# Land-use and livelihoods dynamics around payments for ecosystem services in Mexico's forest communities

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The PhD researcher and supervisors declare that the PhD research was conducted according to the principles of scientific integrity, as mentioned in the General PhD Regulations and the General Charter for PhD Researchers of UAntwerp and the Integrity Charter for PhD Researchers and Supervisors affiliated with the University of Antwerp.

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For Rodrigo, the love of my life
and Maya, the life of our love

In loving memory of
Margit Frenk Freund
(1925-2025)

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Very few things in life can trace their origin to a single key moment or decision that changes everything. This thesis is one of those things. None of what led to it would have been possible if not for the opportunity to work with Professor Elizabeth Shapiro-Garza (Liz) as a master's student at Duke University between 2017 and 2019. I was actually looking for a PhD programme, having already graduated from a Master of Science in conservation science and obtained a Bachelor's degree in biology, but was instead offered a place at Duke's Master of Environmental Management programme and a generous scholarship. I took it, and moved my family to Durham (North Carolina), because I knew I wanted to continue working with Mexico's payments for ecosystem services (PES) programmes, and Liz seemed like just the expert I wanted to learn from. This decision has paid out in many wonderful ways which I will try to summarize below, and for which I will be forever grateful. For her part, Liz turned out to be not only a brilliant scholar, but one of the nicest, most down-to-earth and overall wonderful people I have ever had the pleasure of meeting. So, thank you, Liz, for literally everything.

Soon after joining Duke, I set out to meet Liz and basically recruit her as a mentor for my masters' project. We were both, of course, interested in PES, but also on how PES were interacting with other land uses on the ground. We got another student, Johanna Depenthal, to join our ambitious project, which would involve eight weeks of fieldwork in three different regions of Mexico (thank you, Johanna for continuing to be a dear friend and someone I reach out to when I'm struggling to wrap my head around research methods or the interpretation of my findings). One of the regions we visited was Oaxaca, where we were hosted by an organization that Liz had already been partnering with for about a decade: the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO). Meeting ICICO's technical services team and talking to community leaders and young people involved in community forest enterprises in Capulálpam de Méndez, Santiago Xiacuí, La Trinidad Ixtlán and San Juan Lachao was the most eye-opening experience of my career. Thank you immensely to the late Carlos Marcelo Pérez González, then technical director of ICICO and himself from Capulálpam de Méndez, for sharing his vision for communities and their forests and for demonstrating an endless commitment to sustainability, justice and respect that the rest of us can only aspire to. Getting to hear that he was proud of and impressed by the work I was doing back in 2024, just a few months before his passing, was one of the highlights of my PhD. Thank

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Shortly after graduating from Duke University, Liz put me in contact with her friend and colleague Santiago Izquierdo Tort, who at the time was a postdoctoral researcher at the Université du Québec en Outaouais (UQO) and was leading a review of the literature on Mexico's PES. This was another key moment, facilitated by Liz, that led to a fruitful partnership with a wonderful mentor and would eventually open many doors. Thank you, Santiago, for your trust and generosity, and most importantly for constantly reminding me that there is much to love about PES (yes, I will wear your I <3 PES shirt if you ever get around to making them, I may just add some small print). A few of the many connections that I made through Santiago deserve to be highlighted here. As part of the work we started doing together in 2021, Santiago introduced me to Jimena Deschamps Lomelí, who I would go on to recruit as a research assistant for my PhD fieldwork during the summer of 2023. Jimena, thank you so much for your hard work and excellent company, I could not have asked for a better person to share this adventure with, as evidenced by the fact that everyone in Lachao and La Trini keeps asking about you every time I go back. In a PES workshop that I helped him organize, Santiago also introduced me to Tanya Hayes, who I would later ask to be a member of my PhD jury. Thank you, Tanya, for your sharp and insightful comments delivered with kindness that greatly improved this thesis, particularly Sections 4 and 5. And finally, Santiago also put me in contact with what I call the Manchester team: Johan Oldekop and his students and postdocs. Thank you, Johan, for making me feel part of the gang at times when I have really needed it, and thank you Lucas, Katie, Mariana, Sandy, Pepe and everyone else for making it so rewarding.

But going back to my story, around the same time that I started working with Santiago, I started looking (again) for a PhD programme that would allow me to pursue my interest of working with communities in Mexico on PES and other forest policies. While pursuing an ultimately unsuccessful funding application to come back to Duke, Liz once again worked her magic and introduced me to Gert Van Hecken, a longtime colleague and friend based at the University of

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## RÉSUMÉ EN FRANÇAIS

Que ce soit pour leurs ressources naturelles ou leur importance en matière de conservation, les forêts communes font depuis longtemps l'objet de débats quant à leur intégration dans divers régimes de gestion qui ont, directement et indirectement, remodelé leur utilisation et leur valorisation. Au Mexique, les concessions forestières étatiques et la désignation d'aires protégées ont cédé la place à des approches plus décentralisées, où les communautés mettent en place volontairement des programmes de gestion forestière conformes à la réglementation étatique et intègrent leurs aires de conservation à un registre national. Parallèlement, les communautés ont de plus en plus recours aux paiements pour services écosystémiques (PSE) et, plus récemment, aux systèmes de compensation carbone forestière (CCF), dans le cadre desquels les gouvernements ou des acteurs privés versent des paiements annuels en échange de la préservation de forêts gérées activement. Ces politiques de gestion et de conservation des forêts sont mises en œuvre simultanément et souvent sur les mêmes territoires, ce qui témoigne d'une vision des forêts dont on peut tirer profit aux niveaux local et national sans en réduire la superficie totale.

Cette thèse adopte une approche multi-échelle et transdisciplinaire pour examiner qui bénéficie de ces services et qui en supporte les coûts. Dans le but d'explorer comment les interactions dynamiques entre les modes historiques d'occupation des sols et la participation aux politiques forestières décentralisées influencent les territoires, les visions et les institutions au sein des communautés mexicaines, trois études indépendantes mais complémentaires sont menées dans le cadre des systèmes socio-écologiques (SSE) ; elles répondent à des objectifs plus spécifiques aux échelles nationale, régionale et locale. À l'échelle nationale, nous confirmons le constat souvent cité selon lequel les communautés possèdent et gèrent plus de la moitié des forêts du Mexique — une proportion restée stable autour de 52 % entre 2010 et 2020, représentant 42 % des forêts situées hors des aires protégées. Il existe de fortes synergies entre certaines politiques forestières clés : les communautés ayant déjà participé à des programmes de paiement pour services environnementaux (PSE) sont plus susceptibles d'avoir obtenu, par la suite, une autorisation d'exploitation du bois. Par ailleurs, bien que seules 12 % des communautés possèdent des territoires chevauchant des aires protégées, ces dernières représentent 30 % de la couverture forestière communautaire totale. Sur une période de vingt ans, les communautés dont les terres étaient soumises à la fois aux PSE et à des autorisations d'exploitation du bois ont enregistré une perte de couvert forestier moindre que celles participant uniquement aux

PSE ; cette perte est d'une ampleur comparable à celle observée dans les communautés dont les terres sont incluses dans des aires protégées formelles. Toutefois, cette analyse décontextualisée ne permet pas de saisir la manière dont ces politiques sont perçues par les communautés concernées ni le rôle qu'elles jouent dans des stratégies de subsistance plus larges.

Pour répondre à ces questions, nous adoptons une approche fondée sur une analyse à l'échelle régionale du rôle que jouent la planification et la mise en œuvre de projets dans le renforcement — ou l'entrave — de la capacité de cinq communautés à faire face aux chocs et aux tensions qu'elles perçoivent. À travers une étude de cas, mes coauteurs et moi examinons le rôle d'une organisation dirigée par des peuples autochtones — Integradora de Comunidades Ingígenas y Campesinas de Oaxaca (ICICO) — dans l'élaboration et la mise en œuvre de projets de compensation carbone forestière (CCF) avec cinq de ses communautés membres. Notre analyse des données issues des entretiens révèle que les stratégies adoptées par les communautés pour la mise en œuvre des projets CCF et la répartition des revenus s'inscrivent dans une logique de résilience transformatrice et y contribuent ; cela se traduit notamment par la création d'emplois locaux pour les jeunes et les femmes, le renforcement des capacités de lutte contre les incendies de forêt et l'amélioration de la sécurité hydrique. Nous observons également un large consensus parmi les membres des communautés ayant participé à la prise de décision ou à l'exécution des projets CCF quant au rôle essentiel joué par l'ICICO pour assurer le succès de ces projets, notamment en instaurant un climat de confiance, en facilitant des processus de planification participative et en mettant en œuvre des stratégies de résolution des conflits. Toutefois, certains défis subsistent, notamment en ce qui concerne le décalage perçu entre les aspects de la forêt valorisés par les projets CCF (principalement le bois d'œuvre et le potentiel de stockage du carbone) et la vision de certains interlocuteurs, pour qui la forêt possède une valeur intrinsèque et la conservation constitue la voie privilégiée pour assurer leur avenir. Par ailleurs, les institutions de gouvernance traditionnelle fondées sur le service communautaire obligatoire sont perçues par certains comme étant incompatibles avec les structures entrepreneuriales nécessaires à la gestion efficace d'une entreprise forestière.

J'examine ces défis en adoptant une méthodologie participative au sein de deux communautés ICICO qui diffèrent considérablement par leurs caractéristiques socio-écologiques et leur historique de gestion forestière. J'étudie la manière dont La Trinidad Ixtlán et San Juan Lachao ont adapté et modifié leurs institutions traditionnelles pour les harmoniser avec les règles et

réglementations formelles, notamment en ce qui concerne les systèmes de service communautaire obligatoire et non rémunéré ainsi que la propriété privée de fait au sein des espaces forestiers communs. Ce faisant, j'apporte une validation empirique au « cadre de gélification institutionnelle » (institutional jelling framework), récemment proposé, qui vise à identifier les situations permettant une fusion entre institutions formelles et informelles. Dans le cas de La Trinidad, communauté pionnière de la foresterie communautaire, tous les aspects des structures de gouvernance ont été adaptés au cours des quatre dernières décennies afin de maximiser les retours économiques de la gestion forestière, notamment par l'intégration de postes relevant du service communautaire au sein de leurs entreprises d'exploitation forestière, d'écotourisme et de scierie. À l'inverse, à Lachao — où la foresterie communautaire constitue un modèle beaucoup plus récent —, une mauvaise gestion de la part des responsables élus au titre du service communautaire, conjuguée à des conflits concernant la délimitation des zones du programme, a exacerbé des tensions préexistantes et conduit à la suspension du plan de gestion forestière.

