994; Malla *et al*., 2003; Xu *et al*., 2004; Rahman *et al*., 2005; Adhicari *et al*., 2006; Sunderlin, 2006) countries as well as Mexico (Bray *et al*., 2003) show that this type of management may be both sustainable and useful to alleviate poverty.

Forest areas in Mexico cover close to 65 million hectares. About half of this area is covered by tropical forests (49%) and the rest is dominated by temperate forest, mainly pine and pine-oak forests (Velázquez *et al.,* 2002). Forest communities are established in approximately 57% of this forest land (INE, 2005) which own collective land grants (in two categories known respectively as *ejidos* and *indigenous communities*) given as part of the revolutionary reforms at the beginning of the last century. These communities are organized as agrarian villages with full property rights on the agricultural land but under the requirement to keep their forest land under community control under 1992 reforms to the Mexican constitution that exempt forests (temperate and tropical) from privatization. However, CFM only occurs in approximately 24% of the common property forest land.

A review on the statistics of the harvest concessions granted to forest communities revealed that there were 2,214 communities with authorized legal timber harvest activities between 2002 and 2004. The average size of these communities is around 8,734 ha with an average forest cover of 52% of the total land. In these communities the size distribution is very biased ranging from a few hectares (20 hectares of forest land) to more than 360,000 ha, although almost 68% of the communities have a total area smaller than 5,000 ha. Some average attributes of these CFE are shown in 0.

TABLE 1. SOME AVERAGE ATTRIBUTES OF COMMUNITY FOREST ENTERPRISES

FOREST TYPE	NUMBER OF CFE	AVERAGE TOTAL SIZE (HA)	AVERAGE FOREST LAND (HA)	AVERAGE ANNUAL HARVEST VOLUME (M3)
TEMPERATE FOREST	1,824	7,852.43	4,338.59	5,155.84
TROPICAL FOREST	390	12,929.77	5,333.48	1,694.43
WEIGHTED AVERAGE	2,214	8,746.81	4,513.84	4,546.10

Source: Own estimate based on data from SEMARNAT (www.semarnat.gob.mx).

Size distribution of CFE

The National Survey of Community Forest Enterprises (NSCFE) was an inter-institutional initiative to survey the community-managed forests of Mexico (Antinori *et al*., ms). It focused primarily on ten states which account for 68% of the forest area in the country, near 88% of the timber production and close to 78% of the Forest Community Enterprises (CFE's). 0 shows some average attributes of these CFE's.

The area distribution of the sampled CFE's shows a biased distribution very close to an exponential one (0). Comparing this sample distribution with the distribution of all CFE's, it results slightly biased towards large CFE and those located in temperate areas with large harvest volumes. However, confidence intervals for variables such as total size, forest area, number of community members and harvest volume include the estimates for the whole population (0). Tropical CFE's tend to be larger than temperate ones; size with maximum frequency in tropical CFE's ranges from 1,000 to 3,000 ha, while in temperate ones it is less than 1,000 ha.

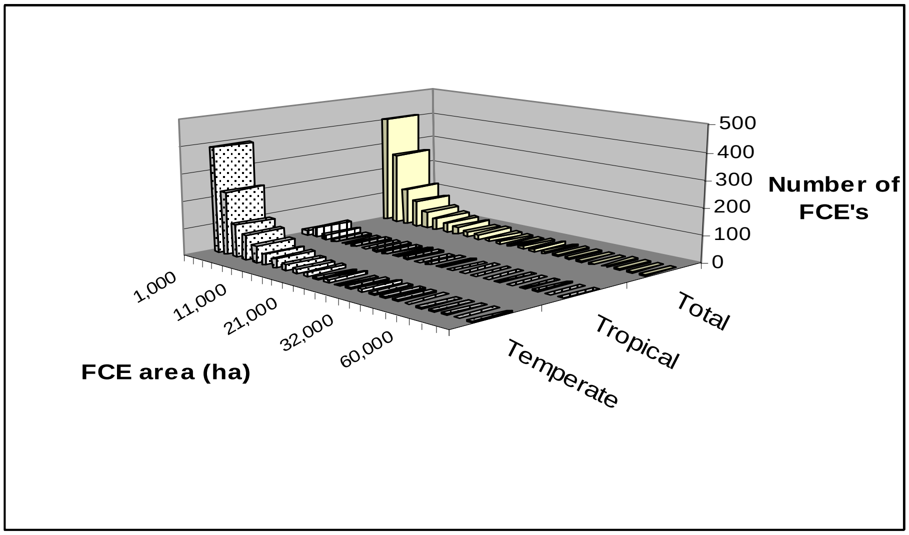
TABLE 2. SELECTED AVERAGE ATTRIBUTES OF COMMUNITY FOREST ENTERPRISES (NSCFE)

FOREST TYPE	NUMBER OF COMMUNITIES	AVERAGE TOTAL SIZE (HA)	AVERAGE FOREST LAND (HA)	AVERAGE NUMBER OF EJIDO MEMBERS	AVERAGE HARVEST VOLUME (M3)
TEMPERATE FOREST	1,115	9,387.16	5,615.53	182.32	6,448.53
TROPICAL FOREST	124	26,897.77	11,225.42	233.78	3,121.08
WEIGHTED AVERAGE	1,239	11,139.64	6,176.97	187.47	6,115.51

Near 90% of the sample is composed by CFE's located in temperate areas (sampling fraction for temperate areas is 62%) whose harvest volume is almost 25% larger than the average harvest volume for temperate CFEs at the national level. Sampling fraction for tropical CFE's is 38%, and biased toward CFEs with harvest volumes 68% higher than the national average (0) in tropical areas. Sampling over timber producing states is the main reason for obtaining such a bias in the sample. Nevertheless, the sample is that large (sampling fraction is 56%), that provides a good estimate for the CFE sector in Mexico.

