



# Scaling up in community forest enterprises: the case of central Mexico

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## Abstract

For community forest enterprises (CFEs) in central Mexico, ‘scaling up’ can be an effective means of achieving the transition to economically attractive and sustainable forest management, but little is known about the potential and challenges that they face in this regard. We used a qualitative case study to evaluate a set of variables that determine the limitations and opportunities for scaling up CFEs in central Mexico and thereby expanding their commercial capacities, activities and outputs. The framework included concepts related to sustainable forest management, natural resource governance and temperate forest ecology. We interviewed leaders of four communities ( $n=30$ ) and 15 external actors (regional industry, and national non-governmental organizations). Communities that had developed long-term plans for forest management that embrace conservation values were also those with the greatest capacity to generate sustainable income streams from diverse sources. The robust legal frameworks and community institutions that set up procedures for responsibly harvesting and selling timber, thereby generating income, offer opportunities to enhance the effectiveness of CFEs. Demand continues to grow for wood products involving skilled crafts in central Mexico, but local production remains low; a lack of access to finance imposes limits on investment in the forests and value-added options for the products and services. Market opportunities and growth are also restricted by substandard physical infrastructure (e.g., roads, electricity) limited access to finance (e.g., credit, private-sector investors), and an absence of business plans. There are no formal networks to facilitate learning among these CFEs. Scaling up for these CFEs will require access to markets, innovations, and finance to create sustainable value chains for wood and non-wood forest products. The Mexican government could be instrumental in this by incorporating the notion of scaling up for CFEs when enacting policy that builds on and supports the country’s proven models of community-based forest management. On the other hand, this approach can be useful for developing more robust theoretical and methodological frameworks that capture these complex dynamics, contribute to the theory and practice of enterprise forestry development, sustainable natural resource management, and effective policy formulation.

**Keywords** Forest economics · Governance · Management · Mexico · Temperate forest

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## 1 Introduction

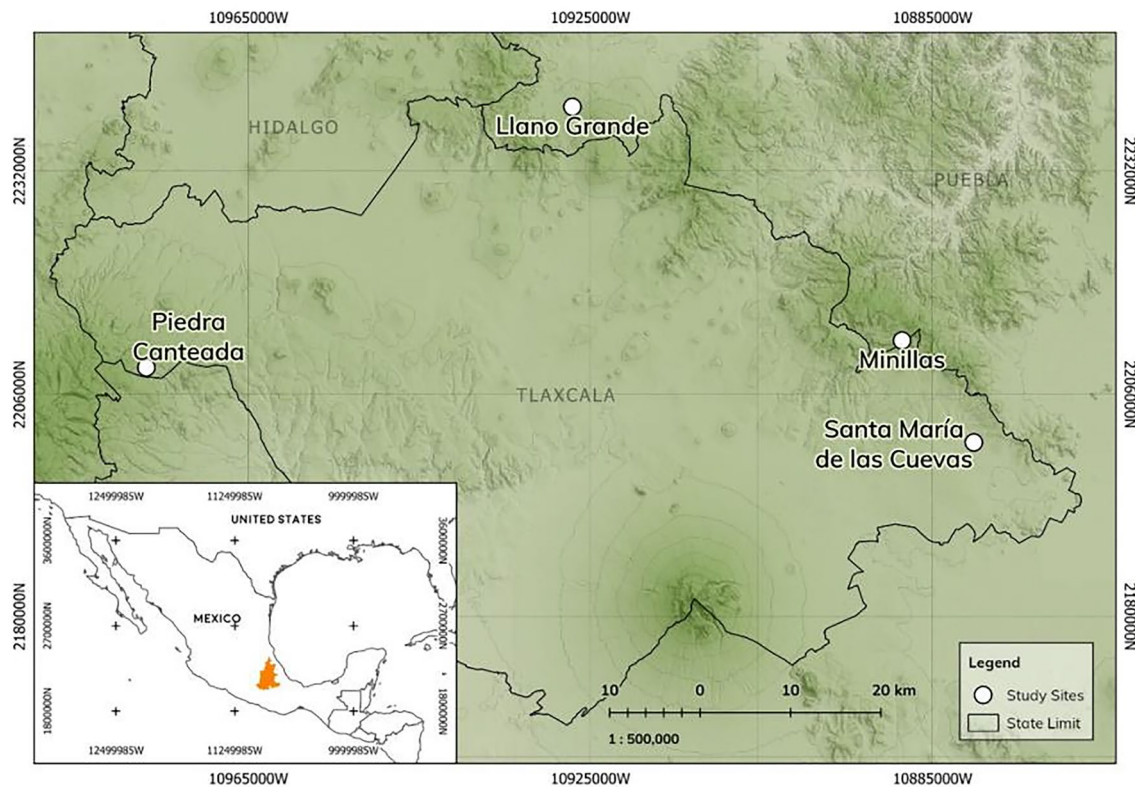
Governance of the world's forests is increasingly entailing decentralized forms of ownership. Just over 15% of global forest lands are either owned by or designated for indigenous peoples and local communities, and this approaches 30% of forests in lower and middle income countries (RRI 2018). These forests are often governed and managed by community-based commercial entities known as community forest enterprises (CFEs); these provide an alternative to traditional models of private enterprise, which have limitations regarding the integration of social, environmental, and economic goals within natural resource sectors (Panwar et al. 2015). Their governance empowers local communities through principles of collective participatory management. When well-managed, CFEs can be economically profitable, with high rates of return (Torres-Rojo et al. 2005). They have the potential to reduce poverty and enhance livelihoods in rural communities (Ribot et al. 2006, p. 34; Scherr et al. 2004), while also contributing to forest conservation objectives (Charnley and Poe 2007, pp. 301–336; Chhatre and Agrawal 2009, pp. 17,667–17,670; Porter-Bolland et al. 2012, pp. 6–17). Despite the perceived potential of the CFE model, positive evidence is limited to only a few case studies (Measham and Lumbasi 2013). Obstacles include limited financial, administrative, and business capacities, disadvantageous legal and economic contexts, and governance issues, both internal (e.g., power inequalities, undemocratic decision-making) and external (e.g., negative relationships with governments). These challenges explain, at least in part, why most CFEs operate at a small scale (Molnar et al. 2007), underperform and grow only slowly (Sunderlin et al. 2005).

Scaling up is defined as expanding the capacity and operations of community forest enterprises in ways that align with community goals (Wani et al. 2021, pp. 21). It can move communities beyond individual subsistence or small-scale market production (Antinori and Bray 2005) and into enhanced production and market reach, broader control over value chains, and/or more successfully engagement in political processes (Uvin and Miller 1996, pp. 344–354). For example, economic diversification beyond timber can reduce dependence on a single resource and mitigate the risks associated with price volatility (Measham and Lumbasi 2013, pp. 649–659), and it can encourage innovation and the development of new economic and ecological opportunities contributing to long-term economic growth. However, for CFEs, scaling up may need to offset a plurality of goals (Hajjar et al. 2013, pp. 158–167) against limited resources (de Jong et al. 2010, pp. 299–313; Porro et al. 2008, pp. 163–199). An

inability to articulate, or even understand, the complexities of scaling up severely limits our capacity to develop effective strategies to facilitate growth of the CFE model, since many practitioners view CFEs as a subsistence policy rather than a commercial venture (Gebreegziabher et al. 2021).