Cette thèse approfondit notre compréhension des conséquences, voulues ou non, des approches décentralisées de la conservation et de la gestion des forêts dans les SSE en explorant la question à différentes échelles et selon diverses perspectives disciplinaires au sein d'une même étude. Elle s'appuie sur un véritable engagement envers une recherche participative et ancrée dans la communauté, démontrant ainsi la pertinence de cette approche pour aborder des questions complexes dans le cadre de partenariats constructifs et de mécanismes de rétribution appropriés. En passant d'une échelle d'analyse nationale à une échelle régionale puis locale, chacune avec sa propre approche méthodologique et analytique, ce travail démontre également qu'une compréhension globale des politiques de décentralisation forestière doit s'appuyer sur la combinaison de différentes perspectives disciplinaires et échelles, notamment les évaluations d'impact, la contextualisation et l'analyse des dynamiques de pouvoir. Compte tenu de la popularité mondiale des programmes promettant des solutions gagnant-gagnant pour la conservation et le développement tels que les PSE et les CCF, ce type d'analyse est crucial pour identifier les compromis dans les usages, les valeurs et les institutions autour de la gouvernance forestière qui émergeront sans aucun doute.

**Mots-clés :** Systèmes socio-écologiques ; régime communautaire ; politiques de décentralisation forestière ; recherche engagée ; résilience transformatrice équitable ; cadre de gélification institutionnelle

**ENGLISH ABSTRACT**

Whether for their natural resources or their conservation relevance, the forests that endure within communities' territories have long been a contested target for incorporation into diverse management regimes that have directly and indirectly reshaped how they are used and valued. In the case of Mexico, state-led forest concessions and protected area designations have given way to more decentralized approaches, where communities voluntarily establish timber management programmes that adhere to state regulations and incorporate their conservation areas into a national registry. Meanwhile, communities have increasingly embraced payments for ecosystem services (PES) and, more recently, forest-based carbon offsets (FBCO) schemes, where governments or private parties make annual payments in exchange for the preservation of actively managed forests. These decentralized forest management and conservation policies are being pursued at the same time and often within the same territories, which conveys a vision for forests from which local and national utilities can be extracted without diminishing their total extent.

In this thesis, a multiscale and transdisciplinary approach is mobilized to examine who is collecting these utilities and who is bearing the costs. With the central objective of exploring how dynamic interactions between historical land-use patterns and participation in decentralized forest policies influence lands, visions and institutions in Mexican communities, three independent but complementary studies are developed within a social-ecological systems (SES) framework that address more specific objectives at national, regional and local scales of analysis through an explanatory sequential mixed methods approach. At the national level, we confirm the often-cited statement that communities own and manage more than half of Mexico's forests, having stayed constant at around 52% between 2010 and 2020 and representing 42% of the forest outside protected areas. Strong synergies exist between certain key forest policies, with communities that have a history of participation in PES being more likely to have obtained a timber authorization at a later date. And while only 12% of communities have territories that overlap with protected areas, these account for 30% of all communal forest cover. Over a 20-year period, communities with land under both PES and timber authorizations saw less forest cover loss than those with PES only, and this forest loss is at a similar scale as that which is occurring in communities with lands under formal protected areas. This decontextualized analysis, however, fails to reveal how these policies are perceived

in affected communities and the roles they play within broader livelihood strategies and institutional setups.

To answer these questions, we turn to a regional-scale analysis of the role of project planning and implementation in strengthening or hindering communities' capacity to address perceived shocks and stresses. Through a case study approach, we look at the role of an Indigenous-led organization – the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO) – in developing and implementing FBCO projects with five of its member communities. Our analysis of interview data shows that communities' strategies for FBCO project implementation and revenue allocation are consistent with and contribute to transformative resilience, including generating local employment for youth and women, strengthening capacity to fight wildfires, and increasing water security. We also find strong consensus among those community informants who were involved with decision-making or execution of FBCO projects on the essential roles played by ICICO for successful project development, including building trust, facilitating participatory planning processes, and implementing strategies for conflict resolution. Some challenges remain, however, with regards to perceived misalignments between the aspects of forests that are valued by FBCOs, mainly their timber and carbon storage potential, and some interviewees' views of forests as intrinsically valuable and their perception that conservation is the preferred path that can sustain them into the future. Additionally, traditional governance institutions or rules based on mandatory community service were perceived by some as incompatible with the entrepreneurial structures that are required to successfully manage a forest-based business.

The perceived misalignments in institutions and values are explored through a participatory methodology in two ICICO communities that differ greatly in terms of socio-ecological characteristics and their history of forest management. I study how La Trinidad Ixtlán and San Juan Lachao have adapted and modified their traditional institutions in an effort to align them with formal rules and regulations, particularly their systems for mandatory, unpaid community service, and de-facto private ownership within the forest commons. In doing so, I provide empirical validation for the recently proposed 'institutional jelling framework', which seeks to identify cases where formal and informal institutions (rules) can be blended. In the case of La Trinidad, a pioneer of community forestry, they have adapted all aspects of their governance structures over the past four decades to maximize returns from forest management, adding community service positions within their logging, ecotourism and sawmill enterprises. In the

case of Lachao, where community forestry is a much more recent paradigm, mismanagement by leaders elected for community service and conflict over the coverage of programme polygons exacerbated preexisting tensions and led to the suspension of the timber management plan.

This thesis increases our understanding of the intended and unintended consequences of decentralized approaches to forest conservation and management in SES by exploring the issue from multiple scales and disciplinary perspectives within a single study. It does so with genuine commitment to participatory, community-engaged scholarship, thus demonstrating the strength of this approach for addressing complex questions in meaningful partnership and with appropriate retribution mechanisms. By moving from a national to regional and then local scale of analysis, each with its own methodological and analytical approach, this work also demonstrates that a comprehensive understanding of forest decentralization policies in community contexts must be informed by piecing together different disciplinary perspectives and scales, including impact assessments, contextualization, and unpacking power dynamics. In light of the global popularity of schemes promising win-win solutions for conservation and development such as PES and FBCOs, this type of analysis is crucial for identifying the trade-offs in the uses, values and institutions around forest governance that will undoubtedly be created or exacerbated.

**Keywords:** Social-ecological systems; communal land tenure; decentralized forest policies; community-engaged scholarship; equitably transformative resilience; institutional jelling

## NEDERLANDSE SAMENVATTING

Of het nu gaat om hun natuurlijke hulpbronnen of hun belang voor natuurbehoud: gemeenschappelijk beheerde bossen zijn lange tijd een doelwit geweest voor opname in uiteenlopende beheersvormen, die – direct en indirect – de manier waarop deze bossen worden gebruikt en gewaardeerd hebben veranderd. In Mexico hebben door de staat aangestuurde bosconcessies en de aanwijzing van beschermde gebieden plaatsgemaakt voor meer gedecentraliseerde benaderingen; hierbij zetten gemeenschappen op vrijwillige basis programma's voor houtbeheer op die voldoen aan overheidsvoorschriften en nemen ze hun natuurbehoudsgebieden op in een nationaal register. Tegelijkertijd maken gemeenschappen steeds vaker gebruik van betalingen voor ecosysteemdiensten (PES) en, meer recentelijk, van regelingen voor koolstofcompensatie via bosbeheer (FBCO), waarbij overheden of private partijen jaarlijkse betalingen verrichten in ruil voor het behoud van actief beheerde bossen. Dit beleid inzake bosbeheer en natuurbehoud wordt gelijktijdig en vaak binnen dezelfde gebieden uitgevoerd; het weerspiegelt een visie op bossen waarbij lokale en nationale voordelen kunnen worden behaald zonder dat de totale bosoppervlakte afneemt.

In dit proefschrift wordt een benadering gehanteerd die zowel meerdere schaalniveaus als meerdere disciplines omvat, om te onderzoeken wie de opbrengsten van deze voorzieningen en diensten ontvangt en wie de kosten draagt. Met als centraal doel te verkennen hoe de dynamische wisselwerking tussen historische landgebruikspatronen en deelname aan gedecentraliseerd bosbeleid invloed heeft op het land, de toekomstvisies en de instituties in Mexicaanse gemeenschappen, zijn drie onafhankelijke maar complementaire studies opgezet binnen het kader van sociaal-ecologische systemen (SES). Deze studies richten zich op specifiekere doelstellingen op nationaal, regionaal en lokaal schaalniveau. Op nationaal niveau bevestigen we de veelgehoorde stelling dat gemeenschappen eigenaar zijn van en beheer voeren over meer dan de helft van de Mexicaanse bossen; dit aandeel bleef tussen 2010 en 2020 stabiel op ongeveer 52% en vertegenwoordigt 42% van het bosareaal buiten beschermde gebieden. Er is sprake van sterke synergie tussen bepaalde belangrijke vormen van bosbeleid: gemeenschappen met een geschiedenis van deelname aan programma's voor PES hebben vaker op een later tijdstip een vergunning voor houtkap verkregen. Hoewel slechts 12% van de gemeenschappen over grondgebied beschikt dat overlapt met beschermde gebieden, beslaan deze gebieden 30% van het totale bosareaal in gemeenschappelijk bezit. Over een periode van twintig jaar vertoonden gemeenschappen met grond die zowel onder PES-regelingen als onder

houtkapvergunningen viel, minder bosverlies dan gemeenschappen die uitsluitend aan PES deelnamen; dit bosverlies is vergelijkbaar in omvang met dat in gemeenschappen met grond binnen formeel beschermde gebieden. Deze analyse, die losstaat van de specifieke context, maakt echter niet duidelijk hoe dit beleid in de betrokken gemeenschappen wordt ervaren en welke rol het speelt binnen bredere strategieën voor levensonderhoud.

Om deze vragen te beantwoorden, richten we ons op een analyse op regionale schaal van de rol die projectplanning en -uitvoering spelen bij het versterken of belemmeren van het vermogen van vijf gemeenschappen om om te gaan met ervaren schokken en stressfactoren. Aan de hand van een casestudy onderzoeken mijn co-auteurs en ik de rol van een door inheemse volken geleide organisatie – Integradora de Comunidades Indígenas y Campesinas de Oaxaca (ICICO) – bij het ontwikkelen en uitvoeren van bosgerelateerde koolstofcompensatieprojecten (FBCO-projecten) met vijf van haar lidgemeenschappen. Uit onze analyse van interviewgegevens blijkt dat de strategieën van de gemeenschappen voor de uitvoering van FBCO-projecten en de verdeling van de opbrengsten aansluiten bij – en bijdragen aan – transformatieve veerkracht. Dit omvat onder meer het creëren van lokale werkgelegenheid voor jongeren en vrouwen, het versterken van het vermogen om bosbranden te bestrijden en het vergroten van de waterzekerheid. Daarnaast is er onder de geïnterviewde gemeenschapsleden die betrokken waren bij de besluitvorming of uitvoering van de FBCO-projecten een grote mate van overeenstemming over de essentiële rol die ICICO speelt bij een succesvolle projectontwikkeling; hierbij gaat het onder meer om het opbouwen van vertrouwen, het faciliteren van participatieve planningsprocessen en het toepassen van strategieën voor conflictbeheersing. Er blijven echter enkele uitdagingen bestaan. Zo is er sprake van een ervaren discrepantie tussen de aspecten van bossen die voor FBCO's van waarde zijn – voornamelijk hun houtopbrengst en potentieel voor koolstofopslag – en de opvattingen van sommige geïnterviewden, die bossen als intrinsiek waardevol beschouwen en van mening zijn dat natuurbehoud de beste weg is naar een duurzame toekomst. Bovendien werden traditionele bestuursvormen die gebaseerd zijn op verplichte gemeenschapsdienst door sommigen als onverenigbaar beschouwd met de ondernemersstructuren die nodig zijn voor het succesvol beheren van een bosgerelateerde onderneming.