The sample shows that tropical CFEs have harvest volumes lower than temperate one. This is primarily due to the fact that tropical CFEs concentrate on harvesting mahogany (*Swietenia macrophylla*), red cedar (*Cedrella odorata,* a variety of lesser-known tropical species whose yield is about 1.3 cubic meters per hectare per year (Torres *et al*., 2006) contrasting to the higher yield in temperate forests.

FIGURE 1. AREA DISTRIBUTION OF CFE IN MEXICO

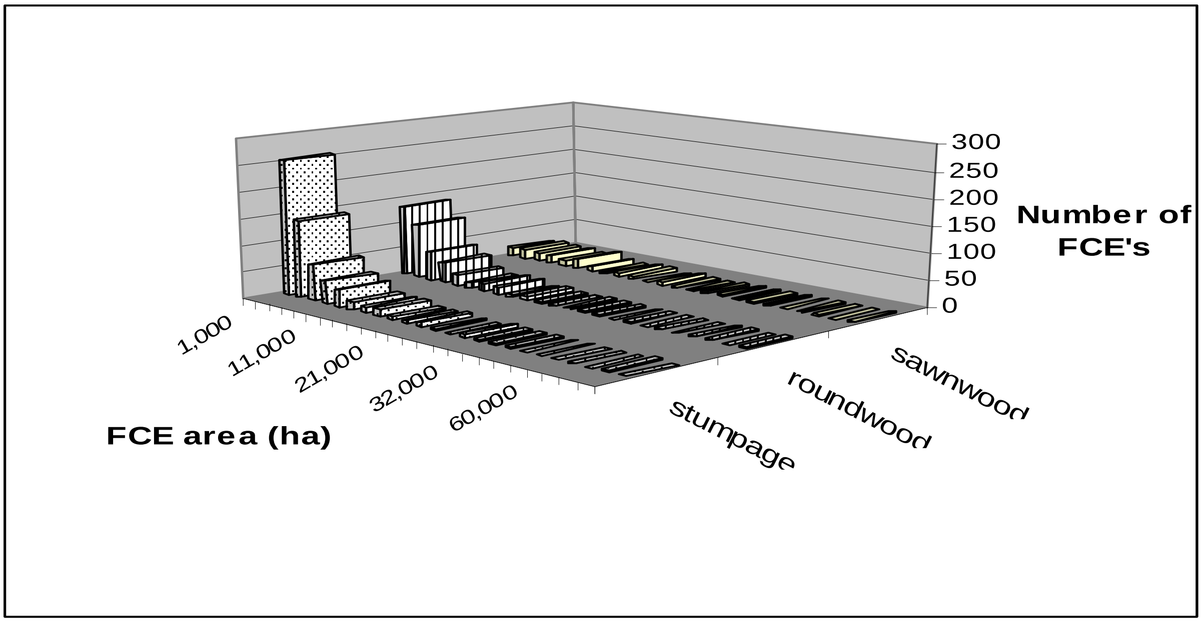


Size and level of vertical integration

Communities engaged in commercial logging have many different ways to organize themselves for production. The timber harvest requires the organization of the community for market production at various levels to develop a wide variety of tasks in different seasons, from protection and conservation activities to the marketing of forest products. One useful means of categorizing community organization is by industrial vertical integration. Vertical integration in timber production can be classified by the value-added and processing activities of the forest production system, from selling timber on the stump through contracts with little direct community involvement, to communities with advanced processing such as moldings and furniture with export markets, and diversification into other forest products such as water bottling and ecotourism (Antinori, 2000: Antinori and Bray, 2005). Most of the CFE's in Mexico are not vertically integrated; survey data shows that some 52% of them sell standing trees with limited participation in logging activities (termed "stumpage CFE's); 35% sell logs that they fell and transport themselves ("roundwood CFE's) and 13% have sawmills and thus sell sawnwood ("sawnwood CFE's). Community participation in stumpage CFE's may be limited to forest maintenance activities and temporary labor force paid by the contractors. In the case of roundwood CFE's community participation can go from felling, logging and yarding activities up to log transportation to sawmills. Finally, sawnwood CFE's include additional participation of community members in the industrialization at different levels.

Vertical integration depends on many different factors such as the level of human capital skills in forest operations, education, organizational and social capital as well as the size and commercial quality of the forest (Antinori, 2000). Sample data suggest that the size of the forest land (quantity) and allowable harvest volume (stock quality) are not relevant for the forest community to progress to becoming a roundwood CFE from a stumpage CFE. The two tail statistical test for difference in means of both stumpage and roundwood CFEs was not significant at $\alpha \leq 0.05$. On the contrary, both variables (size of the forest land and allowable harvest volume) are statistically higher $(\alpha \leq 0.05)$ for sawnwood CFE's compared to roundwood CFE's. Forest land is in average 94% larger and allowable harvest volume per hectare 3.2 times larger in sawnwood CFE's than in roundwood CFE's. Observe that the size distribution for sawnwood CFEs (Figure 2) looks like a biased distribution rather than an exponential one.