Success in community forest management in Mexico is mixed. Only 12% of national forest lands have management programs (Torres-Rojo et al. 2016, pp. 93–105). Only 0.01% of the national budget is allocated to the forestry sector, and federal economic support programs cover only 13% of the country's temperate and tropical forested areas (Torres-Rojo et al. 2016, pp. 93–105). The communities perceive that market engagement can reverse the deprivation that forest communities often experience (Donovan and Nicholls 2008, Macqueen 2008). To achieve this, however, communities must enhance their interaction with markets and collaboration with other actors to ensure that benefits from market transactions will scale up their income rather than being transferred to other actors who are better positioned in the value chain (e.g., traders, intermediaries, and timber processors) (Donovan and Butry 2008). However, little is known about the external conditions (e.g., regulatory frameworks, access to markets, insecurity of land tenure) or the internal characteristics of the participating communities (e.g., governance, organization, distribution of power, and degree of participation) that can lead to successful communal management and catalyze the development and scaling up of CFEs. Most studies of CFEs in Mexico have concentrated on southern states (e.g., Oaxaca, Quintana Roo). Yet central Mexico is also an important forest region, contributing to the national timber production and comprising more than one-quarter of the country's population. Challenges faced by forest management in this region (Cubbage et al. 2015, pp. 623–650) include the small size of forested properties (which reduces profitability), political and economic inertia, and ill-conceived forms of social organization in forest management.

Despite the social and economic importance of forests in central Mexico, little is known about the potential of CFEs in this region and the challenges they face. In this context, the guiding research questions were: (1) How do external factors such as markets, clustering and national institutional frameworks limit the scaling up capabilities of CFEs at the regional level? and (2) How do socio-ecological of CFEs constraints limit or favors increasing the economic attractiveness to create sustainable value chains for wood and non-wood forest products? Therefore, the international contribution of our research lies in the possibility of providing knowledge and experiences that can be applicable or extrapolated to similar contexts in other regions of the world. This type of study could contribute to the understanding of common challenges faced by forest enterprises in rural or



**Fig. 1** Location of the four CFEs analyzed in the states of Puebla and Tlaxcala, Mexico, with a scale of 1:500,000. Mexico is divided into seven regions according to the needs, capacities and potential of forest enterprises. The states of Puebla and Tlaxcala are part of region 5, characterized by temperate forest management in a rural and peri-

urban context, with a strong interaction with the metropolitan area of Mexico City. This region has a dynamic timber market with the highest prices in the country, due to industrial demand. Twenty of the 33 CFEs in the center of the country are in these states

semi-urban areas, as well as to the identification of effective strategies to improve their sustainable development and their contribution to the adequate management of natural resources. It could also serve as a basis for the formulation of policies and programs aimed at strengthening the forestry sector in different international contexts.

The present study draws on the work of Sánchez-Badini et al. (2018), who developed a theoretical framework outlining 12 critical success factors in enabling business environments for small and medium forest enterprises. Although this framework was not explicitly designed for CFEs, it is useful for assessing the relevance of contextual factors to forest enterprise development. We examine the opportunities and obstacles facing four forest communities in central Mexico; they differ in their organizational models and in their levels of diversification and vertical integration of economic activities. This multi-level, multi-context approach yields insights into how CFEs might scale up, and the circumstances that determine success or failure. We propose improvements in policy and management that would be conducive to their continued development, mainly through increasing the economic potential of sustainable forest

management, and facilitating access to markets, innovation, and finance for sustainable wood and non-wood forest products. In this sense, we evaluate these barriers with the aim of providing tools to facilitate the path towards the diversification of activities. Our contribution includes formulating concrete recommendations to improve forest policy and management, with a focus on increasing the economic potential of sustainable forest management and facilitating access to markets, innovation and finance. For example, the diversification of economic activities and the potential for regional collaborations.

## 2 Methods

### 2.1 Study sites

The study involved four community forest enterprises in central Mexico (Fig. 1) within the states of Puebla and Tlaxcala (CONAFOR 2018, pp.1–62); these two states encompass one of seven areas in the country with active forest use, generating timber outputs of approximately 350,000 m<sup>3</sup>/y

(CONAFOR 2020, pp. 489–507). The study sites are on the Trans-Mexican Volcanic Belt, which favors highly diverse and productive forests; most have soils predominantly of volcanic origin (andosols) which, despite low fertility and predisposition to erosion, sustain intermixed forest stands comprising more than six conifer species and 10 broadleaf species. This reflects the mountainous topography, with slopes ranging from 30 to 40%, coupled with precipitation which ranges from 600 to 1000 mm, providing adequate water for temperate forest (Morales 2015, pp. 206–208). The average timber stock ranges between 200 and 300 m<sup>3</sup> of roundwood per hectare (Morales 2015, pp. 206–208), among the highest in Mexico. Hence, the area may yield valuable information regarding the commercialization of forest products and services in CFEs at differing stages of development.

Although the climatic and edaphic factors favor productivity, the size of forest lands held by a CFE in this region is smaller than average for Mexico. Management is influenced by the proximity to Mexico City, where the high industrial demand for timber products creates a dynamic market, with timber prices being among the highest in the country. It has also led to this being one of the most deforested regions in the country. The long history of human occupation in this central region has led to deforestation for agriculture, with severe to extreme land degradation (CONAFOR 2018, pp. 1–62; Buendía et al. 2008). Consequently, most of the forested area in this region is secondary forest that has been subjected to diverse management regimes (Morales 2015, pp. 206–208).

The four CFEs differ with respect to the productivity, harvesting and commercialization of their timber and non-timber forest products.<sup>1</sup> We classified the CFEs according to the level of diversification in their economic activities

<sup>1</sup> An “ejido” is a type of communal land tenure system in Mexico. In modern times, an ejido refers to a specific form of land tenure where rural communities collectively own and manage land for agricultural or other purposes. Of the four entities studied herein, three are *ejidos*, although the term CFE will be used throughout. CFEs in Mexico can also be classified according to a system developed by the Program for Forest Conservation and Sustainable Management of Forest Resources (PROCYMAF). This recognizes four levels of vertical integration (National Forestry Commission of Mexico, 2013). Type I, the community owns the forest and has the potential to commercialize timber resources, but does not do so because authorized management plans are lacking; Type II, the community owns the forest but is not directly involved in harvesting, which uses external contractors; Type III, the community owns the forest, authorizes how the timber is used, and can directly participate in timber harvest and commercialization; and Type IV, the community owns the forest and has infrastructure for timber processing and commercialization (CONAFOR 2018, pp.1–62). The CFEs under study are recognized as owners of their forest lands who enjoy harvest rights and participate directly in harvesting activities. Only two of the studied cases have developed the infrastructure for the processing and commercialization of timber and non-timber forest products.

(Table 1). Santa María de las Cuevas (low diversification) focuses only on the extraction of non-timber forest products, such as pine nuts (*Pinus cembroides*), firewood, and *Yucca* sp. Las Minillas (moderate-low diversification) revolves around the harvesting of roundwood only. Llano Grande (moderate diversification) also focuses primarily on roundwood, of which 64% is *Pinus patula*, one of Mexico’s tree species with the highest commercial value; it has its own nursery and sawmill, as well as a women-led handicraft cooperative. Finally, Piedra Canteada (high diversification), albeit with the smallest land base, processes roundwood in its own sawmill, produces plants in its nursery, and runs a series of ecotourism activities (Table 1).

## 2.2 Data collection: interviews and surveys

We employed a qualitative approach to identify opportunities and limitations for scaling up CFEs in the study region. Detailed analysis of each CFE allowed comparison of their situations and challenges (Eisendhardt 1989, pp. 532–550; Ritchie and Lewis 2003). We used the twelve critical success factors developed by Sánchez-Badini et al. (2018) but with the additional criterion of ‘security and illegality’ to enhance the applicability to Mexico; although this factor could have been included under ‘forest law enforcement’, we separated it because of the number of times it was mentioned by participants and the key role of CFEs in managing these issues. Researchers gained access to community leaders through a collaborative and transparent process, establishing relationships of trust and mutual respect with local communities. Prior approaches were made to local authorities and community leaders to explain the purpose of the study and to obtain their consent to participate in interviews. In addition, established ethical protocols were followed, guaranteeing the confidentiality of the information and respecting the autonomy of the communities.