Ik onderzoek deze uitdagingen aan de hand van een participatieve methodologie in twee ICICO-gemeenschappen die sterk van elkaar verschillen qua sociaal-ecologische kenmerken en hun geschiedenis van bosbeheer. Ik bestudeer hoe La Trinidad Ixtlán en San Juan Lachao

hun traditionele instituties hebben aangepast en gewijzigd om ze in lijn te brengen met formele regels en voorschriften; dit betreft met name hun systemen voor verplichte, onbetaalde gemeenschapsdienst en de feitelijke privé-eigendom binnen de gemeenschappelijke bosgebieden. Hiermee lever ik empirische onderbouwing voor het onlangs voorgestelde 'institutional jelling framework' (raamwerk voor institutionele versmelting), dat gericht is op het identificeren van gevallen waarin formele en informele instituties kunnen worden gecombineerd. In het geval van La Trinidad – een pionier op het gebied van gemeenschapsbosbeheer – zijn in de afgelopen vier decennia alle aspecten van de bestuursstructuren aangepast om de opbrengsten uit bosbeheer te maximaliseren; zo zijn er functies voor gemeenschapsdienst gecreëerd binnen hun ondernemingen voor houtkap, ecotoerisme en houtzagerij. In het geval van Lachao, waar gemeenschapsbosbeheer een veel recenter concept is, leidden wanbeheer door leiders die voor gemeenschapsdienst waren verkozen en conflicten over de afbakening van programmagebieden tot een verergering van reeds bestaande spanningen en uiteindelijk tot de opschorting van het houtbeheerplan.

Deze dissertatie vergroot ons begrip van de beoogde en onbedoelde gevolgen van gedecentraliseerde benaderingen van bosbehoud en -beheer in sociaal-ecologische gebieden door de kwestie vanuit meerdere schalen en disciplinaire perspectieven binnen één studie te onderzoeken. Dit gebeurt met een oprechte toewijding aan participatief, gemeenschapsgericht onderzoek, waarmee de kracht van deze aanpak wordt aangetoond voor het beantwoorden van complexe vragen in zinvolle samenwerking en met passende compensatiemechanismen. Door van een nationaal naar een regionaal en vervolgens lokaal analyseniveau te gaan, elk met een eigen methodologische en analytische benadering, laat dit werk ook zien dat een alomvattend begrip van decentralisatiebeleid in bossen in gemeenschapscontexten moet worden gevormd door verschillende disciplinaire perspectieven en schalen samen te voegen, waaronder effectbeoordelingen, contextualisering en het ontrafelen van machtsverhoudingen. Bovendien is dit type analyse, gezien de wereldwijde populariteit van regelingen die win-winoplossingen beloven voor natuurbehoud en ontwikkeling, zoals PES en FBCO's, cruciaal voor het identificeren van de afwegingen in het gebruik, de waarden en de instituties rondom bosbeheer die ongetwijfeld zullen ontstaan of verergeren.

**Trefwoorden**: Sociaal-ecologische systemen; gemeenschappelijk grondbezit; beleid voor decentralisatie van bosbeheer; maatschappelijk betrokken wetenschapsbeoefening; rechtvaardige en transformatieve veerkracht; institutionele consolidatie

## FOREWORD

*Where are you from?*

This is the question I get asked more than any other while out in "the field". Implied in this question is, of course, how evident it is for everyone I come across that I am not from there, nor from anywhere they may immediately recognize. Part of this is the fact that these are tight-knit communities where people know each other. But a big part is my physical appearance, the way I dress, even the way I speak. I am tall, I have light skin, and I usually wear the traditional outfit you would expect from a field scientist (hiking boots, quick-dry pants and long-sleeved shirts with multiple pockets, wide-bream hat, ergonomic backpack, sunglasses), none of which you would commonly expect to find on a woman from their region. (In one of my meetings with the leadership body in charge of monitoring territorial zoning and conflicts, where they were getting ready to go measure a farmers' plot, I will never forget a woman who put an open reel measuring tape into her small purse, got up, and left to join her colleagues wearing open sandals and a medium-length skirt, while I was dressed like Indiana Jones just to conduct interviews.)

*Where are you from* is also a question I dread, because there is no simple and straightforward answer. If I were to ask them the same question, many of them would immediately picture the place where they were born, where usually their parents and grandparents were also born, where they grew up, where they went to school, where they and their children continue to live and work. But for me, each of these examples requires a different answer. I was born in the UK. My mother was born in Bolivia, and so were her parents, and while my father was born in Mexico City, his mother was born in Germany and his father in the state of Jalisco. I grew up between the city of Xalapa (in the state of Veracruz), the city of Morelia (in Michoacán) and then Mexico City towards the end of high school. I did my undergraduate degree in Mexico City, but then a masters' degree in the UK, followed by another masters' in the United States, and at the time of writing I am a joint doctoral candidate at the University of Quebec and the University of Antwerp. My child was born in Marseille, and my family and I currently live in Paris, where we are hoping to settle in the long term, whatever that might mean.

Through years of practice, I now have a pre-prepared answer to this question. *¿De dónde es usted? Soy de Xalapa, Veracruz*. This is the city where I spent the longest amount of time (nine

years) and makes me seem more approachable than if I gave any of the other possible answers. But any follow-up questions require long and complicated answers.

All this to say that, while the international academic community may perceive me as a Mexican researcher doing work in her home country, in her own culture, an example perhaps of turning a critical eye on our own backyards, they are not entirely right. Yes, I am Mexican, but Mexico has not been my *home* for the past thirteen years. And having been raised by the son and daughter of immigrants, my *culture* is a true mix of influences, to which I have now added all the other foreign contexts in which I have chosen to live and work. So, when I am in the field, when I am talking to people from small rural communities in Oaxaca, I am as much an outsider as any other *güera* from a university abroad. I even get told fairly often and with mild surprise that my Spanish is very good. Difficult to tell which one of us is more embarrassed when I tell them why…

Having a life that is so far removed from my study sites, both physically and mentally, also meant that my time in the field was always very constrained. As a mother to a small child, and as a family that have emigrated far from our networks that could have offered us more support, I could not spend very long away from home. This was a real challenge. My longest stay was a six-week period in the summer of 2023, during which I made several trips back and forth from Mexico City to visit my daughter. I was even lucky enough to be able to bring her with me for a few days before really launching into my fieldwork, as part of a visit to three ICICO communities with the ROSES team (Researching Oaxaca's Socio-Ecological Systems). She was only three years old, but she still remembers some moments from that trip, and I am sure that it helped open her eyes to the ways that other people live and care for the land. Overall, what I lacked in length of stays I tried to make up for in frequency of visits, spending time in La Trinidad and Lachao in five different occasions between 2023 and 2025.

Beyond these logistical and positionality challenges, this PhD adventure also came with some serious epistemological dissonance. This thesis is being written to fulfil the requirements of a joint PhD degree in Ecological Economics (UQO) and Development Studies (UA). I will admit that when I set out on this journey back in 2021, I did not fully grasp what this would entail. To date, when I explain my situation to people at scientific conferences, I usually get raised eyebrows or even a rhetorical question: is that even a thing? Apart from the bureaucratic challenges, which have been many and considerable, grasping and integrating the worldviews of each of these well-established disciplines is a herculean task. From my very naïve

perspective, based on my background in the natural sciences (biology and conservation science), I figured both of these disciplinary perspectives ultimately want the same thing, which is development that is sustainable, just, and equitable for all. Turns out it is not that simple. Worldviews and concepts that many ecological economists accept and even embrace, such as ecosystem services (ES), are criticised by many development scholars. As part of my PhD trajectory, I had the opportunity to write and defend a qualifying exam about the connections and tensions that exist between political ecology and the concept of ecosystem services, which I titled "Whose ecosystem? Whose service?". This exercise proved incredibly valuable, and basically put me off from employing an ES framework for the rest of my doctoral research. I still had the challenge, however, of coming up with a thesis that can be considered relevant and appropriate by both study programmes. Time will tell whether and to what degree it succeeded.

Finally, I wish to close this section by highlighting the fact that my experience as a PhD student and candidate was incredibly rich and wide-ranging, as it provided me the opportunity to create and collaborate in a number of projects during the course of this 5-year adventure which did not make it into this thesis. These include the outputs I produced as part of my commitment to community-engaged scholarship, through which I sought to give back to the communities of La Trinidad Ixtlán and San Juan Lachao for hosting me and participating in this work:

- Alatorre, A. 2025. *San Juan Lachao – Lugar de encrucijadas*. Written report of research findings delivered to community leadership and collaborators.
- Alatorre, A. 2024. *La Trinidad Ixtlán – Entre el bosque, la mina y el campo*. Written report of research findings delivered to community leadership and collaborators.
- Alatorre, A. (conceptualization and filming), Deschamps Lomelí, J. (filming), Cuevas, M. (editing). 2024. *San Juan Lachao*. Short video documentary about the history of the community's territory and its transformations.
- Alatorre, A. (conceptualization and filming), Deschamps Lomelí, J. (filming), Cuevas, M. (editing). 2024. *La Trinidad Ixtlán*. Short video documentary about the history of the community's territory and its transformations.