FIGURE 2. AREA DISTRIBUTION OF CFE'S BY LEVEL OF VERTICAL INTEGRATION



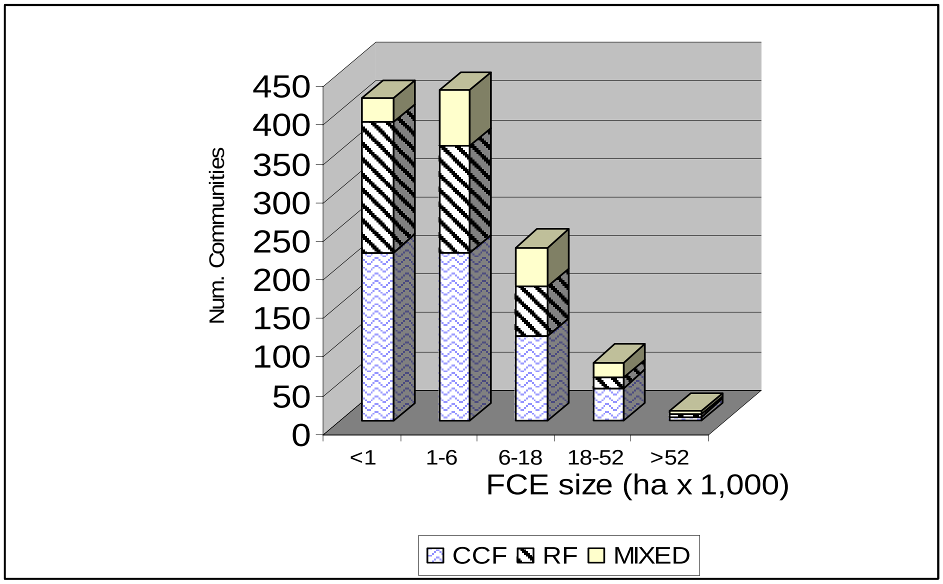
Horizontal integration has been less documented than vertical integration. It happens when communities selling similar products converge in one enterprise generally to reach economies of scale or additional market power. Horizontal integration in CFE's varies in contracts and levels of integration. Some communities just agree on the location of the sawmill that they will use year to year in order to reduce costs (Chapela, 2000). Others agree on the acquisition of equipment, infrastructure or services that are commonly used to reduce high fixed costs (Mota, 2002; Nascimento and Mota 2004). However, in spite of the fact they are integrated through some agreement, they rarely act as a unique firm. In some regions, these communities agree on pricing products or services acting more like a cartel rather than a horizontally integrated enterprise (Mota, 1985).

There are not that many cases of horizontally integrated communities. Antinori (2000) has suggested that local decision-makers' preferences for autonomy and avoidance of bargaining costs, even with other agrarian communities, may be a reason. Nascimento and Mota (2004) have also suggested that the lack of inexpensive accountability mechanisms as well as the loss of rights to receive additional help from development and resource conservation programs are incentives to not integrate. However, horizontal integration is expected to happen as large community sawmills with long idle time and many workers become too costly for the CFE. Some examples of this phenomenon have been already documented where CFE's buy additional log volumes from their neighbor communities (Mota, 2002; Torres *et al.*, 2005).

Size and harvest

Size of the forest ownership as well as the forest tracts are important elements to ensure technical and economic efficiency in forest operations. Sutton (1968, 1969) determined that per acre overhead costs in New Zealand for relatively small forests (2,500 acres≅ 1,000 ha) were about 5 times those of large forest (more than 150,000 acres). Moreover, he estimated that forest tracts less than 50 acres were very expensive to manage. Cubbage (1982) studied the efficiency of different tract sizes under different logging systems including manual harvesting. He found that tracts less than 40 acres were very expensive to harvest, and that forest areas of at least 1,200 ha were optimal. Evidently productivity of forest tracts plays an important role in defining the minimum economically optimal size of a forest to manage. In the classic and comprehensive study by Andersson (1965), testing a wide range of harvesting methods in Austria, he found that annual extractions less than 1,800 m^3 (around 1,000 ha for Mexico) reduces profitability under any system mechanized or not. In addition, annual extractions between 2,000-10,000 m^3 have differences in average costs less than 5% (between 1,000 and 6,000 ha for the average productivity in Mexico). He found no significant direct cost advantages of increasing forest size, although apparently some diseconomies might arise with annual extractions more than 100,000 m^3 (more than 54,000 ha for the average productivity in Mexico). Based on these intervals the sample from the NSCFE was divided into different strata as shown in 0. Observe that under these criteria nearly 36% of the CFE's might not be harvesting in an economically efficient way (less than 1,000 ha).

FIGURE 3. DISTRIBUTION OF FOREST MANAGEMENT SYSTEMS AMONG CFE'S



Source: Own estimate with data from the NSCFE.