We used semi-structured interviews with open-ended and multiple-choice questions to explore the criteria established by Sánchez-Badini et al. (2018) (Table 2). The interviewees were informed about the purpose of the research and did not receive payment for their participation. First, we interviewed leaders in each community ( $n = 30$ ) regarding the history and formation of the CFE, as well as their perceptions of barriers, opportunities, and organizational capacity for scaling up. Specific topics were: (1) the history of communal lands; (2) internal organizational structures; (3) clustering capabilities; (4) forest enterprises; (5) management capacities; (6) markets; (7) natural capital; (8) financial capital; and (9) forest management capacities.

A separate questionnaire was developed for interviews with 15 external actors who were selected by snowball sampling and included representatives from academia, regional industry, and national non-governmental organizations.



**Table 1** Self-described characteristics of four CFEs in central Mexico

Forest community	Land Size (ha)	Land use	Land ownership		Use of raw materials (extractive activities)				Processing		Services	
			Private or partner-owned	Number of ejidal (ejidal plots)	Non-timber forest products	Roundwood	Milling	Furniture	Nursery	Ecotourism		
											Yes	No
Santa María de las Cuevas	1,029	Agriculture: 55% Forestry: 44% Urban: 1%	Yes	130	Yes	No	No	No	No	No	No	No
Las Minillas	1,104	Agriculture: 46% Forestry: 52% Forest Conservation: 19%	None	66	No	Yes	No	No	No	No	No	No
Llano Grande	2,343	Agriculture: 24% Forestry: 59% Forest Conservation: 11% Other 6%	None	99	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Piedra Canteada	632	Forestry 83% Conservation 17%	40	None	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes

We sought their perceptions about: (1) the external factors that limit or enhance the scaling up of CFEs in the region, notably the macroeconomic environment and regulatory frameworks; and (2) the influence of internal factors, such as the capacity to form clusters with similar organizations (Table 3). In addition to the semi-structured interviews, we consulted the academic and gray literature to characterize and contextualize the implementation of government forestry programs in the study region, particularly with respect to the use of instruments and incentives (Kozak 2007). The issues assessed in the interviews were the 12 criteria proposed by Badini et al. (2018), with the addition of the topic of security because this was mentioned in more than one-half of the interviews we conducted. Their assessment of security included mention of the criminal gangs that not only threaten the security of the region, but also contribute to illegal logging and commercialization of timber without certification. The 25 questions were: Each interview lasted about 40 min and was conducted in Spanish, the first language of all those interviewed.

Data were collected between September and November 2019. Interviews were designed to elicit information from key actors on the development of CFEs. Informants were found by a snowball method (Ritchie and Lewis 2003). The interviews were recorded and fully transcribed. We recognize the limitations of this methodology, especially in communities whose members do not know each other well, but in these small communities under study we assume a lower connection effect between people. We completed a total of 30 interviews: 23 with community leaders. Those deemed community leaders were > 50 years old and/or landowners. Of all those interviewed only two were women, reflecting their lower representation among the community authorities. Including six in Santa María de las Cuevas, five in Las Minillas, eight in Llano Grande and seven in Piedra Canteada; and seven with external actors. The proportion of interviewees reflects the presence of men and women in the authorities and the community.

### 2.3 Data analysis

In Microsoft Excel, we organized the data collected on criteria and sub-topics (by column) for each type of respondent (community leaders and external actors, by row). Cells were populated with information supplied by individual respondents. We used deductive content analysis of the data based on the 11 criteria (Table 2). Deductive content analysis is a qualitative research technique that relies on the use of a pre-existing theoretical framework or hypothesis to guide the coding and analysis of data. This method allowed focus on previously established categories and themes, facilitating a structured comparison consistent with Badini’s (2018) theoretical framework. Although it cannot be claimed to be

**Table 2** Criteria and sub-topics used in semi-structured interviews with leaders in each community, based on the Sánchez-Badini et al. (2018) framework

Criteria	Sub-topics	
Forest Law Enforcement	Governmental agencies and management policies for public forest resources	Could you tell us about the conformation of the ejido, i.e. the history of the ejido?
Tenure and Land Ownership	Property rights	Within the ejido, which economic activity is the most relevant (or which generates the most income?)
Management and Land Use Planning Rights	Management rights: Economic activities Planning and land use	Throughout the time that the company has been operating, have there been any cases of non-compliance with legislation (laws), which is cause for sanction? or
Markets	Local accountability: Economic management Access to and strengthening of markets Communication platforms and exchange of product information Physical infrastructure: Logistics and accessibility Key products for commercialization Buyers and consumers of products Products and services Key economic activities	Have you considered taking advantage (for yourselves or to sell) of any other benefit that you are not currently taking advantage of? Which one?
Natural Capital	Resources within own territories Ecosystem services Utilization of products that fall outside of forest management plans	
Financial Capital	Capital investments: Value of key investments Government support Value of credits and loans	
Forest Management Capacities	Knowledge of the harvesting cycle and forestry practices Knowledge of forest management impacts Monitoring capacity Certification Improvements in forest management	
Business Management Capacities	Legal capacity: Knowledge of legal and management functions in enterprises Accounting and financial management Human resources	
Organizational Capacities	Governance: Capacity to order assemblies Governance: Frequency of assemblies Distributional equality of resources and benefits Collective identity: Time and terms for appointed seats in the organization	
Clustering	Partnerships with other actors Perspectives on partnering with other actors	
Security and Illegality	Insecurity/ illegal logging Actions to mitigate illegality	

inherently better than other methods, deductive content analysis offered significant advantages in terms to comparing forest enterprise practices and outcomes with Badini's postulates, allowing for a more direct and accurate assessment of alignment between theory and practice. Finally, NVivo software (version 11) was used to code each data point as an opportunity, challenge, or barrier. These codes (Table 4) were applied to the criteria and sub-topics related to scaling

up a CFE, as described in Tables 2 and 3. Finally, each data point was identified as an opportunity, challenge, or obstacle for CFEs to scale-up and codes were applied throughout the results (Table 4). The codes used in NVivo for the deductive content analysis included categories such as 'Opportunity', 'Challenge' and 'Obstacle'. These codes applied to the different Criteria and sub-topics related to scaling up CFEs, as described in Tables 2 and 3.

**Table 3** Criteria discussed in interviews with external actors, based on the Sánchez-Badini et al. (2018) framework

Criteria	Sub-topics
Macroeconomics	Projection of global timber flows Demand, industry structure, and technological change Trade regimes and associations Monetary and fiscal policies: Commercial taxes Favorable trade regimes: Systems for import/export of timber and non-timber forest products Investment programs
Regulatory frameworks	Programs, laws, norms, and regulations timber and non-timber forest products, as well as forest conservation

**Table 4** Definitions of opportunities, challenges, and barriers for scaling up a CFE. Note. We use the terms barriers as synonyms for obstacles

O	Opportunity: favors scaling up	Intrinsic to the organization and/or external (politics or market forces)
C	Challenge: requires adjustments to achieve scaling up	Internal actions taken by the community for scaling up which can lead to barriers in the short, medium, or long-term
B	Barrier (That means obstacles): does not favor scaling up	Internal (organizational capacities) and/or external (macroeconomic environment and legal frameworks)

### 3 Results

Sections 3.1.1 and 3.1.2 rely largely on data collected from external actors, whereas Sects. 3.2 and 3.3 are more focused on data collected from the CFEs under study. We define success indicators in the communities as those criteria that favor scaling up.

#### 3.1 Analysis of the barriers to promote diversification of activities in CFES

##### 3.1.1 Macroeconomics barriers

All 15 external actors stated that national-level monetary and fiscal policies affect the commercialization, processing, and competitiveness of forest products (Table 5), and would require adjustments for scaling up to occur. Perceived barriers to scaling up were as follows: lack of industrial-scale tools and technologies for wood treatments and processing; scant infrastructure for industrial-scale processing of products; unknown demand for the product; and imposition of taxes in response to commercialization.