Additionally, during this time I contributed to a systematic review of the literature on Mexico's PES by coding full texts and collating implementation data from 12 PES subprogrammes, which became the first step in the broader database I would then go on to assemble for Section 3. I participated in the analysis, write-up and dissemination of the results by co-organizing a conference held in Mexico City in June 2023, as first author of an open-access database of the coded literature review, and as co-author of a paper:

- Alatorre, A., Deschamps Lomeli, J., & Izquierdo-Tort, S. 2024. *PESMEX20: 20 years of payments for ecosystem services in Mexico* [Data set]. Zenodo. DOI: 10.5281/zenodo.11549024
- Izquierdo-Tort, S., Alatorre, A., Shapiro-Garza, E., Corbera, E., Deschamps, J., Ávila Foucat, S., Carabias, J., Dupras, J., Kolinjivadi, V., Nuñez, J.M., Perevochtchikova, M., Sims, K., Van Hecken, G. 2025. *Payments for ecosystem services in Mexico: Two decades of progress and challenges between research and practice.* Ecosystem Services. DOI: 10.1016/j.ecoser.2025.101720

I then continued working with Santiago Izquierdo-Tort as a research assistant and elaborated a theoretical framework and participatory methodology for a pilot project on community biodiversity monitoring involving PES participants in the Lacandona region of Chiapas, Mexico:

- Izquierdo-Tort, S., Alatorre, A., Arroyo-Gerala, P., Shapiro-Garza, E., Naime, J., Dupras, J. 2024. *Exploring local perceptions and drivers of engagement in biodiversity monitoring among Payments for Ecosystem Services participants in Southeast Mexico*. Conservation Biology. DOI: 10.1111/cobi.14282

I also had the joy of seeing a work that I contributed to before beginning my PhD finally see the light, and worked closely with my coauthors to prepare and publish a systematic map of enabling conditions for conservation in the lands and territories of Indigenous Peoples and local communities. This work was also incredibly helpful in getting up to date on this body of literature:

- Brittain, S., Alatorre, A., Bullough, L.A., Newing, H. 2025. *Enabling conditions for conservation on Indigenous and community lands*. Conservation Biology. DOI: 10.1111/cobi.70055

Another collaborative work that was recently published is one that was led by a former PhD candidate at UQO, and where I contributed to writing and preparing the paper for publication by sharing my insights about PES and community forestry in Mexico:

- Zaga-Méndez, A., Izquierdo-Tort, S., Alatorre, A., Gagné-Mimeault, F.A., Dupras, J. 2026. *"We invest it in the forest": multiple payments for ecosystem services (PES) programs as inputs for community forestry in Amanalco, Mexico*. Trees, Forests and People. DOI: 10.1016/j.tfp.2026.101280

I also undertook a solo project which built on the PESMEX database, mentioned above, and the ePEStemology database, a project that represented the beginning of the inter-institutional collaboration between UQO and the IOB that would eventually lead to my joint appointment. I was invited to contribute a chapter to the Routledge Handbook of Cultural Ecosystem Services, and used both reviews of the PES literature to explore the existing and hypothetical

ways in which PES programmes are designed to pay for cultural ES, and how the intended and unintended impacts have been studied:

- Alatorre, A. 2025. Paying for cultural ecosystem services: How and for whom? In: McElwee, P., Hsu, M., Allen, K., Gould, R., Hsu, M., He, J (eds). *Routledge Handbook of Cultural Ecosystem Services*. ISBN : 9781032540467

Among the eight academic conferences and workshops in that I participated in in different capacities throughout these five years, I want to highlight one which brought me special joy. Since 2023, I have been working with the ROSES team to develop funding applications that would allow us to fulfil a long-term goal of Prof. Shapiro-Garza and ICICO, which was to bring together Indigenous communities and their partner organizations from across North America to share experiences and concerns around their interaction with forest-based carbon offsets. We were successful in receiving funding, and I continued to provide logistics support for the planning of the first International Convening on Indigenous Forest-Based Carbon Offsets, held in Vancouver, Canada, between April 28th and May 1st, 2025. I organized notetaking during the event and produced a final report, in English and Spanish, based on the summaries I developed from these notes.

Also, since August 2024 I have been working on a project led by my long-term colleague Santiago Izquierdo-Tort, where I took the lead in an impact evaluation of Mexico's PES programmes. We are specifically looking at the issue of programme permanence by assessing whether reductions in funding lead to increased forest cover loss in communities that were previously participating in PES. I have already presented some of the findings from this work at the 2025 Forests & Livelihoods: Assessment, Research, and Engagement (FLARE) Annual Meeting in Lima, Peru, and am currently contributing to writing a paper that will be submitted for publication very soon.

Finally, I must also mention the other, all-consuming, life-changing project that I undertook simultaneously and constantly along with my PhD: raising a wonderful, magical human being from a toddler to a confident child. Maya was not even two years old when I embarked on my PhD journey, and she and this thesis have both been painfully but lovingly nurtured with care and dedication. I am incredibly proud of them.

## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ADVC | *Áreas Destinadas Voluntariamente a la Conservación* (Areas Voluntarily Destined to Conservation) |
| CAR | Climate Action Reserve |
| CARBIOIN | *Carbono, Agua y Biodiversidad Indígena* (Indigenous Carbon, Water and Biodiversity) |
| CES | Compensation for Ecosystem Services |
| CFE | Community Forest Enterprise |
| CONABIO | *Comisión Nacional para el Conocimiento y Uso de la Biodiversidad* (National Commission for the Knowledge and Use of Biodiversity) |
| CONAFOR | *Comisión Nacional Forestal* (National Forest Commission) |
| CONANP | *Comisión Nacional de Áreas Naturales Protegidas* (National Commission of Natural Protected Areas) |
| CONEVAL | *Consejo Nacional de Evaluación de la Política de Desarrollo Social* (National Council for Development Policy Evaluation) |
| ES | Ecosystem Services |
| FAPATUX | *Fábrica de Papel de Tuxtepec* (Tuxtepec Paper Factory) |
| FBCO | Forest-Based Carbon Offsets |
| ICICO | *Integradora de Comunidades Indígenas y Campesinas de Oaxaca* (Integrator of Indigenous and Campesino Communities of Oaxaca) |
| IFM | Improved Forest Management |
| INECC | *Instituto Nacional de Ecología y Cambio Climático* (National Institute of Ecology and Climate Change) |
| IP&LC | Indigenous Peoples and Local Communities |
| IRDef | *Índice de Presión Económica a la Deforestación* (Index of Economic Pressure on Deforestation) |
| LTI | La Trinidad Ixtlán |
| NAFTA | North America Free Trade Agreement |
| NGO | Non-Government Organization |
| ODRENASIJ | *Organización por la Defensa de los Recursos Naturales de la Sierra Juárez* (Organization for the Defence of Natural Resources of the Sierra de Juárez) |

| | |
|---|---|
| OECM | Other Effective Conservation Measures |
| PES | Payments for Ecosystem Services |
| PROCYMAF | *Proyecto para la conservación y manejo sustentable de los recursos forestales* (Project for the Conservation and Sustainable Management of Forest Resources) |
| PRODEFOR | *Programa de Desarrollo forestal* (Programme for Forestry Development) |
| PSA | *Pago por servicios ambientales* (Mexico's payments for ecosystem services programme) |
| SAO | *Servicios Ambientales de Oaxaca* (Environmental Services of Oaxaca) |
| SEMARNAT | *Secretaría de Medio Ambiente y Recursos Naturales* (Ministry of the Environment) |
| SES | Social-Ecological System |
| SJL | San Juan Lachao |
| SMJ | Santa María Jaltianguis |
| SMP | Santa María Peñoles |
| SX | Santiago Xiacuí |
| UZACHI | *Unión de Comunidades Productoras Forestales Zapotecos Chinantecos de la Sierra Juárez* (Union of Zapotec-Chinantec Forest Producing Communities of the Sierra Juarez) |

# 1. INTRODUCTION

The importance of forests for the survival of life on earth is uncontested (Potapov et al., 2017), particularly in the face of climate change (Griscom et al., 2017). Many of the world's remaining forests are in the hands of Indigenous Peoples and other groups who have long stewarded their lands under customary or community-based regimes (Fa et al., 2020; Fernández-Llamazares et al., 2024; Garnett et al., 2018) despite immense pressures from a wide range of extractive activities. Demand for forest products such as timber, for example, must often compete with other uses and values for forest landscapes, including food production and conservation (Torres-Rojo et al., 2016). Today, the owners of forest landscapes face a wide variety of instruments of public policy and incentives related to the production of timber, nontimber products, and 'ecosystem services', including the emergence of incentive-based programmes and subsidies aimed at reducing deforestation or land use change.

Among the growing number of programmes and interventions aimed at facilitating or incentivizing Indigenous Peoples and local communities to continue safeguarding their forests, many can be grouped under the label of payments for ecosystem services (PES), which consist of financial or other incentives for stewardship practices that maintain or increase some proxy ecological feature that has been monetarily valued (Kaiser et al., 2021). These instruments can take the form of publicly funded and administered programmes, where water fees are used to finance the active conservation of upstream forests, for instance, or international markets for carbon or biodiversity offsets in which public and private actors participate (Salzman et al., 2018). Recently, this type of intervention has been rebranded and grouped under the banner of 'other effective conservation measures' (OECMs), which a prominent sector of the international community aims to deploy in order to meet ambitious global targets such as the 30x30 objective (CBD, 2024), net zero (IPCC, 2022), or the decade on restoration (UN environment programme, 2021).

In Mexico, as in other parts of the world, the prevalence of communal ownership of land and forests (Barsimantov & Kendall, 2012; Madrid et al., 2009a), which resulted from a flawed but comprehensive process of agrarian reform (Assies, 2008; D. Bray, 2013; D. B. Bray et al., 2006), has placed Indigenous and peasant communities as targets for various forest decentralization policies or OECMs aimed simultaneously at securing the supply of forest 'products' and 'services' while aiding in their economic 'development'. Communal forests under active timber management working under the form of community forest enterprises

(CFEs) receive extensive financial and technical support to increase their output (Cubbage et al., 2015; Frey et al., 2019), while balancing goals that go beyond the maximization of profits (Macqueen, 2008; Torres-Rojo et al., 2016). Mexico also has some of the largest and longest-standing public PES programmes in the world, and they represent a powerful force in its policy landscape. Since 2003, they have provided cash payments and technical support in exchange for forest management activities such as fire prevention and monitoring to ensure the prevalence of forest cover (Córdoba et al., 2021; Denham, 2017; Gómez Bonilla, 2017; Pischke and Wellstead, 2020; Shapiro-Garza, 2020). More than seven million hectares have been enrolled in Mexico's national PES programmes, 90% of which have been in communities (Izquierdo-Tort et al., 2025). More recently, forest-based carbon offset projects have been expanding across Mexico, mostly in communal lands (Haya et al., 2025).

The effects of an intervention or programme like forestry subsidies or PES go far beyond those originally intended. Each choice to participate or engage with a given intervention is informed by a community's historical context, as well as internal and external power structures, and will in turn influence future land-use decisions. Furthermore, the impact of these forest decentralization policies is often described in terms of fragmented social *or* ecological outcomes, which occludes the connections between them (Lund et al., 2018) and the multiple meanings that landscapes have for the people who are part of them (Dempsey & Robertson, 2012; Kull et al., 2015a; Lele et al., 2013; Robertson, 2012). And in addition to the objectives of policymakers and proponents of forest decentralization, forest stewards have their own objectives, their own visions for the future, and their own institutions that have enabled them to care for their lands over generations. What happens when these visions align? And what happens when they do not?