Continuous cover forestry (CCF) management was the official forest management strategy until the middle of the 70's for both tropical and temperate forests. In the late 70's rotation forestry (RF) was introduced in the northern part of the country for temperate forests and rapidly expanded to southern and central Mexico. Despite the fact that the system was designed for medium to large properties, it was also used in small to medium forests, which caused rapid liquidation of the surplus forest stock which, in some cases, lead to permanent land use change. In recent years CFE's under RF systems have started to combine the treatments with CCF systems particularly in medium size forest lands (6,000 to 18,000 ha), which appears to be more efficient (Chapela, 2005). Tropical forest management in CFE's is done under selective cuttings relatively well organized for the regulation of the timber harvest. However, most of the harvesting is done in high value species and the inherent deficiencies of the method applied in tropical regions (Fredericksen, 1998) jeopardizes the sustainability of the harvest in some CFE's, especially when regeneration is not ensured or spatial distribution of timber harvests is not ecologically suitable (Torres *et al.*, 2006).

Techniques to optimize harvest schedules as well as to monitor forest dynamics are present in a few CFE's; some of them with a long history of technical development particularly in northern Mexico. However, these tools are not available for most CFE's, which in addition present severe gaps in training on logging and harvest scheduling. The sample shows that only 43% of the forest management plans reported estimates of allowable cut based on timber yields and a defined forest regulation goal. Moreover, only 2% reported a long term forest management plan (more than 30 years).

The survey shows that nearly 52% of the communities follow a CCF management, 34% use a RF type of management and the rest use a combination of both. This distribution is very homogeneous along different sizes of CFE's as shown in 0. This observation is aligned with the well known argument that CCF systems offers more environmental services and non timber forest products than traditional even-aged management (RF), whose demand is also high in this type of communities. Interestingly CFE's with high level of vertical integration tend to adopt RF systems, particularly if their forest tracts are not large. This might be related to the fact that RF systems offer a fast liquidation of the surplus forest stock which guarantees high harvest volumes to feed the community's industry. However, as we know, such large harvest volumes are difficult to sustain in the long run. Similarly, a larger proportion of CFE's under 1,000 ha have RF systems, although it is not statistically significant.

Harvest rates are very variable and not totally related to forest productivity. Timber yield in most commercial forests owned by CFE's is low. Some authors have argued that this is the result of years of selective management and lack of knowledge for improving forest practices (Merino, 1997; Alix *et al.*, 2005). This is true in some regions, however, the low timber productivity of most Mexican forests must also be recognized. Average yield in tropical forests ranges from 1.3-1.6 $m^3ha^{-1}year^{-1}$ (Torres *et al.,* 2006) taking into account only mahogany or red cedar, while in temperate forests it ranges from 1.6-1.9 $m^3ha^{-1}year^{-1}$ accounting just for pines and firs (DGPF, 1994). However observed harvest rates can be as high as 12.8 $m^3ha^{-1}year^{-1}$ for some areas as shown in 0. Evidently those rates account for several species, however it is clear from 0 that the smaller the ownership the larger the allowable cut rate, regardless the level of vertical integration in the CFE. In addition, the proportion of the forest area that is logged is higher in small CFE's than large ones, which enlarges the effects of large allowable cuts. Both trends suggest that small CFEs (less than 1,000 ha) might be liquidating their surplus forest stock jeopardizing its future sustainability, since a large percentage (47%) of these CFEs (<1,000 ha) have RF systems and harvest a large proportion of their forest. On the contrary, communities with forest tracts larger than 1,000 ha seem to have harvest rates close to the national average. Sawnwood CFE's have on average larger harvest rates than the others, which can be associated to both the likely higher productivity of their forests (supply side) or to greater pressure to feed the community's industry (demand side).

TABLE 3. AVERAGE ALLOWABLE CUT PER HECTARE (M3HA-1YEAR-1) AND FOREST AREA UNDER MANAGEMENT IN CFE'S BY SIZE OF THE OWNERSHIP AND BY LEVEL OF VERTICAL INTEGRATION

CFE FOREST AREA (HA)	RATIO LOGGED FOREST AREA / TOTAL FOREST AREA	LEVEL OF INTEGRATION		
		STUMPAGE	ROUNDWOOD	SAWNWOOD
<1,000	68.92%	6.19	5.74	12.83
1,000-6,000	47.23%	1.85	1.57	2.75
6,000-18,000	33.81%	0.91	0.70	1.47
18,000-52,000	23.60%	0.27	0.43	0.96
>52,000	22.88%	0.25	0.02	0.79

Source: Own estimate with data from the NSCFE.

Size and CFEs development

Firm size distributions have been studied in different ways since the pioneering work by Zipf (Zipf, 1949), who established that the assets of US corporations approached a power law function: $S_r \approx 1/r$ where S_r is the size of the firm ranked in the position r in a list ordered by asset size, beginning with the largest. Power laws appear widely in physics, biology, earth and planetary sciences, economics, and other social sciences (Reed, 2001; Chave and Levin, 2003). The analysis of power laws in the study of firms has covered not only the size distribution (Axtell, 2001), but also the dynamics of sizes (Voit, 2000) and recent studies have even introduced the dynamics of the industry (set of firms) at different geographic levels (Gatti *et al*., 2004). Despite firm size distribution dependence on many different economic, social and physical factors, these works have proved that power law distributions are consistent and universal. They seem to hold for multiple years, for various definitions of size (e.g. number of employees, revenue, assets), for developed and developing countries (Ramsden and Kiss-Haypál, 2000; Hernández *et al*., 2006) and for different groupings of firms (Gaffeo *et al*., 2003), namely industry, sector, and country scale among others.