The regional forest industry is insufficiently diversified and its lack of a modern infrastructure favors only the sale of primary wood products such as dimension lumber, boards, and beams or pallets and packaging; diversification could lead to market gains, but communities would need better business management skills. There is little

capacity for processing value-added, semi-finished, and finished wood products such as furniture, veneers, and plywood; an example is the use of oak (*Quercus* sp.) as a source of firewood and charcoal (Martínez-Pérez et al. 2015; Márquez-Reynoso et al. 2017). A lack of technology further limits the possibility of entering export markets that focus on kiln-dried wood products, with very few companies possessing kilns for wood drying in the region (Martínez-Pérez et al. 2015). The National Forest Commission (CONAFOR) incentivized the use of solar-powered kilns as part of a program that promoted value-added activities in *ejidos*, but none of the studied CFEs had accessed this program. The CFE that we studied did not agree due to lack of knowledge of the benefits of the diversification of activities and lack of motivation on the part of the authorities. All 15 interviewees indicated that overcoming technological barriers may involve investment to develop specialized manufacturing and automated accounting; however, the costs incurred are likely to increase the price of the products and decrease market sales. Although the quality of the national timber is recognized, some interviewees perceived the macroeconomic climate to be a major drawback; the potential of CFEs to export forest products is constrained by their limited access to technology, poor information about prices, and failure to recognize opportunities for partnership between sections of the forest economy.

**Table 5** Responses (translated from Spanish) from external actors regarding the macroeconomic environment and regulatory framework for strengthening CFEs in central Mexico

Criteria	Result	Criteria	Interviews with external actors
Macroeconomic Context	Challenges	Client's demand, industry structure, technological change	"There are differences between domestic production and imports. First, CFEs do not have the necessary machinery to perform wood drying, perform exact timber cuts and measurements, and explore value-added opportunities for waste products. Although national wood has potential, compared to the plantation base wood that is being imported. Thus, a more standardized process is needed to train and capacitate CFEs to enhance their potential in the above areas." (Academia)
	Opportunities	Trade regime: prize Information	"There is not a mechanism at the national level to set prices for timber and non-timber forest products, they are established by means of conducting a local cost benefit analysis" (President commissariat of ejido)
	Barriers:	Monetary and fiscal policy: commercial taxes	"National-level commercialization of wood products from <i>ejidos</i> and CFEs falls under the federal Tax Revenue Law. Taxation is thereby based on the degree of processing. However, there is no simplified tax collection system in place in the central Mexican region, which is why this process is carried out by means of demonstrating purchasing receipts and invoices. This causes an administrative burden, high costs of compliance, as well as problems with fulfilling legal documentation requirements in time to market the product. As a result, prices are high and competitiveness of the products is limited (Industry representative, Academia)"
	Challenges	Trade regime: systems for import/export of timber and non-timber forest products	"The export of wood products from CFEs is governed by NOM 144 of SEMARTNAT 2015. In the central region there are no exports due to lack of regional markets. The export system operates mainly on a demand base for transformed wood, that is, furniture or freight pallets." "Mexican timber is not competitive for export due to high costs and lack of sophistication in timber processing (higher costs due to inefficiencies) (Industry, Academia)"
	Barriers:	Trade regime: systems for import of timber products	"Mexico imports materials used to manufacture pallets, they come mainly from Chile and Canada. There is a marked difference in the prices of imported and domestic wood. The costs of imported wood tend to be lower due to unregulated systems for the collection of taxes (VAT) and tracking of volumes entering the country, which affects national markets." "Industry professionals of Mexico often prefer to buy imported wood, notably instead of the central Mexican region where the price for roundwood is high. This is because Mexican producers are principally located close to urban areas of Mexico City, Puebla, and Pachuca where the demands for timber are high (Academia, Industry)."
	Challenges	Commercial regime: associations	"In the central Mexican region, partnerships exist between industry and some of the producing ejidos. However, this is not a strategy that is generally accepted by most ejidos due to lack of coordination and trust to collaborate with others to increase production capacity. It is suggested that, for the case of central Mexico, such a strategy should be directed by competent institutions, given the small size of forestry properties in the region and prospect of cost reductions through clustering. Clustering would also help guarantee more consistent production and reduced competition (Government)"
Regulatory Framework	Opportunities	Investment programs for small and medium forest enterprises	"Government Investments Programs Administered by CONAFOR: Acquisition of machines (technical equipment) Production Forest Protection National Banks Credits and Loans for Investments in Production NGOs UNDP Programs for Training and Infrastructure
	Opportunities	Forest policies in Mexico that regulate CFEs: programs, laws, norms, and regulations for the use for timber and non-timber forest products, as well as forest conservation	Among the most important policy programs at the national level for the creation and formation of CFEs are the following: PROCYMAF and PROARBOL. These programs entail plans and strategies for their implementation, as well as allocation of a budget to promote the formation of CFEs. All programs are tailored to support the formation of enterprise activities. The most sought types of support are: Reforestation Programs (Economic Support for Purchase of Plants and Planting Activities) Fire Brigades (Economic Support and Programs for Fire Prevention and control) Program for increase timber production and productivity operated by CONAFOR Community silviculture (Economic support) All operated by CONAFOR under the direction of SEMARNAT and laws for forest development (Academia)"



### 3.1.2 Regulatory frameworks are a regional barrier?

Interviews with external actors also considered programs, laws, and regulations for resource use, conservation, and business development (Table 5). Interviewees believed that regulatory frameworks in Mexico provide limited opportunities for joint forest management and economic activities in forest communities. Revised regulatory frameworks encompassing technical training, provision of management tools, and community participation could facilitate scaling up. Indeed, there are incentives and recognition for those communities that successfully comply with regulations and demonstrate sustainable forestry practices. Complying with administrative requirements is an incentive for escalation. Although various programs have been implemented by the federal government over the past two decades to promote forestry to support the management of the commons, some interviewees noted the limited success of these programs.

## 3.2 How different organisational contexts influence the success of CFEs?

### 3.2.1 Forest law enforcement

Forest law enforcement is an obstacle for communities with scarce resources and scant organizational capacity for forest legislation, whereas it is viewed as an opportunity for those with continuous and secure management. Regulations for forest use were not perceived by the CFEs to be direct barriers, but some interviewees regarded the bureaucratic burden involved in complying with timelines and regulations under the legal framework to be disproportionate relative to the economic gains resulting from forestry operations. For instance, the cyclical harvest and commercialization of pine nuts (as practiced in Santa María de las Cuevas) is not profitable enough to prepare and process the authorization of a technical study for their legal use. On the other hand, regulatory compliance can also prove beneficial. Two communities, Las Minillas and Piedra Canteada, received significant economic benefits under official support programs that reward compliance with forest management regulations; Las Minillas even received direct investment towards their CFE.

### 3.2.2 Tenure and ownership

The CFEs in this study enjoy well-defined legal rights and titles in terms of land ownership, as well as use and management of their territories and resources. This is essential for the sustainable management and long-term scaling up of forest communities. The right to plan and manage land use enables a community to plan sustainable economic activities. Santa María de las Cuevas, Las Minillas, and Llano Grande each hold communal ownership of their lands

(*ejidos*), where decisions are reached collectively through *ejidal* assemblies in accordance with the Agrarian Law of 1992. The Piedra Canteada CFE comprises a group of *ejidatarios* who bought land from an *ejido* and control it as a board of partners. Some interviewed forest technicians suggested that land rights come with certain requirements in terms of resource management. It may be best to separate political governance of *ejidal* forests from the commercial activities. In addition, a forest technician also commented that continuous monitoring by forestry technicians and the government is also essential for maintaining oversight and accountability.