This thesis reflects on these questions with an exploration of the interactions between decentralized forest management and conservation policies, on the one hand, and communities' lands, their visions for the future, and their governance institutions, on the other. Using a transdisciplinary and multiscale approach that combines geospatial data at the national level (Section 3) and qualitative interview data at the regional (Section 4) and local scale (Section 5), this thesis examines the case of Mexico, a country that is well-known for forest decentralization policies in the form of large-scale community-based natural resource management and incentive-based conservation policies (Barkin & Fuente, 2013; Izquierdo-Tort et al., 2025). I study how establishing community forest enterprises and complementing

them with income from incentive-based forest conservation and management programmes has become a prevalent strategy that many communities in Mexico have employed to diversify their income sources and generate significant collective benefits such as local employment and infrastructure, while grappling with the ways their traditional governance institutions and arrangements can come into conflict with programme rules and expectations.

Written in partial fulfilment of a joint PhD degree in Ecological Economics and Development Studies, this thesis is composed of three interrelated but distinct articles, each with its own specific focus and theoretical framework embedded within a social-ecological systems (SES) approach. After introducing the thesis (Section 0) and presenting the analytical frameworks, research objectives and methodologies (Section 1), Section 3 looks at Mexico's forest communities 'from above', elucidating some overarching trends and patterns around land privatization, land cover, and enrolment in forest conservation and management programmes. This descriptive chapter sets the stage for the more contextualized analysis that follows by demonstrating how the Mexican government sees communities' forests and the prevalence of certain types of participation that elucidates when and where communities are engaging with these visions. This section is written as a draft of an article that will be submitted to Geoforum.

Section 4 then moves into a regional scale and analyses a particular type of incentive-based forest policy, forest-based carbon offsets (FBCOs), and the impacts of project planning and implementation on perceived threats and strategies for 'resilience' in five communities across the state of Oaxaca. This empirical chapter presents findings from work conducted through a participatory, community-engaged partnership with the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO). Here, I use thematic analysis of semi-structured interviews with individuals involved in a participatory planning process to put people's visions for the future of their communities and their forests front and centre. I map out the shocks and stresses perceived by interviewees and the strategies their communities employ to face or mitigate those threats, the community actors involved at each stage of the FBCO project planning process, and how different aspects of project planning and implementation address perceived threats and strategies. This section is written as an article prepared for a special issue based on the 2025 global assessment report titled 'Forests as pillars of social and economic resilience' (Allen et al., 2025).

Then, by narrowing the spatial scope but broadening the types of voices heard and the methods employed, Section 5 looks at two of these five communities in Oaxaca and explores the effects

of PES and other forest management and conservation policies on traditional institutions for forest governance. Through semi-structured interviews, timeline focus groups, participatory mapping and participant observation, I explore the changes in forest governance across time and space that the communities of La Trinidad Ixtlán and San Juan Lachao have put in place in response to the rules and regulations of the forest enterprises they manage and other sources of funding. This section is written as a book chapter that will feature in an upcoming publication titled 'Institutional jelling theoretical approach: Global cases on Outcomes of (mis)alignment across socio-ecological systems'. Finally, Section 6 presents the general conclusions of this thesis, outlining its theoretical and empirical contributions as well as limitations and avenues for future work.

This chapter proceeds as follows. Section 1.1 introduces the key topics of land and land use, forests and commons. Section 1.2 presents the historical background of the current land tenure situation in Mexico, and how the governance structures that support community life were put in place. Section 1.3 introduces the origins of community forestry in Mexico and the forms it currently takes. Section 1.4 describes Mexico's experience with PES, both as a key policy that has touched communities across the country for more than 20 years as well as the most recent incentive-based forest policy that has rapidly expanded: Forest-based carbon offsets.

## 1.1. Land and land use; commons and common use

A central premise of this thesis is that land, particularly the forest commons, is subject to many competing interests and visions, and that these interacting pressures will lead to different outcomes depending on the context as well as the scale of analysis and the methodology employed. In this section I will reflect on the key concepts of 'land', 'nature', 'forest' and 'commons' and briefly discuss some relevant schools of thought.

### *1.1.1. On whose 'land' will 'nature' be protected?*

Within the context of international climate and environment commitments that drive the emergence of the types of forest programmes that are the subjects of this thesis, access to land and land tenure are key, especially since "a significant part of climate mitigation and adaptation ideas and actions require maintaining or reordering access to natural resources" (Franco & Borras, 2021). But the way that land itself is understood is highly political, as it can be seen both as a physical resource and as a complex social institution (Assies, 2009). The term 'land politics' refers to "the land-based social relations between social classes and groups within

society, and between the state and society, that are structured by formal and informal, state and non-state rules, procedures or norms, and the degrees of autonomy and capacity of actors to understand their situation and take actions to maintain or change it" (Franco & Borras, 2021). While some see land as "the basis of all life" and central to sovereignty and self-determination (Gutto, 2014), several competing schools of thought exist. Assies (2009) identifies two primary (although limited) orientations: one treating land as an economic asset, another emphasizing human rights, food security, and shelter. A comprehensive report on land and land rights similarly contrasts the "Western-legal view" (land as property rules) with the "anthropological view" (emphasizing social and political relationships) (Daley & Hobley, 2005). These differences in views and definitions about land are at the heart of the dynamics that will be explored in this thesis, where the views of the Mexican state or the international voluntary carbon market towards communities' territories will repeatedly clash with communities' own visions and the institutions that they have developed and adapted to access and steward their land.

The next subsection of this introduction will describe in detail the history of land tenure in Mexico, and how communal ownership got to be recognized and become relatively secure. Land tenure can be defined as "an institution that mediates the relationship between social and ecological components of a socio-ecological system" (Barnes, 2009). Land tenure can also be conceived of as a bundle of rights, where it is not always the same person that holds all the rights (Klein & Robinson, 2011). In land politics, the concept of 'land tenure security' is highly contested: whose tenure and whose security, and for what end? (Franco & Borras, 2021). As a concept it is not always an objective measure of the declared status of land tenure, but rather a subjective perception that land will not be taken. Both formal and informal tenures usually coexist, and informal realities, in which tenure security starts with the recognition of land rights by family, neighbours, and local leaders, are often stronger than formal or legal ones (Deininger, 2005).

This is an issue that has become particularly prevalent under the contemporary global land grab debate. The term 'land grab' generally refers to large-scale, cross-border land deals or transactions that are carried out by transnational corporations or initiated by foreign governments and concern the lease (often for 30–99 years), concession or outright purchase of large areas of land in other countries for various purposes (Zoomers, 2010). As Fairhead and colleagues write, land grabbing involves "the restructuring of rules and authority over the

access, use and management of resources, in related labour relations, and in human-ecological relationships, that may have profoundly alienating effects" (Fairhead et al., 2012). The purposes of such global land investments include mainly food and energy crops, but this is just the tip of the iceberg. "Green" projects such as conservation and carbon offsets can also be seen to represent types of land grabbing (Fairhead et al., 2012; Zoomers, 2010).

Target 4 of Sustainable Development Goal 1 (No Poverty) aims to "ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property" (United Nations, 2025). One indicator for this goal is the "proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure." This follows a logical thought process that investing in mapping and registration would lower transaction costs and lead to land commodification, as well as preventing conflict by providing clarity and solving overlapping claims (Vendryes, 2014). In practice, however, titling, or the process of providing legal documentation proving land ownership, can have negative consequences for the poor and marginalized, as described by Vendryes (2014). Tenure insecurity can result when a title is now required to prove ownership that was previously widely accepted, which costs time and money to acquire. These types of initiatives often focus on the heads of households, meaning that women and youth often do not benefit. They may also increase conflict, at least initially, and must be accompanied by deliberate mediation mechanisms and access to justice. According to Vendryes, replacing informal with formal land tenure should be done in a context-specific way as well as gradually and incrementally within a broader land policy that combines and prioritizes land issues in an inclusive manner (Vendryes, 2014).

Another key aspect with regards to land is what goes on it and how it is used. Ecosystems or land-use types represent management and use regimes that are decided on by people, and are outcomes of past ecological and social dynamics (Lakerveld, 2012). A review of the term 'forest', for example, found that different management objectives form the basis from which a forest is conceptualized and definitions are created, which can range from a source of timber products, an ecosystem composed of trees along with other forms of biological diversity, a home for Indigenous Peoples, a repository for carbon storage, a source of 'ecosystem services', as social-ecological systems, or as all of the above (Chazdon et al., 2016). Essentially, forests can be conceived of as a 'land cover' category, when they describe the type of things that grow

on the land, or a 'land use' category, when it is acknowledged that human societies depend on and manage them for specific purposes. Chazdon and colleagues note the emergence of an integrated, landscape-level conceptualization of forests, which I adopt in this thesis: Forests and their surrounding landscapes are complex, adaptive systems, whose properties arise through self-organization and interactions among internal and external components, including human societies; their management requires balancing multiple types of ecosystems with the needs of multiple sets of actors who use them.

An ecosystem can also be conceived of as a concept for analysis, not a tangible thing (Kull et al., 2015b): the concept is predominantly applied to 'natural' areas, which are predominantly viewed by Western societies as something conceptually separate and physically set apart from the human (Adams & Hutton, 2007; Kull et al., 2015b). The way nature itself is understood is political, as different social actors define it in very different, and culturally dependent, ways (Adams & Hutton, 2007; Vaccaro et al., 2013). Since the earliest examples, the demand for nature as a scarce, highly valued commodity by powerful elites has led to parks and protected areas being created on peripheral, often mountainous rural areas (Adams & Hutton, 2007; Vaccaro et al., 2013). The protection of 'nature' in non-urban areas at national and global scales is achieved by economically and culturally reorganizing rural areas, leading to a structural urbanization of the rural world by connecting and integrating it into regional, national and international management schemes and markets (Vaccaro et al., 2013). This integration does not happen without economic, infrastructural, and cultural transformations. Conservation actors have a remarkable power to define and delineate nature, to determine who can engage with it and under what rules, and to divide landscapes into zones that structure rights and access (Adams & Hutton, 2007). Paradoxically, this view has led to 'wilderness' creation in formerly inhabited lands (Adams & Hutton, 2007).