Some authors (Ramsden and Kiss-Haypál, 2000; Gaffeo *et al*., 2003; Hernández-Pérez *et al*., 2006) have analyzed the firm size distribution using net revenue as proxy for size and testing non Zipf's alike models. They have found that the power law is consistent although other models provide more information about the dynamics of the firm size distribution. Based on this framework we tested the so called Simple Canonical Law (SCL) model as suggested by Ramsden and Kiss-Haypál (2000) with the NSCFE data to analyze the dynamics of the different types (levels of vertical integration) of CFEs. The data on size of the forest area (assets) and harvest volume (a proxy for revenues) were fitted to the following model (Ramsden and Kiss-Haypál, 2000):

$$S_r = P(r+\rho)^{-1/\phi}$$

where S_r and r are as defined previously for a sample of n firms and ρ and ϕ are the parameters of the distribution, while P is a normalizing coefficient $\left(P^{-1} = \sum_{r=1}^{n}(r+\rho)^{-1/\phi}\right)$.

Ramsden and Kiss-Haypál (2000) proposed that the role of ϕ could be analogous to that the temperature plays in protein transitions from one conformational substate to another. In terms of firm's dynamics it means that CFE's with low ϕ might find difficult to make transitions from one economic activity substate to another, in other words, to evolve into a more advanced vertical integration stages. On the other hand, they proposed that ρ could be correlated to the tendency of an economy to concentrate the economical activity in few high yield sectors. The analogy for CFE's is that the larger the value of ρ for a type of CFE the larger the concentration of them in high timber harvest rate units. Moreover, they proposed a link between ρ and the competitive exclusion in the economy: as ρ tends to zero, the system becomes non degenerate, in other words, competition is tolerated and the distribution is power law. Such a behavior is consistent with the result obtained by Takayasu and Okuyama (1998) which states the power law size distributions are obtained in the totally free competition limit.

0 shows the fitted SCL parameters for the three types of CFE's and the two proxys of size used. The goodness of fit statistics show good fits for sawnwood CFE's and acceptable statistics for the other types of forest enterprises. Considering the estimates for ϕ, results confirm that they are relatively frozen in their present state, in other words, there is almost no mobility among successive levels of vertical integration. What seems to be interesting and intuitive is that sawnwood enterprises seem to have more activity and higher likelihood to evolve (ϕ is higher) to other economic states, presumably getting into the advanced industrialization stages such as finishing and furniture manifacturing. When size is measured in terms of harvest volume, sawnwood enterprises show more economic activity and diversifications than the other levels of vertical integration. This trend might have been captured because highly industrialized CFE's were considered within the sawnwood strata.

TABLE 4. PARAMETER AND GOODNESS OF FIT STATISTICS FOR THE SCL MODEL BY TYPE OF CFE AND USING TWO PROXYS FOR SIZE: FOREST AREA AND ANNUAL HARVEST VOLUME

LEVEL OF VERTICAL INTEGRATION	NUMBER OF CFE'S	HERFINDAHL INDEX OF CONCENTRATION	ESTIMATE FOR ϕ	ESTIMATE FOR ρ	PSEUDO R SQUARE
FOREST AREA (HA)					
STUMPAGE	633	0.0079	0.0278 (**)	50.01 (**)	0.4298
ROUNDWOOD	425	0.0098	0.0209 (*)	49.84 (**)	0.5114
SAWNWOOD	163	0.0222	0.0357 (**)	20.18 (**)	0.7167
ANNUAL HARVEST VOLUME (M3YEAR-1)					
STUMPAGE	633	0.0043	0.0192 (**)	64.08 (**)	0.3220
ROUNDWOOD	425	0.0052	0.0202 (**)	58.61 (**)	0.3365
SAWNWOOD	163	0.0263	0.2512 (**)	0.59 (**)	0.8304

* Significant at the 5% level. ** Significant at the 1% level.

Economic activity has the feature that the generated value added compared to invested capital varies among scales. Often the highest yields are only obtained with the highest capital investment and a sector economy working in this way concentrates unevenly on those activities yielding the highest value added returns. The parameter ϕ in the SCL model is also related to firm's concentration. Large ϕ values correspond to economies with a larger concentration of sales or investments in few firms (Ramsden and Kiss-Haypál, 2000). Such a relationship can be checked by observing the direct relationship between the Herfindahl concentration index and the ϕ values (Table 4). Sawnwood enterprises have a larger concentration in large firms than stumpage and roundwood ones. Current trends might suggest that such a concentration will continue since there is an important proportion of small firms in this category and a wide diversity in the sawing technology among them.

There is no statistical difference among the estimates of ρ for both stumpage and roundwood CFE's, computed with both proxys for size. Following Ramsden and Kiss-Haypál (2000), these figures show that both types have many members (firms) of similar size occupying different niches, in other words, there is more diversity in the sense the activity is more spread, contrasting with sawnwood enterprises, which are more concentrated.