The four studied CFEs seem to recognize their rights to private property as a potentially favorable factor for scaling up forestry activities in the region. *Ejidal* territories are divided into parceled areas with individual rights and usufruct (crops and livestock), as well as areas of common use (forests and pasturelands). Although each CFE has collective forest management processes, their organizational processes are run separately, which can hinder the pursuance of value-added activities. In Santa María de las Cuevas, only the use of the Spanish Dagger (*Yucca carnerosana*) is managed in the *ejidal* assembly, while commercialization and use of other forest resources fall outside its jurisdiction, in this case a forest technician does not determine the volumes and areas of annual production. In Las Minillas, the forest management plan is established under the guidance of a forester, then it is voted on in the *ejidal* assembly, alongside an agreement on prices and annual volume of timber to be extracted. In Llano Grande, the annual allowable cut is decided in the *ejidal* assembly, but the sawmilling business and the handicrafts workshop are run by separate management which reports to the *ejidal* assemblies at least once a year. Finally, in Piedra Canteada, decisions on the management of economic activities are made during meetings of the partners, which occur up to four times per year. Despite these differences in administration and management, CFEs are accountable, under Mexican law, to a common set of fiscal and administrative obligations if they wish to diversify their forestry activities.

### 3.2.3 Management and land use planning rights

The collective assembly of *ejidatarios* is the only legal figure of authority and autonomy to make decisions regarding their territory. This model is observed in Santa María de las Cuevas, Las Minillas and Llano Grande, but not in Piedra Canteada with its cooperative of private landowners. The lack of land use planning and management rights in Santa María de las Cuevas is seen as a major hurdle; scaling up would be more feasible if these rights were granted.

The degree of decentralization of management differs. In Santa María de las Cuevas, a lack of communication and

cooperation between the commissariat (*ejidal* head) and the *ejidatarios* has prevented the development of a management plan for harvesting pine nuts. Las Minillas has maps and management documents, but the *ejidal* assembly decides on the volumes of timber sold; even though a land use plan is in place, the *ejidatarios* do not recognize themselves as formal participants in the planning process, but rather as decision-makers on the use of each individual territory through an internal process in assemblies where no external agents can intervene. The forestry technician has a guidance/support role in providing technical advice and ensuring that forest regulations are met. In both Santa María de las Cuevas and Las Minillas, difficulty in achieving consensus during *ejidal* assemblies can become a challenge for communal land use planning. In Llano Grande, land use is planned with support from CONAFOR, but one of the *ejidatarios* stated that the assembly lacked the necessary knowledge, sense of ownership, and participatory capacity to meaningfully engage in these processes. In Piedra Canteada, the distribution of activities enables the payment of salaries to the partners and secures the livelihoods of the managers (people who work full time caring for the forest) of the communal lands.

### 3.2.4 Markets

Limited access to markets precludes scaling up. Llano Grande and Piedra Canteada are engaged in timber processing and harvesting activities for only a few months at the end of each calendar year (CONAFOR 2020, pp. 489–507); this periodicity, coupled with fluctuating demand, make these CFEs vulnerable to market conditions. However, the accessibility of Piedra Canteada facilitates the commercialization of its products and ecotourism services. Piedra Canteada is the only one of these CFEs with digital marketing strategies for its products and services, and it has the highest degree of diversification in terms of product and marketing strategies; this diversification, operational experience, and local knowledge allows Piedra Canteada to access markets with lower risk than merely trading roundwood. In Las Minillas, geographic isolation is a limiting factor; markets for roundwood are more remote and lacking in adequate roads, thereby complicating access, increasing transportation costs, and ultimately reducing profits. In Santa María de las Cuevas, the production of pine nuts is a participatory activity, in which the *ejidatarios* or their relatives harvest the pine nuts and prepare the product for commercialization and trade, but there are no formal marketing strategies. The *Y. carnerosana* harvest is authorized by the *ejidal* assembly but is administered by a forest technician who determines the volumes and areas of annual production, and the prices are set by a local company that operates at industrial scale; this results in a monopoly market.

### 3.2.5 Natural capital

Assessment of natural capital was based on the use of resources within each CFE (wood, pine nuts, ecotourism), as well as their benefits (Table 5). Ensuring access and sustainable utilization of resources within the territory is crucial for scaling up and long-term sustainability, arguably for the entire region. The low productivity of forest lands in Santa María de las Cuevas does not allow for the harvest of roundwood, so pine nuts are the main basis of economic activity, and *Yucca*, with its own management plan, is harvested annually, albeit with low profitability. In contrast, the forests of Las Minillas, Llano Grande, and Piedra Canteada are well suited to the harvesting of roundwood and timber production. Furthermore, those communities that manage ecosystem services have greater experience in recognizing and taking advantage of sustainable management strategies and encouraging the added value of forest products. In Las Minillas, the *ejidatarios* have been harvesting the forests for firewood for more than two decades, largely to supply their own needs; however, although they have diverse forests and have identified other natural sources of capital, as well as potential benefits, they have developed no plan to diversify into timber production, non-timber forest products, and/or ecotourism sites. In Llano Grande the pine forests, already producing roundwood, also show a great deal of promise for tourism. In Piedra Canteada, forest benefits have been clearly identified, and no harvesting occurs without a management plan; non-timber resources have been added to the harvesting portfolio, and the preservation of nature and biodiversity has become a priority, with prohibition of hunting or extraction of medicinal plants.

## 3.3 Internal financial and business skills

### 3.3.1 Financial capital

There are opportunities to access financial services in the early stages of scaling up, but a lack of social organization can be a barrier for less diversified CFEs. In Santa María de las Cuevas, opportunities for the accumulation of collective financial assets have been missed for example, investment in forestry-surveying equipment was not made because of and lack of a solid organizational plan. Santa María de las Cuevas also struggles with the management and implementation of activities; for example, a lack of formalized commitment and continuous support from the community governing body led to a failure to build a seedling nursery. In Santa María de las Cuevas and Las Minillas, access to government funding and/or private financial capital is further complicated by a high dependence on outside experts, such as forestry technicians, to oversee requests for support (Table 6).

**Table 6** Overview of natural capital, financial capital, and human capital of the CFEs. NA=Not Applicable. Data obtained from CFE forest management plans and interviews

	Land used for forestry	Predominant type of forest	Commercialized products	Tourism activities
<b>Natural capital</b>				
Santa María de las Cuevas	32%(448 of 1400 ha)	<i>Pinus cembroides</i> subsp. <i>orizabensis</i> , <i>Yucca carnerosana</i>	Pine nuts, Yucca	NA
Las Minillas	25% (484 of 1780 ha)	Fir-Pine forest	Roundwood (2,078 m <sup>3</sup> )	Viewpoints & springs
Llano Grande	63%(1375 of 2167 ha)	Oak-Pine forest	Roundwood (19,259 m <sup>3</sup> )	Conservation areas & viewpoints Lagoons
Piedra Canteada	84%(530 of 632 ha)	Oak-Pine forest	Roundwood (1 m <sup>3</sup> )	Firefly viewing, camping, bird watching
	Reinvestments in CFE infrastructure	Sawmill	Plant nursery	Ecotourism
<b>Financial Capital</b>				
Santa María de las Cuevas	No	No	Yes (currently not active)	Yes (private property)
Las Minillas	No	No	Yes (currently not active)	No
Llano Grande	No	Yes	Yes	Yes (limited)
Piedra Canteada	Yes	Yes	Yes	Yes (cabins, restaurants, guides, trails)
	People with education in topics related to forest management	Decision-making body for product commercialization	Employees	Local staff
<b>Human Capital</b>				
Santa María de las Cuevas	No	<i>Ejidal</i> assembly	NA	NA
Las Minillas	No	<i>Ejidal</i> assembly	NA	NA
Llano Grande	Yes	<i>Ejidal</i> assembly/ CFE management	3 managers, 20 workers (milling and handicrafts)	Yes
Piedra Canteada	Yes	Partner assembly	2 managers, 20 workers (milling and ecotourism)	Yes

A greater access to financial capital in Llano Grande and Piedra Canteada has allowed these CFEs to diversify and move further up the value chain to process timber. Government aid can facilitate access to financial resources and provide significant support for scaling up. This has reduced the costs of reforestation with the installation of nurseries, a sawmill has been established, and there are training opportunities for women in the commercial production of handicrafts. Llano Grande has received the highest amount of official funding. However, external actors indicated that high dependence on external support (governments, NGOs, donor organizations, elites, external operators) can also present an obstacle. Unlike Las Minillas, Llano Grande has strengthened its financial capital through reinvesting harvesting returns towards land stewardship and forest management taking advantage of government support but becoming highly dependent. Piedra Canteada has also received government support but is not necessary for this CFE to survive. In fact, together with the less diversified Santa María de las Cuevas, Piedra Canteada is the CFE with the least amount

of external financial government support (CONAFOR 2020, pp. 489–507).