### *1.1.2. The commons*

In this thesis, I look at questions around forests and land use from one specific perspective, that of the territories where groups of people make collective decisions around their access, use and management. According to Berkes and colleagues (1989), common-property or common-pool resources can be defined as those for which exclusion is difficult, and where joint use involves subtractability (Berkes et al., 1989). Like other resource types, common-pool resources can be held in one of four basic property rights regimes: open access (absence of well-defined property rights), private property (an individual or a corporation has the right to exclude others and

regulate its use), state property (rights vested exclusively in government which controls access and levels of exploitation), and communal property (Ibid.). In communal property tenure systems, resources are held or managed by an identifiable 'community' of users who can exclude others and regulate their use (Berkes et al., 1989). A commonly used definition of 'community' is that of heterogeneous groups composed of individuals with varying degrees of power and formal ownership, whose members are often linked by social ties, share some common perspectives, and may engage in joint action (MacQueen et al., 2001). The concept of the 'commons' is a more inclusive term, encompassing both common-pool resources and well as common property regimes (Hess, 2008). Through a review of the literature, Hess (2008) arrives at the following definition: "A commons is a resource shared by a group where the resource is vulnerable to enclosure, overuse and social dilemmas. […] it requires management and protection in order to sustain it" (Hess, 2008, p.37). This definition adequately conveys the situation that is the unit of study for this thesis, that is, Mexico's forest commons.

Within the commons literature, a lot of emphasis has been placed on the role of institutions in securing the future prevalence of the resource or resources. The term 'institution' can be understood as a system of socially embedded rules and norms (Hodgson, 2006). In her groundbreaking book, Governing the Commons, Ostrom derives a hierarchy of decision systems that govern rights of access, withdrawal, management, exclusion and alienation over common-pool resources (Ostrom, 1990, 2005): operational rules govern day-to-day decisions around the use, maintenance and monitoring of resources and the rules developed by the users, including sanctions for rule breaking; collective-choice rules are developed by resource users or external authorities and refer to policymaking for management and conflict resolution that affects operational rules; and constitutional-choice rules govern collective choice through rule formulation, governance, and processes for modifying existing rules. This conception separates the standard categories of private, public and common property rights into a separable "bundle of rights", as described above (Klein & Robinson, 2011; Ostrom, 2005). As noted by Bray (2020), and as will be explored in this thesis, in the case of Mexico most constitutional and collective choice rules as well as many operational rules around forest management and conservation are not chosen by the communities, but come from the state (D. B. Bray, 2020). The way these rules at different levels meet and merge with each other will be explored in Section 5, while Section 4 reflects on the role of intermediaries in making these links and the potential for resilient outcomes to occur.

Another key contribution by Ostrom with regards to institutions as rules are her proposed 'design principles' from the study of common-pool resources which she associates with enduring institutions (rules) that preserve these resources (Ostrom, 1990). These were then modified and refined in a later work (Ostrom, 2005). Ostrom's design principles can be summarized as: 1) Clearly defined boundaries for the commons and individual rights; 2) The rules devised to govern the commons are congruent with local conditions; 3) Most individuals affected by the operational rules are included in the group that can modify these rules; 4) The monitors who detect infractions are either the users themselves or accountable to the users; 5) Violators receive graduated sanctions; 6) Parties have rapid access to low-cost local arenas to resolve conflicts; 7) The rights of appropriators to design their own institutions are not challenged by external government authorities; and 8) Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises. As will be described in more detail in Section 1.2.2, communities in Mexico often exhibit many of Ostrom's design principles. However, important discrepancies exist, and addressing these differences is helpful for understanding Mexico's communities and their forests as social-ecological systems (SES).

As outlined by Hall and colleagues (2014), the notions of the 'commons' or 'collective action' rely on the presumption that local practices are internally generated (Hall et al., 2014). However, as Bray explains in two key publications, "In Mexico, a country-wide common property regime was legislated into existence, with great difficulty over several decades and is still a work in progress in many regions" (Bray, 2013, p.37); and "Mexican CFEs [community forest enterprises] actually violate some of the important design principles" (Bray, 2020). This is because the Mexican government, after a century-long agrarian reform process, ended up supplying institutions and governance structures for enterprise management, complementing them with significant incentives for collective action. The following subsections will describe these processes in more detail.

## 1.2. Mexico's forest communities

In the case of Mexico, the term 'community' or *comunidad* has a very specific legal meaning. Approximately 50% of the country's forests are held under communally-owned and governed structures, which include *ejidos* and *comunidades* or Indigenous communal lands (Bonilla-

Moheno et al., 2013; Madrid et al., 2009b)[1]. These mostly rural, agrarian communities have been shaped by a century-long process of agrarian reform (D. Bray, 2013). Government bodies at the federal, state and municipality levels, as well as non-government organizations, must therefore routinely interact with these complex communal governance structures when implementing forest policies or programmes (Antinori & Rausser, 2007; Klooster & Masera, 2000).

### *1.2.1. Epochs of change in land tenure and their implications*

Mexico's colonial dual system of Indigenous communal lands and Spanish/criollo holdings established patterns of land concentration that 19th century liberal privatization intensified (Assies, 2008). While the Cárdenas reforms (1934-1940) temporarily reversed this through redistributing land into *ejidos* and *comunidades* (Barnes, 2009), the 1992 neoliberal counter-reforms re-opened pathways to concentration by legalizing ejidal land sales and rentals (Torres-Mazuera, 2016). This oscillation between redistribution and re-concentration, rather than resolving historical inequities, has created contemporary stratified land tenure where formal *ejidatarios* or *comuneros* maintain relatively stronger positions while non-rightsholders or *avecindados* face increasingly contested access to land and resources (Navarro-Olmedo et al., 2016). Many have written in great length about the complex history of land tenure in Mexico. For instance, Willem Assies' 2008 article on 'Land Tenure and Tenure Regimes in Mexico' presents a comprehensive outline of the historical background of modern land distribution. Most of the information summarized in the following subsections is taken from that seminal work (Assies, 2008) unless otherwise indicated.

#### 1.2.1.1. Under colonial rule

During three centuries of colonial rule, the Spanish Crown distributed thousands of titles and deeds that laid the legal groundwork for the present-day agrarian communities. Upon their arrival, in 1519, the Spanish colonizers encountered a socio-political landscape dominated by the Aztec empire, with its heartland in central Mexico. The Tlaxcala state remained an important independent polity within the same region, while the Tarascan state to the west defended itself against Aztec incursions. The region of Oaxaca comprised a diversity of

[1] As is common in the literature (see for instance Bray, 2020), in this thesis I will use the English term 'communities' to refer to both *ejidos* and *comunidades*, while the Spanish term *comunidades* will be used specifically for that type of agrarian structure.

Zapotec and Mixtec kingdoms, while Maya city states and empires dominated further south. The colonizers initially dictated that 'natives' would pass into the custody of the conquering soldiers, who would take care of their evangelization in return for tribute in labour and in kind. However, the rapid population decline that followed, caused by the abuses committed and compounded by famines and new contagious diseases, led to the introduction of the New Laws of the Indies (1542), whereby 'Indians' would now work on a rotational basis for a fixed wage. The state also sought to resettle the remaining population by concentrating them in *pueblos de indios*. Such villages were to be granted an *ejido*, or a plot of land where the 'Indians' could hold their livestock. Meanwhile, criollos (people of Spanish descent born in the Americas) and mestizos (people of mixed descent) were given family plots in usufruct, which could be lost if one left the village or did not cultivate the land for three consecutive years, and village lands that could be rented out. The term *ejido* and the distinction between family and village plots still reverberate in today's tenure landscape.

In 1681, the Laws of the Indies formally institutionalized a policy of 'indirect rule' that viewed the 'Indians' as a 'separate nation' under the tutelage of the Spanish colonial state. The communal property of the natives became be the object of various forms of appropriation, whether through royal land grants, the confirmation of de facto occupation, sales or outright usurpation. This process was reinforced by the rise of the mining economy and the northward advance of the colonial frontier. The *haciendas* were consolidated during this time, driven by the rapid rise of stock-raising following the importation of cattle and sheep. These large estates practiced various forms of labour control, ranging from wage labour to forms of leasing and sharecropping. Driven mostly by urban and mining demand, *haciendas* expanded throughout the temperate valleys of central Mexico (where wheat cultivation was feasible), the warmer valleys further south (where sugar plantations were established), the plains of the central west and the vast prairie and steppe grasslands of the north (propelled by cattle raising). 'Indian' villages survived where the economic incentives for *hacienda* expansion were weaker, mostly in the central highlands and the southern regions of Oaxaca and Yucatán. By the end of the 17$^{th}$ century, estimates suggest that over half of the arable and grazing land in New Spain was held by the colonizers with formal titles. However, in regions and landscapes where Spanish interests were not as strong, particularly the central highlands, 'Indian' villages maintained possession of most of their lands and even acquired titles during the 17$^{th}$ century, while isolated mountains and forests across the country became refuges to native populations (Klooster, 2003a).

#### 1.2.1.2. The post-independence period

Although the leaders of the independence struggle in 1810 sought to do away with the *haciendas*, they mostly failed to change the agrarian structure. The emerging leadership attempted to attract Europeans to colonize the vast northern regions, menaced by US expansionism. Meanwhile, concern grew over the vast areas of land that had come into the possession of the Church, which was seen to impede the progress of the country. In 1856, the government of Benito Juárez sought to adjudicate lands held by civil or religious corporations to those who leased them through the Lerdo Law. This law was enshrined in the Constitution of 1857, which also allowed *ejido* lands (the village commons) to be 'denounced' and bought by private parties that claimed to have rented them. Despite the intention of redistributing land to smallholders, this reform led to the consolidation of large private landholdings or *latifundios*.

Further concentration of land took place under the long authoritarian rule of Porfírio Díaz (1877–1910). This period was characterized by economic growth driven by agricultural exports, the consolidation of the *hacienda* system, and industrialization. Land policies sought to identify and demarcate lands presumably without owner to privatize them. Between 1883 and 1910, some 50 mostly US-based companies were given concessions and demarcated 59 million hectares, for which they received 20 million hectares (over 10% of the national territory) in compensation for their services. The remaining newly demarcated parcels became public lands that subsequently were mostly acquired by large landowners, including mining enterprises and railway companies. Since very few communities or smallholders had titles or deeds to support their land claims, most lost their lands in the demarcation and adjudication process. By the end of Díaz' regime, 87% of rural holdings were in the hands of 0.2% of the landowners.

An interesting study by Ponette-Gonzales and Fry (2014) used historical studies, land-tenure maps from 1907, and recent land cover data to examine the footprint of historical land tenure on modern land cover in the Xalapa-Coatepec region. They found evidence of the appropriation by *haciendas* of flatter, more fertile lands, with 71% of land under 12% slope controlled by haciendas in 1907, while native populations were relegated to steep, marginal lands distant from the main town of Xalapa. Shade coffee and grassland were dominant on intermediate slopes, while the steepest lands were dominated by forest and shade coffee. By 2007, former *hacienda* lands had 20% more land allocated to grass or pasture, sugar cane and urban land covers than 'non-hacienda' lands (Ponette-González & Fry, 2014). This case study reinforces

the fact that the present-day distribution of communal territories is not an accident, nor is the fact that communities today own and manage an important proportion of the country's forests.