The interpretation proposed by Ramsden and Kiss-Haypál (2000) about the link between ρ and the degree of competitiveness within each one of the markets (stumpage, roundwood and sawnwood) is revealing what has been observed in the field. 0 shows that stumpage and roundwood markets present relatively high values for ρ, which according to these authors, suggests low competition levels in contrast to sawnwood markets where a high level of competition is observed. Stumpage markets in Mexican CFEs are highly controlled by contractors with prices relatively fixed in regions of abundant firms within this category. A extreme case, but with the same effect, is the stumpage and log markets in tropical regions, where stumpage and logging fees are fixed by an association of community enterprises. Roundwood markets are in general very dependent on contractors who buy at the road or at the stump. Antinori (2000) has described these markets as incomplete markets and Mota (1985) has argued that lack of information, administrative burdens, costs of obtaining harvest permits, and internal disputes within the community are the main entrance barriers to these markets, facilitating the contractor's business. These markets contrast with sawnwood markets whose structure and behavior is highly dependent on the international markets as wood imports increase yearly (Forest Trends, 2005). Communities in this market have incentives to attain a higher level of knowledge on the forestry production process, to reduce costs through the improvement of the level of organization and social capital building, such that they are not only able to manage their assets but also to grow into other levels of vertical integration or have explored a more diversified market of forest products and services (Velázquez *et al.,* 2003).

Size and stability of the CFE

It has been observed that CFE's are relatively resilient since few stop logging activities permanently, although some may temporarily suspend operations for a variety of reasons, despite international competitive pressures and relatively low efficiency (Antinori and Bray, 2005). It would be expected that the larger the amount of resources greater resilience of the CFE, since the resource can be used as a buffer to initiate or maintain the enterprise. To test this hypothesis, we used the NSCFE's sample, which shows that nearly 356 (22% of the total enterprises) stopped logging activities temporarily during 1992-2002. This information was used to contrast enterprises that continued operating during the period throughout a logit model where the dichotomous response variable took the value 1 if the FCE stopped activities (event=1) and zero if it continue logging (event=0). Results are shown in Table 5.

TABLE 5. DETERMINANTS OF CESSATION OF OPERATIONS IN CFE'S

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	PR > CHI-SQUARE	STANDARDIZED ESTIMATE
DEPENDENT VARIABLE: LOGIT (STOPPING OF ACTIVITIES = 1)				
INTERCEPT	3.2809	0.87	0.0002	.
AREA OF FOREST	-0.00003	0.000012	0.0186	-0.207149
FOREST TYPE (TEMPERATE=1)	-0.9637	0.2272	0.0001	-0.204561
MANAGEMENT SYSTEM (1=CCF; 2=MIXTURE CCF, RF, 3=RF)	-0.3075	0.1214	0.0113	-0.152836
LENGTH OF FOREST PLANNING (YEARS)	-1.8511	0.3592	0.0001	-0.212098
YEARS OF EDUCATION	-0.0198	0.00915	0.0301	-0.110806

-2 Log L =809.012 (p=0.0001)
Sample size: stop activities=160 Continuous logging= 659
Association of Predicted Probabilities and Observed Responses:
Concordant = 67.9% Discordant = 31.4% Somers' D = 0.365

Observe that the likelihood for cessation of operations is lower for larger CFE's than for small ones. Similarly, CFEs located in temperate areas have lower risk for cessation of operations than those located in tropical areas. The management system is also a good indicator of reduced logging activities, the more intensive the management system used (RF or combination of RF and CCF) the more likely to continue logging. This result might be related to the larger harvest volume derived from intensive management systems, which ensures more profits in the short run for the CFE and more incentive to continue in business. The model also shows that CFE's with long term planning permits are more likely to extend the period of operations than those that have to renew the permits every few years. The length of the planning horizon depends on many factors, from administrative to those related to the quality of the forest management plan. Hence the role of the forest manager as well as the involvement of the community to ensure a good forest plan turns out to be important for the CFE stability as noted by many authors (Merino, 1997; Antinori, 2000; Durán *et al*., 2004). Finally, CFE's where members have a higher level of education are more likely to survive than those with less educated. Variables such as the ratio of area managed by forester, the ratio of community member with property rights to the total population, percentage of indigenous population and other social characteristics were not statistically significant. However, more research is needed to define the role of CFE social characteristics in the continuance of logging operations.

Size and poverty

The relationship between community forests and poverty alleviation has been recently studied with varying results. Some authors argue that community forests can alleviate poverty and generate economic development under certain conditions (Sunderlin, 2003, Torres *et al*., 2004; Xu *et al*., 2004; Bray and Tardanico, 2006; Sunderlin 2006), while others have claimed that management of common property forests, normally for products other than timber in the Asian cases, channel greater benefits to the richer members of the community (Malla *et al*., 2003) or have relatively mixed effects on the livelihood of the community members (Adhikari *et al*., 2006). However, as newer field data is available hypotheses about such a relationship can be more thoroughly investigated and new ideas continue to emerge.

The Mexican case studies have approached the relationship at two different levels. The first approach considers the effect of the FCE on the level of welfare of those community members with property rights over the forest resources trying to isolate the effect of access to forest on welfare (Bray and Tardanico, 2006). The second approach attempts to evaluate the effect of the FCE on the welfare of the entire forest community under the premise that conservation of forest resources within the community can only be granted by the whole community as non timber forest products harvest, illegal cuttings and prevention of anthropogenic catastrophic events depend on the whole community (Torres *et al*., 2004).