### 3.3.2 Capacity for forest management

Training in forestry management and other technical skills is key to the sustainability of CFEs. In Santa María de las Cuevas, management of the commercial harvest of pine nuts is in the hands of only a few members of the community, and there is no collective system to ensure the sustainable use of the resource. Knowledge of the harvest cycle and forestry practices improves management; this, coupled with third-party certification, can improve sustainability indicators, providing certainty and lead to market opportunities, thereby contributing to scaling up.

In Las Minillas and Llano Grande, significant knowledge about forest management is confined to those *ejiditarios* who work in forest operations. In Piedra Canteada, the greater economic diversification enables increased opportunities for training, including in forest management; forest management

capacities are strengthened collectively through the work in the nursery and sawmill.

### 3.3.3 Capacity for business management

Communities with higher levels of legal capacity, operational efficiencies, and business formation have many of the key elements required for scaling up. In central Mexico, this is not the norm and, therefore, this represents a barrier for the four communities studied here. Santa María de las Cuevas has not yet developed market capacity because of issues with the social organization of the business, there is no forest management plan, nor the interest in managing collectively. In Las Minillas, the ability to sell products or to enter new markets was not identified as a priority. Another barrier that impedes scaling up in Las Minillas is a lack of internal business capacity; since business management skills have not been developed within the *ejido*, the CFE relies on external professionals for administrative work such as chartered accountancy. Llano Grande and Piedra Canteada ensure the training of their own people in accounting, finance, and other areas of business management.

### 3.3.4 Organizational capacity

Organizational capacity encompasses governance systems (the ability to hold assemblies, as well as their frequency), equitable distribution of profits, and a sense of organizational identity (Table 6). In this region, scaling up will require transference of local mechanisms to regional governance, as well as financial management that ensures the equitable distribution of revenue. Sustainable management and utilization of a forest resource becomes an opportunity for scaling up. The CFEs under study differ in their degree of internal organization, particularly in the mobilization of community members and the establishment of initiatives for scaling up. Santa María de las Cuevas faces the greatest challenges in terms of organizational capacity and difficulties in reaching agreements because of the inefficiency of its assemblies in communicating knowledge and information about forest harvest and management amongst *ejidatarios*; to this is added the unequal distribution of harvesting opportunities and profits from the pine nut crop. In Las Minillas, *ejidatarios* can attend the assemblies, and decisions can be timely and collective, although in some cases, such as the decision to enter a new market, the *ejidatarios* have found it more difficult to reach an agreement; exploration of alternative commercial opportunities may also be impeded by a lack of local initiative and by the complex nature of the decision-making.

In both Llano Grande and Piedra Canteada, organizational capacity is robust; these communities have fostered collective identities and established clear terms of appointment

to strengthen organizational capacity, thus supporting scaling up. For example, in Llano Grande, women organize themselves around making handicrafts; this has the potential to form the base of clustering activities, where business capacity increases as women across CFEs collaborate. Hence, women's involvement in business management has the potential to result in greater CFE success.

### 3.3.5 Clustering

We found no evidence of effective regional governance or collective participation, which are important factors in decision-making and scaling up. Hence, one of the greatest barriers to scaling up in this region is the lack of clustering. These four CFEs were not affiliated among themselves, and only rarely with other entities beyond the scope of this study. In Santa María de las Cuevas, the *ejidatarios* generally perceive that the community must reach a greater level of unity and trust within its own ranks, so the prospect of external affiliations is unlikely. In Las Minillas, the *ejidatarios* stated that they were not formally connected with other *ejidos* in any way. In Llano Grande, four interviewees saw no obstacle to affiliation, whereas the other four considered affiliations to be impossible due to a lack of internal agreement; there, many *ejidatarios* want to continue to operate independently. In Piedra Canteada, collaborations and associations exist with other businesses in other parts of the region because specialized services have been developed. For all four enterprises in the study, efforts to scale up would benefit from the promotion of a regional collective identity.

### 3.3.6 Insecurity and illegality

For CFEs to scale up, the illegal sale of products must be eradicated. Santa María de las Cuevas and Las Minillas are the most susceptible to the insecurity arising from illegal logging and theft. Llano Grande and Piedra Canteada have fenced mountainous areas and deployed surveillance brigades with some success. Four of the eight interviewees in Llano Grande reported that surveillance brigades work efficiently, while the other four believed that there were no issues with security. In contrast, interviewees from Santa María de las Cuevas and Las Minillas believed that measures informally accepted by community members, such as the deployment of surveillance brigades, have been insufficient to deal with theft and insecurity, according to what was said in the interviews. In Santa María de las Cuevas, community landholders spoke of robberies, damage to private property, and theft of their main crop, pine nuts; although the pine nut harvest is a collective activity, the use of the resource is not regulated under community management plans nor recognized under official legislation, and this weakens any attempt at surveillance. This means that there is no plan for

**Table 7** Summary of criteria and sub-topics for the scaling up of CFEs. B, Barrier; O, Opportunity; C, Challenge

Criteria	Sub-topics	Santa María de las Cuevas	Las Minillas	Llano Grande	Piedra Canteada			
Forest law enforcement	Fulfillment of forest law	B	C	O	O			
Tenure and ownership	Property rights	O	O	O	O			
Management and Land Use Planning Rights	Management rights: economic activities	O	O	C	O			
	Land use planning	B	B	C	O			
	Local accountability. Economic management	B	C	O	O			
Markets	Access and strengthening of markets	B	C	C	C	O		
	Communication platforms and product information exchange	B	C	C	O	O		
	Physical infrastructure, logistics and accessibility	B	C	C	C	C		
	Period of commercialization	B	B	B	B	B		
	Key product for commercialization	B	C	O	O	O		
	Buyers and consumers of products	C	C	C	C	C		
	Products and services	O	O	O	O	O		
	Key economic activities	O	C	O	O	O		
Natural capital	Resources within own territory	O	O	O	O			
	Ecosystem services	O	O	O	O			
	Utilization of products that fall outside those determined in the forest management plan	O	O	O	C			
Financial capital	Capital investments (value of key investments)	B	C	O	O			
	Government support	B	B	C	O			
	Value of credits and loans	C	C	O	O			
Forest management capacities	Knowledge of the harvesting cycle and forestry practices	O	C	O	O			
	Knowledge of forest management impacts	B	O	O	C			
	Monitoring capacity	B	O	O	O			
	Certification	C	C	O	O			
	Improvements in forest management	O	C	C	O			
Business management capacities	Legal capacity. Knowledge of legal and management functions in enterprises	O	C	C	O			
	Accounting and financial management	B	C	B	C	O		
	Human resources	B	C	B	O	O		
Organizational capacities	Governance. Capacity to order the assembly	B	O	O	O			
	Governance. Frequency of assemblies	B	C	O	O			
	Distributional equality of resources (gains)	B	O	O	O			
	Collective identity; time and terms for appointed seats in the organization	C	B	C	O			
Clustering	Partnership with other producers	B	C	B	C	B	C	O
	Perspectives on partnering with other producers	B	C	B	C	B	C	B
Insecurity and illegal logging	Insecurity/ illegal logging	C	B	O	O			
	Actions to mitigate illegality	C	B	O	O			
	Efficiency of activities	C	B	O	O			

the use of forest resources in this community. In Las Minillas, community landholders regard the lack of security as an ongoing problem (Table 7).