#### 1.2.1.3. A century of agrarian reform

The high degree of autonomy that communities in Mexico enjoy today when it comes to forest management is the result of a long process of alignment through political organization and resistance that directly traces its origins to the Mexican Revolution of 1910-1920. This armed conflict began as opposition against the re-election bid of dictator Porfírio Díaz but turned into a civil war after the assassination of President Francisco I. Madero. The conflict claimed about 1.5 million lives. Three main factions were formed, each with their own proposals for agrarian reform which they sought to implement in their areas of influence. In the central state of Morelos, where Indigenous peasant communities had lost their lands to expanding sugar cane growing *haciendas*, Emiliano Zapata led a rebellion in 1911 under the emblem of 'Land and Liberty', calling for the immediate return of appropriated lands and the division of part of the *hacienda* lands. In the northern state of Chihuahua, Francisco Villa issued an expropriation decree in 1913, followed by an Agrarian Law in 1915, where large estates were confiscated and came under state control to finance the war effort, with only a limited redistribution to individual farms. In the northern states of Sonora, Coahuila and Nuevo León, where agrarian problems were less acute, Venustiano Carranza issued a decree to return lost village and community lands in 1915, which nullified the alienation of lands carried out through the Lerdo Law and the concessions and demarcations that occurred after 1876.

These proposals provided the groundwork for the new Article 27 of the 1917 Constitution, which stipulated that all lands and waters 'originally' belong to the Nation, which can transmit them under certain conditions. Large estates would be divided up with limited compensation and redistributed to villages, smallholders and communities. Three broad categories of land tenure were recognized: public lands (belonging to the Nation), private property, and *núcleos agrarios* or agrarian nuclei, consisting of *ejidos* and *comunidades*. The latter were formed by Indigenous communities who had previously been granted land rights by the Spanish Crown and could therefore demonstrate long-term occupation of land, while *ejidos* were formed by new land grants given to former *hacienda* workers, and could not be sold or transferred (D. B. Bray et al., 2006). Land in agrarian nuclei would be held communally and each member would be entitled to use a specific parcel.

After the turmoil of the Revolution, successive governments from 1920 onwards effectively failed to carry out large-scale redistribution. This only started during the government of Lázaro Cárdenas (1934-1940), who expropriated nearly 18 million hectares of privately owned land for redistribution to nearly 800,000 peasants, more than twice as much as had been previously distributed (Barnes, 2009). Given the difficulty in demonstrating the ancient rights to lands that had been taken away during the previous periods of land consolidation, it was really *ejidos* that became the predominant form of titling (Nuijten, 2003). By the end of the 20th century, *ejido* tenure covered approximately 105 million hectares, or 52% of the total land area of Mexico (Barnes, 2009). This new "*ejido* sector" received technical assistance, credit, and agricultural inputs, as well as improvements in education, medical care, roads and other facilities, with the objective of promoting productivity and supply of basic goods for the national market. According to Assies, "the *ejido* thus was not only a form of organization of production but also a mechanism of political control" (Assies, 2008, p. 43). Subsequent governments mostly reversed these policy trends and placed a greater emphasis on industrial development, removing many of the sources of support for *ejidos* in favour of large private properties. Concentration of landownership grew (again), leading to the consolidation of a new modernized private commercial sector while the *ejido* sector increasingly became a pool of cheap labour for commercial agriculture and urban areas. This labour relationship between communities and larger population centres continues to this day, making outmigration an important source of anxiety within communities, as explored in Section 4 of this thesis.

Starting in the late 1950s, large-scale peasant unrest and the emergence of rural movements, coupled with student protests that were brutally repressed in 1968, led to a new period of reformist policies, and land redistribution was stepped up once more. However, this impulse did not last long and was promptly reversed in the face of a series of economic crises in the 1970s and 1980s. In 1991, against the backdrop of the negotiations of the North America Free Trade Agreement (NAFTA), President Carlos Salinas de Gortari announced his initiative for a substantial reform of Article 27, promising 'liberty and justice for the countryside'. This meant strengthening individual property rights over *ejido* members' parcels and therefore weakening collective decision-making, in line with the neoliberal thinking that was taking hold. Hence, the 1992 Agrarian Law gave rightsholders the ability to transfer ownership of their individual parcels while designating forested lands as common use areas to be governed collectively by the assemblies (Valsecchi, 2014). The fact that common use areas were not permitted to be sold means that communities in Mexico currently hold a significant but incomplete bundle of

rights according to Ostrom's definition (2005), as alienation is not permitted (Bray, 2020). Withdrawal and management rights were won through a struggle that happened concurrently to land redistribution efforts, as will be expanded on in the next subsection.

To implement the new law, a series of title regularization campaigns were established to encourage the 'voluntary' privatization of individual parcels as well as renting and selling to third parties (Valsecchi, 2014). This process happened in three waves. First, the Programme for Certification of Ejidal Rights (PROCEDE) operated from 1993 to 2006 (Procuraduría Agraria, 2010). The equivalent process for mainly Indigenous *comunidades* was the Program for Certification of Communal Rights, or PROCECOM. These voluntary and free programmes allowed communities to request the certification or full titling of their land. While certification allows for the sale of plots within communities, titling allows for legal land sale to anyone within or outside the community, as well as the use of titled land as collateral to solicit credit (Osborne, 2013). PROCEDE was replaced by the FANAR programme (Support Fund for Non-regularized Agrarian Nuclei), which operated from 2007 to 2016. The RRAJA programme (Regularization and Registration of Agrarian Juridical Acts) then replaced FANAR in 2017 and is ongoing. In Section 3 of this thesis I discuss the reach of these programmes in terms of the 'parcelization' of community lands, and how, contrary to what the government expected and many activists and scholars feared would happen, this process did not lead to large-scale sales of land into the private sector.

### *1.2.2. Community governance*

The term 'governance' can be interpreted as "who decides what the objectives are, what to do to pursue them, with what means, how those decisions are taken, who holds power, authority and responsibility, and who is (or should be) held accountable" (Borrini-Feyerabend & Hill, 2015). Governance therefore encompasses a range of issues around power, authority and control related to decision-making and the interactions between actors and institutions (Dawson et al., 2024). More specifically, in the conservation social and political science literature, the quality or strength of governance has been interpreted as a measure of how effectively Indigenous Peoples and local communities can voice their own perspectives, their relative influence throughout different stages of a given conservation initiative, their treatment in interactions with other actors, and how power is exercised in those processes (Armitage et al., 2020; Tanaka, 2019). High-quality governance would therefore entail full and effective participation where Indigenous Peoples and local communities can meaningfully influence all

planning, design, implementation, and monitoring stages of conservation interventions (Dawson et al., 2024).

Throughout the 20th century, as part of Mexico's agrarian reform, subsequent laws codified a specific governance arrangement that was inspired by ancient communal land tenure systems such as the Aztec *calpulli* as well as institutions for forest and pasture commons imported from Spain (D. Bray, 2013)(Table 1). A general assembly made up of all registered members is the ultimate authority within *ejidos* and *comunidades*, where all aspects of internal rules and land use within common use areas are decided by consensus or majority vote; this includes electing the *comisariado*, a three-member commission (plus three deputies) that represents the community in official processes, and an oversight council (*consejo de vigilancia*) that has a supervisory role (Antinori & Rausser, 2007; Barnes, 2009; D. Bray, 2013; D. B. Bray et al., 2006). The people serving in these roles are typically unsalaried and unspecialized towards any specific management skill (Antinori & Rausser, 2007; D. B. Bray et al., 2006). In addition to these officially mandated rules and roles, many Indigenous communities operate through a system of mandatory, unpaid community service, through which assemblies assign different civic and religious responsibilities called *cargos* to registered community members (Antinori & Rausser, 2007; D. B. Bray et al., 2006; Merino Pérez, 2008).

*Table 1. Description of the traditional roles of community governance bodies in Mexico's ejidos and Indigenous communities. Own elaboration based on field observations and the 1992 Agrarian Law; Antinori & Rausser, 2007; Barnes, 2009; Bray, 2013; Merino Pérez, 2008; Merino, 2005; Bray et al., 2006.*

| **Community governance body** | **Traditional role** |
|---|---|
| *Asamblea* (assembly) | Key decisions related to all aspects of community life are made by consensus or majority vote |
| | All villagers may attend but only rightsholders have a voice and a vote |
| *Comisariado* (commission) | 3-person committee (plus deputies) represents the community in official processes |
| | Can bring proposals to the assembly but does not make decisions over communal matters |
| | Oversees all aspects of natural resource management and reports to the assembly |
| | Usually unsalaried |
| *Consejo de vigilancia* (Oversight council) | 3-person committee (plus deputies) oversees all expenditures and activities undertaken by the comisariado |
| | Monitors the communal territory to detect conflicts or invasions |
| | Usually unsalaried |
| *Consejo consultivo* (Council of elders) | These used to be the maximum authority in communities before the creation of the assembly by the Agrarian Law, but it now serves as a kind of "community Senate" to |

| | |
|---|---|
| | help resolve particularly contentious problems or as an intermediary step where issues can be discussed before convening a full general assembly |
| *Cargos* (service positions) | Rightsholders are assigned to service positions by the assembly that they must mandatorily fulfil or pay someone else to take their place |
| | Usually unsalaried |
| | Cargos follow a hierarchical structure with young people starting at the bottom and earning their way to the top, which are positions in the comisariado and municipal governments |
| *Comités* (committees) | Interest groups that represent schools, churches, health centres and other key community facilities |
| | Members are appointed through *cargos* in accordance with their involvement with each specific place, e.g. parents of schoolchildren get appointed to the school committees |
| *Tequios* (community work) | Community service that is provided by a group of rightsholders convened by the *comisariado* to perform a specific task that has been approved by the assembly |
| | *Tequios* are usually convened whenever labour-intensive public service tasks are required, e.g. paving and maintaining roads, painting or repairing infrastructure, or carrying out forestry tasks such as weeding or reforestations |
| | In some regions of Mexico, they are known as *faenas* or *fajinas* |
| *Ejidatarios* or *comuneros* (rightsholders) | The descendants of the individuals who were originally recognised as rightsholders when the *ejido* or *comunidad* was designated |
| | In the case of ejidos, they are called *ejidatarios*; in the case of *comunidades*, the correct term is *comuneros* |
| | New members obtain land rights (*ejidatario* or *comunero* status) mainly through inheritance, but also through cession or direct transfer, purchase from another member, and leasing agreements |
| | Traditionally, rightsholders name their eldest son as their successor |
| | As the name implies, these people have rights as official community members (voice and vote in the assembly, and shares to any funds that get distributed among individuals), but also responsibilities, such as participating in assemblies, taking up *cargos*, and doing *tequios* |
| *Avecindados* and *posesionarios* (non-rightsholders) | The family members that did not inherit land rights, or other people who move into the community, including community residents (*avecindados*) and/or possessors (*posesionarios*) |
| | *Avecindados*, also sometimes called *ciudadanos* (citizens), have some rights according to the Agrarian Law, including being eligible to acquire the status of *ejidatarios* or *comuneros* (rightsholders) |
| | They may be invited to attend assemblies but usually will have no right to vote |

In this sense, communities in Mexico are a textbook example of design principle #7, which indicates that the rights to organize are recognized and not challenged by government authorities, which guarantee long-term tenure rights (Ostrom, 2005). In fact, communities in Mexico are required by law to organize themselves (D. Bray, 2013; D. B. Bray, 2020). Individual communities can create their own internal rules (*reglamento interno*, in the case of *ejidos*, and *estatutos comunales*, in the case of *comunidades*) with respect to the governance of land and resource rights, which must comply with the legal framework laid down in the Agrarian Law and be ratified by the assembly. These can include the establishment of sanctions

and punishments for individuals deemed to have broken internal rules (Barnes, 2009). Ostrom's second through sixth design principles (Ostrom, 2005) therefore come into play in this arena, within the constraints imposed by the legal framework.