For each approach the relationship evidently depends on a large number of factors and a high degree of endogeneity can be incorporated into the hypothesis tests if appropriate information is not considered. In this section we just describe simple correlations between CFE's size and the degree of poverty in the whole forest community, without attempting to identify a causality relationship and without distinguish between members with and without property rights.

For that purpose we matched the sample data with the Census data for year 2000 (INEGI, 2000) to build a poverty index according to the methodology defined by Mexico's National Population Council (CONAPO, 2000). The methodology consisted on adding the maps of forest communities (RAN, 2000) plus the map of localities in the country (INEGI, 2000). The resulting map defined all the localities belonging to each forest community. Once localities on the census were classified, weighted averages (the weight was population or number of households depending on the variable) for each community were estimated to compute the variables used for CONAPO to calculate the marginality or poverty index. These variables include the level of income, schooling and the availability of private and public goods[1] within the *ejido*.

[1] The variables used by CONAPO (CONAPO, 2000) are: Percentage of illiterate population age 15 or more, Proportion of population without primary school finished age 15 or more, proportion of populations without sewage system, proportion of population without electricity, proportion of population without water service,

Finally, this set of nine variables was used to estimate principal components and the normalized value for the principal component with the best fit was used as an estimate of a poverty index (lower values denote richer localities) for the whole forest community without excluding those members without property rights over the resources.

FIGURE 4. RELATIONSHIP BETWEEN SCALE (FOREST LAND AND HARVEST VOLUME) AND POVERTY

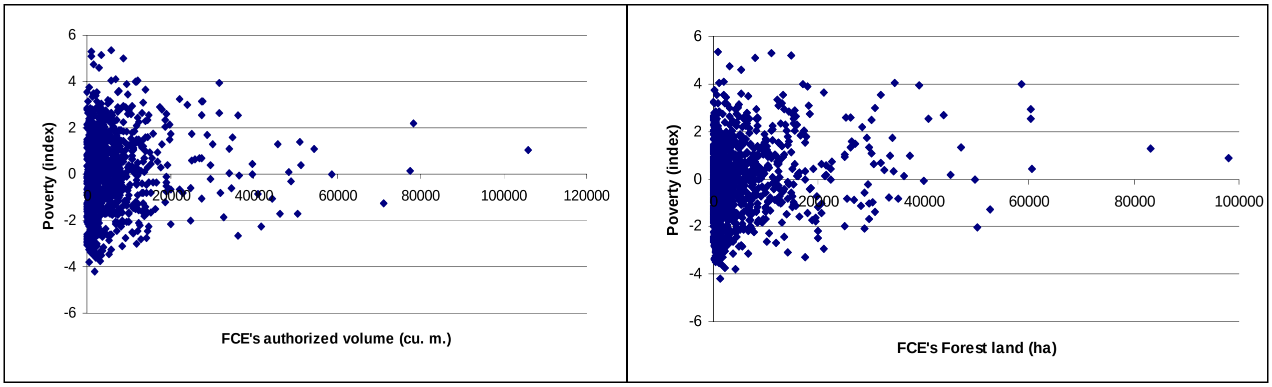


Figure 4 shows the scatter of points relating poverty and scale of the CFE measured in both forest land and harvest volume. Observe that both graphs suggest that scale of the CFE has no relationship with the poverty level of the entire community. These graphs also show that there might be a lot of noise in the relationship, as the proportion, welfare,[2] distribution of rents derived from FCE's and economic activities of community members with property rights (*ejidatarios/comuneros*) to those without them are very variable. It is true that unless all this noise as well as natural endogeneity of the welfare can be controlled it is hard to establish a relationship between poverty of the whole community and CFM.

Case studies (Torres *et al*., 2004; Bray and Tandarico, 2006) have shown that community members with property rights have higher levels of welfare than the rest of the community, which very often are above poverty level (Bray and Tandarico, 2006). This higher welfare level is associated with employment and dividends (*repartos*) related to forest activities, which will be higher as there are few alternative economic activities in the community. The inflow of dividends and higher wages creates some degree of inequity in very poor communities but it is barely perceived in richer ones less dependent

proportion of non overpopulated homes, proportion of homes without flooring, and proportion of households with income lower than 2 minimum wages