Industry professionals and forestry technicians estimated that at least one-half of Mexican forest products are of illegal origin. This is due to poor governance, lack of monitoring, and the presence of organized crime. Interviewees mentioned that

official surveillance measures are practically non-existent, and that illegal logging is pervasive in most communities. Moreover, a general lack of regulations for sawmills facilitates the trade of timber without paying taxes. As a result, CFEs are forced to compete with the lower prices of timber from illegal logging activities in the region (Table 7).



## 4 Discussion

### 4.1 Capacities of CFEs in regional forestry value chains

The external factors that act as barriers to scaling up CFEs in this region include inaccessibility of national-level monetary and fiscal policies, imposition of strict export regimes, a lack of infrastructure for industrial-scale processing, and insufficient diversification of the regional forest industry. Although the legislative framework for forests in this region provides opportunities for scaling up, the macroeconomic context and high degree of competitiveness hinders these CFEs from doing so; the complex mixture of local (land tenure, organizational capacity, governance), regional (markets, clustering) and national (institutional) factors constitutes a barrier. CFEs should improve their organizational and business management skills and consolidate their respective governance structures to provide greater opportunities to diversify. Opportunities could include improved internal organization of the communities, the presence of a regional collective identity, the establishment of clear terms of regional nomination, and improved governance and monitoring to deal with the illegal origins of Mexican forest products. Although CFEs are crucial for local livelihoods and wellbeing by providing much needed goods and services, creating high quality job opportunities, and distributing wealth in an equitable manner (Molnar et al. 2008; Sánchez Badini et al. 2018), their potential to improve local economies and achieve operational effectiveness at the regional and national level has not yet been fully explored. Indeed, in terms of business management capacity and technical skills, the studied communities face many more obstacles than opportunities. A lack of business acumen within CFEs can lead to larger issues, such as low levels of organizational capacity, lack of adequate skills for managing resources, and limited access to markets (Merino and Martínez 2014). Ideally, a CFE should train local staff to perform administrative duties rather than relying on the availability of outside sources. This requires an investment in time, effort, and financial resources, and may represent a steep learning curve for many (Macqueen 2008, Rainforest Alliance 2007), but evidence suggests that improvements in technical, commercial and financial capacities will add value to operations regarding timber and non-timber forest products and will reduce the costs of production and management (Antinori and Bray 2005, pp. 1529–1543; Molnar et al. 2008).

Communities where members are actively involved in forest management decision-making and participate in education and training programs, have an advantage

for scaling up, for example acquisition of skills in management and administration (including use of computers). Piedra Canteada and Llano Grande have developed extensive business management skills, internal training capabilities, and robust consulting capacities, all lacking in Santa María de las Cuevas and Las Minillas, whose representatives expressed interest in external training in accounting and business management for their own staff but said that this would generate a dependence on outside experts. In contrast, CFEs in Madhupur Sal, Bangladesh, have reported that intensive training and education has led to community empowerment, and that the training process itself led to new ideas for the utilization of the forest, including the way to improve local livelihoods with the marketing of non-timber forest products and agroforestry practices (Kabir et al. 2018, pp. 149–170). Our results also show that one of the most important means of scaling up revolved around addressing forest management challenges and better capitalizing on existing market systems. In addition to in-house business and technical capabilities, well-developed organizational capacity is also a commonly cited requirement for CFEs scaling up (Salazar and Gretzinger 2005, pp.25–27). Among the four cases studied in central Mexico, organizational capacity is greatest in Piedra Canteada, where the enterprise was set up separately by the ejido and manages its forest operations as a private enterprise. Its high economic diversification has led to high levels of social cohesion within the community, a necessity for the successful management of a CFE (Baynes et al. 2015, pp. 226–238; Stoian et al. 2009; Macqueen 2008).

In Las Minillas, Llano Grande, and Piedra Canteada—have built organizational capacity through cooperation, here, forest management is carried out collectively, and these collaborations have built institutional strength within the communities. These results are in line with findings from other regions (Chhatre and Agrawal 2009, pp. 17,667–17,670; Garcia-Lopez 2013, pp. 406–431; Hajjar et al. 2011, pp. 2159–2169), and the conclusion that organizational capacity requires strong social capital (Pagdee et al. 2006, pp. 33–52). In these three cases, legitimate power and leadership was exercised through the participation of members of the ejidal assembly. Participation holds authorities accountable to the ejido and ensures transparency in timber and non-timber operations. In addition, several key external actors (forest technicians and government officials) have helped to build organizational and management capacity under government programs in these three CFEs (Baynes et al. 2015, pp. 226–238). These results are not surprising. Several studies have pointed to the importance of establishing collaborations and engaging in support networks for training and business activities, including sharing success stories and ways to adapt those experiences to the realities of each community

(Molnar et al 2008). Such clustering activities can bring into rural communities an entrepreneurial culture that is comprehensive and inclusive of all sectors involved in the timber value chain (Salazar and Gretzinger 2005, pp. 25–27). Policymakers and stakeholders should consider context-specific strategies for the holistic success of CFEs in central Mexico; successful enlargement does not inevitably lead to deforestation. This study provides practical socio-ecological tools and strategies to identify and assess barriers to diversification activities in CFEs in other forest contexts. For example, it can be useful for making evidence-based recommendations to improve forest management policies and strategies; to develop economic potential; and to facilitate access to markets, innovation and finance for sustainable forest products.

## 4.2 Increasing the economic attractiveness of CFEs

The ability of a CFE to scale up is related to efficient business management and production capacity (Donovan et al. 2006 pp. 104) and effective collaboration between the community, local authorities, environmental organizations and private companies. Four case studies in Bolivia, Brazil and Nicaragua (Pacheco 2012) identified the main obstacles for scaling up to be organizational capacity, access to timber markets, and the contextual conditions for forestry operations. Scaling up CFEs also hinges upon the identification of market opportunities that promise economies of scale, increased marketing capacity, and greater bargaining power (Molnar et al. 2008). These factors were all found to limit the potential of the four CFEs studied in central Mexico. Since wood supply within Mexico is not enough to meet the growing demand, these CFEs are vital components of the local economy and infrastructure, buoyed by generally high lumber prices, low transportation costs, and excess machine capacity (Morales 2015, pp. 206–208). Molnar et al. (2008) suggest that alliances ought to be formed between intermediaries, buyers, processors, and CFEs to promote an economic model based on locality and financial self-sufficiency. Pacheco (2012) further suggests factors that lead to CFE success, including community infrastructure, installed capacity, and organization at the regional scale, and access to market information, all of which are lacking in the central Mexican context. Indeed, CFEs in the study region exhibit inadequate strategic business planning and marketing skills, which limit their potential to establish and maintain mutually beneficial business partnerships with other actors in the supply chain. They require institutional support so that issues around business productivity and efficiency receive the same attention as their social and environmental objectives, as has been suggested for Latin America (Molnar et al. 2008; Pacheco 2012, pp.114–123). One potential path forward is to provide market support for these CFEs that would allow them to compete on an industrial scale (Pattberg 2005, pp.

356–374). A case study in Peru suggested that success in timber-oriented CFEs is more likely if they can capitalize on their internal organizational and management capacities to identify opportunities in timber markets (Cossío et al. 2011).

Our study suggests that the degree of internal organizational capacity is key to overcoming problems related to scaling up, including the adoption of measures regarding legality, access to markets, investment, and business growth. We recommend that CFEs seek novel and differentiated business opportunities, while developing internal capacities based on sound business principles, to initiate mutually beneficial business relations with other CFEs and other enterprises along the supply chain. Where community members are actively involved in decision-making (Llano Grande and Piedra Canteada) and participate in education and training programs we see greater potential to achieve scaling up. The region aspires to diversify its sources of income related to forest resources, such as ecotourism, production of non-timber forest products and participation in carbon offset programs. The ecotourism markets are robust. The region's relatively unfavorable macroeconomic environment (Cubbage et al. 2015, pp. 623–650; Torres-Rojo et al. 2016, pp. 93–105) tends to keep lumber prices down. In contrast, CFEs in this area have managed to maintain high margins for their wood products because of unsatisfied local demand, low transportation costs, and proximity to large population centers (Shackleton et al. 2007). Notably, there exist solid markets for forest goods and services, including unmet demand for goods and services in the region's large population centers, where consumption levels are high. This resembles conditions in a municipality of northern Brazil (Pacheco 2012), where CFEs, despite their remote location, benefit from large urban markets and improved organizational capacity.

Non-timber forest products also hold promise for CFEs in central Mexico, but many of the same issues are encountered. For instance, pine nuts command a high price but Santa María de las Cuevas has not fully exploited the potential for market development because it is remote from large population centers, lacks infrastructure, and has poor access to communication (Adam et al. 2013, pp. 90–97). Further, the low income that the CFE obtains under these poor conditions limits the ability to seek out other, more diversified opportunities (Hernández-Moreno et al. 2018, pp. 265–279). Similar problems have been observed elsewhere; for example, in Cameroon, where inefficient marketing of wild edibles has been attributed to poor infrastructure and market conditions (including theft), irregular supplies, weak communication infrastructure, limited access to information, poor organization between producers and traders, and insufficient storage. For CFEs to obtain greater benefits from non-timber forest products, markets must be more competitive, production must be more efficient, and the general business

skills of CFEs must be improved. Identifying barriers to diversification of activities can facilitate the application of instruments and tools to overcome these challenges and promote the development of more resilient and sustainable business models that can improve the socio-economic conditions of forest communities. Therefore, this research provides not only a detailed assessment of the factors affecting CFEs in Mexico, but also guidance to both policy makers and forest managers in promoting more sustainable and economically viable forest management.

### 4.3 Policy considerations for CFEs

Our results point to interdependencies and synergies that exist between internal and external factors, as well as areas for improvement in terms of providing CFEs with more leverage to influence markets and policy-making in the central Mexican region. Policymakers and stakeholders should address issues related to taxation, export regimes, technological constraints, and regulatory frameworks to create an enabling environment for the scaling up of CFEs in central Mexico. Moreover, recognizing and incentivizing compliance with sustainable forestry practices can further contribute to the long-term success of these enterprises.

Although clustering activities with external actors or between communities can be important, CFEs in central Mexico should develop and strengthen their social capital before taking any steps that require collective action and/or partnerships with other communities. These collaborations should be based on trust, as well as a set of shared objectives and goals. However, this has not been achieved in the studied *ejido*-based CFEs, where the *ejidatarios* indicated a lack of trust as the main reason that clustering among CFEs in central Mexico is common. In addition, these CFEs differ in the quantity and quality of their natural and human resources, and this impedes the search for common ground in terms of shared objectives (Guerra-De la Cruz et al. 2007).

Although the ability to engage with actors beyond the boundaries of a community aids successful forest management (Baynes et al. 2015, pp. 226–238), trust between communities relies on institutional systems at regional and local levels to support these clustering activities and to resolve any differences between the CFEs. Therefore, CFEs should reconsider traditional ways of organizing, and decentralized policies should be developed to encourage CFEs to engage in clustering with other supply-chain actors, especially in management procedures (Donovan et al. 2006). An example in Australia's community forests shows that cooperation and partnerships between actors have broadened the capacity for local-level initiatives, leading to increased social capital at the local and regional levels, which, in turn, can lead to improved social bonding and cohesion between CFEs at the regional level (Ordóñez Díaz et al. 2015, pp. 7–16).

Clear delineation of property rights to conduct forest management is crucial in scaling up CFEs and determining a community's joint commitment to develop its CFE. When land tenure arrangements are unclear, illegal forestry activities can emerge, especially if there is a concurrent lack of forest law enforcement and self-regulation (Hajjar et al. 2011). This is the case in central Mexico, where insecurity, violence, and illegal logging limit the potential to scale up these CFEs. The illegal forest sector is complex and involves broad networks of power and influence that operate across many geographic, socio-political, and economic contexts. In our study sites, insecurity and illegality are constant threats to the CFEs and limit their options for internal and external investment in infrastructure or improvement of their management practices. This is exacerbated by a perceived lack of government oversight and control, and an abundance of regionally available illegal wood (Pattberg 2005, pp. 356–374).

For CFEs, illegal logging is especially problematic, not only because it distorts the market, but also because it can erode community cohesiveness and institutions (Cresswell 2011, pp. 149–57). Illegal forestry activities and corruption rob communities of their valuable timber, depress market prices, and reduce sales revenue (Hajjar et al. 2011, pp. 2159–2169; Pokorny et al. 2010). Paradoxically, many CFEs find themselves operating an unauthorized system, particularly due to their inability to meet excessive bureaucratic requirements of the regulatory regime, or in regions where their customary rights are not recognized (Carodenuto and Cerutti 2014). Local, regional, and national policies must provide regulatory frameworks to guide the operations of CFEs. The present case studies suggest the following recommendations for scaling up in terms of sustainability: (1) establish a regular monitoring system to assess forest health and dynamics, (2) develop predictive models to help anticipate possible changes in forest structure and composition, (3) incorporate climate change scenarios and other relevant variables into the models, (4) support scientific research to better understand forest dynamics and the factors that may trigger undesirable changes, (5) adopt sustainable forestry practices to maintain system diversity and interactions, (6) replace clear-cutting with selective cutting to maintain species diversity, (7) encourage natural regeneration and avoid monoculture, (8) conserve key habitats, (9) promote practices that improve forest resilience to natural disturbances such as wildfire or pests, (10) involve local communities in forest management decision making, taking advantage of their traditional knowledge and local experience and (11) develop educational programs for landowners, forest workers and the general public, emphasizing the importance of sustainable management. Our study suggests several future directions, e.g. extending and adapting the theoretical framework of Badini et al. (2018) to different contexts and types of CFEs to fine-tune, validate and promote policy and forest management recommendations. Also, is imperative to explore more broadly the

opportunities for innovation and financing based on sustainable timber and non-timber products, as well as in the value chain. Finally, is necessary to identify elements to maintain long-term economic diversification of activities in forest communities, assessing both socio-economic and ecological benefits.

## 5 Conclusions

Analysis of the obstacles and opportunities of different contexts, organizational models and levels of diversification can provide insights into the advantages and disadvantages of different organizational structures; more effective scaling up in different forest contexts to improve policy and management; and enable a more diversified economy for CFEs. Moreover, an integrated multi-level (local, regional, national) and multi-context (social, economic, political, institutional) analysis allows understanding the complexities inherent in CFEs and how they influence their development. In this context, the high diversification in Piedra Canteada suggests a greater ability to adapt to different markets and tap into multiple sources of income, which could increase the economic resilience and capacity for sustainable scaling up. Llano Grande has moderate diversification and considerable specialization of forest products, with a tree nursery, sawmill, women's artisanal cooperative; this suggests a solid basis for economic growth and scaling up, especially if focused on specific market niches. Las Minillas, despite its moderate-low diversification and a focus on roundwood, may have opportunities for scaling up if it can diversify its activities and explore new markets. Santa María de las Cuevas, with low profitable diversification and a concentration on the extraction of pine nuts, could face greater challenges for sustainable scaling up if it fails to diversify its economic activities to reduce its dependence on a single main resource. In summary, this study suggests that sustainable scaling up of a forest enterprise in central Mexico will be favored by high diversification.

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## Declarations

**Conflict of interest** On behalf of all authors, the corresponding author states that there is no conflict of interest.

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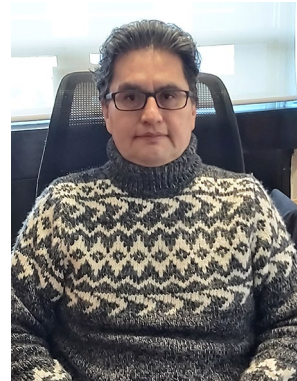
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