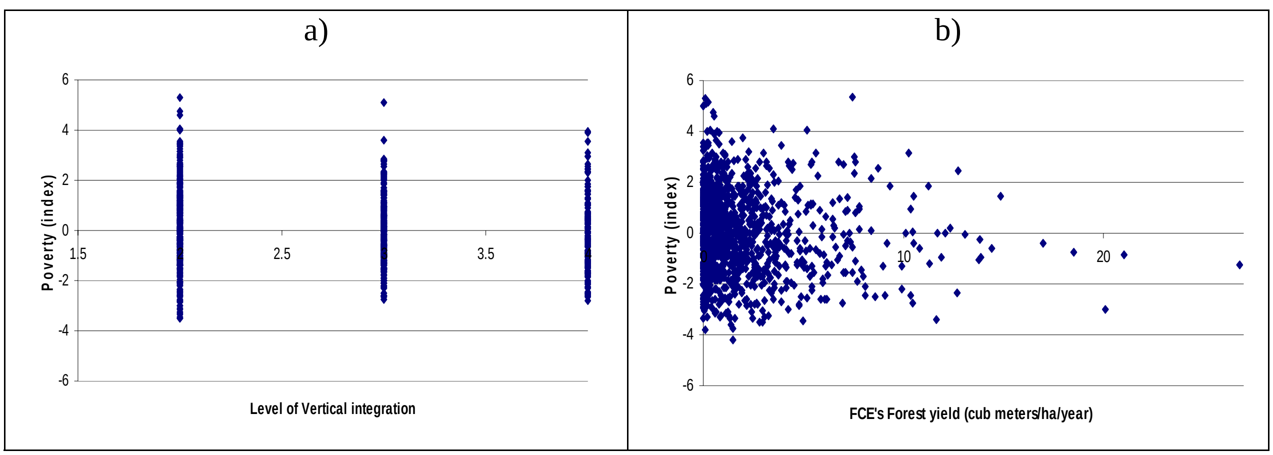
2 Welfare of community members with property rights tends to be higher in poor forest communities and lower in rich ones where there is also a wide diversification of economic activities.

on logging. Although it seems obvious that an inflow of additional income would improve the welfare level of community member with property rights, such a change requires a minimum level of inflow and other synergies to show.

Some FCE's distribute part or the entire dividends to the whole community in the form of public goods, substantially improving the welfare and equity of the entire community (Torres *et al.*, 2004). Wunder (2001) sustains that logging has an economic impact in the community as long as many synergies concatenated with forest and non forest activities can be evolved from logging. Hence, at community level if the inflow of income derived from timber production can not generate enough secondary effects in the community's economy, there is no apparent impact on community's welfare, as the quantity of resources increase in the CFE.

Synergies to improve welfare in the whole community do not depend entirely on the FCE hence we would not expect any relationship between community's poverty and vertical integration as can be observed the Figure 5a. This extension is particularly interesting since suggest that building a vertically integrated enterprise in the forest community does not necessarily guarantees more welfare for the entire community, and open the possibility to think on an optimal level of vertical integration according to scale and level of organization of the CFE.

FIGURE 5. POVERTY VS LEVEL OF VERTICAL INTEGRATION AND FOREST YIELD IN CFE'S



Scale in terms of population has no impact on poverty either. A zero correlation can be found among poverty and forest land as well as harvest volume per capita, considering the whole community as the size of the population (with and without property rights). However, the quality of the resources available seems to have a slight impact. Figure 5b shows that CFE's with forest lands with a harvest rate (harvest volume / harvested forest area) larger than 15 cubic meters per hectare, a year, are consistently better of than those communities with lower yields. This result, linked with a previous one, shows that small CFE (the ones with larger yield) might be doing a good job to improve community's welfare when using the surplus harvest obtained from the early liquidation of their forest lands.

These results come from a static perspective. Evidently they do not mean that CFEs have no impact in the community's economy since such result would require a comparison contrasting the poverty condition before the beginning of the timber harvest activities preferably contrasted with a community without a forest activity. However, they support the idea that availability of forest resources is not a constraint to achieve poverty mitigation

Conclusions

This paper shows the main characteristics of the timber management systems applied in forest communities in Mexico and provides revised estimates on the attributes of such communities. It shows that the size of the forest owned by the community is a relatively important feature to ensure not only continuous, uninterrupted operations of the CFE, but also, to reduce the pressure on the selection of the most appropriate timber management system, as large CFEs more on the extension of their forest than on the availability of surplus forest stock.

Competitiveness of CFEs in the international markets has been achieved by only a very few, and it is not clear if they will be able to maintain that position. The estimated timber yields for Mexican community forests are far beyond international standards and costs associated to logging activities are amongst the highest in the world (FIRA, 2006). A large proportion of the Mexican CFEs are viable because they are enjoying the liquidation of timber surpluses with high quality timber as demonstrated by the distribution of harvest rates. This last feature is the main reason it makes some them temporarily appropriate for an international market. However, such a liquidation is temporal and could jeopardize the survival of small to medium CFE's, especially those applying intensive timber management systems. Particularly vulnerable are those communities in tropical areas with low training and educations levels. Such communities will be relegated to be harvested sporadically without the possibility to integrate vertically and with a high risk of loosing their forest stock through land use changes as community's population grows. For this large proportion of CFE's public policy should focus on organization at different levels, horizontal integration, development of special markets and the opening of other rural development alternatives not in conflict with forest.

By analyzing the size distribution of CFE's we identified that the large majority of them composed by those selling standing trees and logs have almost no mobility, few of them have managed to enter in a higher level of vertical integration. These are symptoms of a very static industry with a low profile and low productivity.

We also identified that size has no relationship with the welfare of the entire forest community. Hence we coincide with the perspectives that it is very unlikely that the CFE by itself can increase notably the welfare level of all community members, with and without property rights However if those dividends from the CFE are well invested it can improve marginally community's welfare without creating serious inequality. In most of the cases especially in the absence of high quality resources (high yield), those dividends and the CFE itself should be thought as initial capital and experience in organization and management to develop alternative productive activities in the community that might improve welfare and reduce the pressure on the forest land.

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