Most communities, but particularly *ejidos*, have three distinct land tenure regimes: an urban zone with individual house lots, common use areas (mainly forest or pasture), and individual agricultural parcels. Membership is strictly controlled, usually by limiting the total number of rightsholders to that which is listed in the original title, so that each rightsholder may only cede or will their land to a single individual. Exclusion rights are therefore guaranteed by law. This means that community residents (*avecindados*) and/or possessors (*posesionarios*) may work the land through a formal or informal agreement with a rightsholder, but they have no voting rights and are not regarded as members. Due to traditional inheritance rules, rightsholders are overwhelmingly male, although the rate of female membership has tended to increase, going from 1.3% to 16% between 1970 and 2000 largely due to an increase in the number of elderly widows who inherited their spouses' rights.

The justice implications of this model of community governance are profound and differentiated. For instance, women tend to experience compounded marginalization through patriarchal norms and structural barriers despite increasing legal recognition as rights-holders (Bee, 2019; Soto-Alarcón & González-Gómez, 2021). Additionally, despite the existence of a legal framework in which these processes take place, communities have long responded by developing autonomous governance mechanisms. These include maintaining separate lists of rightsholders from the official ones (Van Der Haar, 2005), establishing de facto rights beyond formal law (Torres-Mazuera, 2016), and in some cases creating autonomous municipalities entirely beyond state control (Van Der Haar, 2005). Section 5 provides many more examples of community governance adaptations, specifically with regards to forest enterprises and programmes.

What these adaptations highlight is the many diverse ways in which Mexico's *ejidos* and *comunidades* have adopted the governance framework set out by successive Laws since 1925 and made it their own. This exercise of community agency is explicitly recognised and encouraged, with many provisions in the most recent Agrarian Law of 1992 deferring to a community's *reglamento interno* or *estatutos comunales* (internal rules) or specific *usos y costumbres* (usages and customs). This has resulted in a phenomenon whereby many, if not all community members in regions with strong communal land ownership regard their governance

bodies including the assembly and the comisariado as part "a living expression of their tradition for communal participation" (Merino, 2005), and proudly explain that they rule themselves through their own *usos y costumbres*. After 100 years, the origin of these practices and institutions no longer matters, because communities have incorporated them and passed them down from one generation to the next. As noted by Antorini and Rausser, and as will be evidenced in Section 5 of this thesis, these 'traditional' organisations are now being re-engineered by the forestry sector to act as collective commercial production operations (Antinori & Rausser, 2007).

## 1.3. Community forestry in Mexico

### *1.3.1. Historical background*

The agrarian reform process described above laid the groundwork for the establishment of a community forestry sector that would become one of the world's largest. Bray and colleagues (2006) describe the history of forest policy in Mexico in detail in their paper titled 'The Mexican model of community forest management: The role of agrarian policy, forest policy and entrepreneurial organization'. Most of the information summarized in this section is taken from that paper, unless otherwise noted.

The earliest efforts to 'empower' communities (*ejidos* and *comunidades*) to manage the forests within the lands they now owned happened during the Cárdenas administration (1934-1940), when 240 forest *ejido* cooperatives were organized. However, this came to an end when the conservative government of Manuel Ávila Camacho came to power in 1940. Since Article 27 of the Constitution of 1917 gave the Nation "original ownership" of all lands and bodies of water, the federal government retained substantial control over forest resources, leading to two key policies that characterized the forest sector between 1940 to 1970. The first consisted of bans that made it illegal for communities in certain regions to harvest timber in their own forests under the auspice of halting clandestine logging. The second policy was a system of logging concessions based on partial expropriations of community lands, through which private companies backed by the federal government extracted timber from communal lands. In 1956, at the height of the concessions era, a public-private partnership with a Canadian paper company based in the state of Veracruz gave rise to FAPATUX (*Fábrica de Papel de Tuxtepec*), which received the exclusive right to harvest roundwood from designated areas during 25 years in exchange for a stumpage fee paid to the communities who owned the forests (Merino-Pérez, 2004). FAPATUX operated mostly in the Sierra Norte region of Oaxaca (also

called *Sierra de Juárez*), in 250 thousand hectares of pine forests across nine ethnically Zapotec communities, including La Trinidad Ixtlán (Merino-Pérez, 2004). It was also awarded important concessions in ethnically Chatino municipalities in the Sierra Sur and Costa regions during the 1970s, including San Juan Lachao (Emanuel & Greenberg, 2000). During this period, there were isolated efforts to train local communities to manage community forest enterprises (CFEs), but these were only meant to become suppliers for large forest industries run by parastatal companies.

This trend continued throughout the 1970s, notably through the establishment of the National Fund for Ejido Development, which was tasked with organizing CFEs to supply the parastatal companies that held logging concessions. Over 100 CFEs were formed, mainly in the northern states of Durango and Chihuahua, and were provided with funding, training and equipment. Many of these CFEs became the precursors to more autonomous organizations later on. In 1973, the government moved to lift bans in seven states and promote new community-level enterprise institutions. By 1979, logging permits had been extended to 52 *ejidos* and 253 small landowners, mainly in the state of Puebla.

During this time, grassroots mobilizations, particularly in the state of Oaxaca, began organizing resistance against what they perceived as abusive logging concessions. In 1980, communities from the Sierra Norte or Sierra de Juárez region formed the Organization for the Defence of Natural Resources of the Sierra de Juárez (ODRENASIJ), which called a labour strike against FAPATUX in protest against the upcoming renewal of its 25-year concession (Pérez Avendaño, 2017). In 1982, then president José López Portillo issued a decree that renewed the forest concessions indefinitely (Merino-Pérez, 2004); in response, ODRENASIJ took the government to court and won a legal protection that eventually led to the repeal of the presidential decree (Pérez Avendaño, 2017).

In 1986, reformers within the administration of Miguel de la Madrid Hurtado developed a watershed Forestry Law that ended all private concessions and authorized communities to hire their own forest engineers to develop forest management plans. However, lack of public funding due to the austerity measures implemented after world oil prices plummeted in 1982, which severely affected Mexico's incipient oil-based economy (Assies, 2008), meant that the 1982 law had "little impact on communities that were not already well organized for local forestry" (Emanuel & Greenberg, 2000). As described above, the 1992 amendment to Article 27 by President Salinas de Gortari was a turning point in agrarian policy by legalizing the sale

and leasing of agricultural lands within *ejidos*, while exempting forested lands. Communities that chose to sell off the entirety of their agricultural lands would cede their forested lands to the state. At the same time, a new Forest Law was enacted that significantly deregulated the forestry sector. The former complicated paperwork required for cutting, transporting and processing wood products was replaced with a single stamp placed directly on cut logs when they were loaded for transport (D. B. Bray & Wexler, 1996). The new Law also privatized the provision of forest technical services (D. B. Bray et al., 2006) and encouraged long-term associations between logging firms and communities (Emanuel & Greenberg, 2000).

This was a period of rapid change in forest policy. When Ernesto Zedillo Ponce de León came into power in 1994, his government implemented a broad consultative process to evaluate the impact of the 1992 law, including stakeholders from *ejidos* and *comunidades*, forestry engineers, the forest private sectors, and the newly formed Ministry of the Environment, Natural Resources and Fisheries (today called SEMARNAT). This consultation process heard evidence that the deregulations had facilitated widespread illegal logging. A new Forest Law was enacted in 1997, introducing stronger regulations for forest management and more avenues for community forestry. Two key programmes that continue to play a key role in community forestry today were developed: PRODEFOR (Programme for Forestry Development), a government program directed at supporting community forestry, and PROCYMAF (Project for the Conservation and Sustainable Management of Forest Resources), a regional pilot programme supported by the World Bank implemented mainly in Oaxaca.

In a new watershed moment, the government of Vicente Fox Quesada (2000–2006) created the National Forest Commission (CONAFOR), a decentralized agency under SEMARNAT. While CONAFOR was assigned to the "promotion and preservation of the country's forests" (Bray et al., 2006), timber harvesting regulation remained in the hands of SEMARNAT. During this period, PROCYMAF's budget increased tenfold, and it expanded into five more states, while the budget for PRODEFOR quadrupled. By the late 1990's, Mexico's community-based forestry sector was one of the world's largest (D. B. Bray & Wexler, 1996), and by the early 2000's one report considered it to be "at a scale and level of maturity unmatched anywhere in the world" due to a combination of the country's forestry policies, a tradition of rural activism, and the social capital embedded in Mexico's traditional rural communities (D. B. Bray et al., 2003).

### *1.3.2. Current regulatory landscape*

Currently, timber management in Mexico is practiced in communal and private forest lands. The sale of timber and other forest products can only be legally done under a harvesting permit (*permiso de aprovechamiento forestal*) emitted by SEMARNAT. This requires submission of forest management plans (*plan de manejo forestal*) that deal not only with logging itself by setting locally appropriate harvesting volumes but also include additional management activities such as restricted harvesting areas, wildlife corridors, reforestation, and monitoring (Barrón Sevilla, 2016; Ellis, 2016; Torres-Rojo et al., 2016). Therefore, communities in Mexico do not fully fulfil Ostrom's second design principle, as they do not have autonomy to devise rules on how much and how products are to be harvested (D. B. Bray, 2020; Ostrom, 2005), and while they do have full autonomy to impose rules related to benefit distribution[2], it can be argued that the timing for harvesting is also outside of their control, as it greatly depends on the weather (D. B. Bray, 2020). Additionally, while the third design principle contemplates the ability for individuals to modify rules (Ostrom, 2005), this is not the case for forest management, as rules are imposed by law and regulations (D. B. Bray, 2020). However, as will be shown in Sections 4 and 5, the ability to make and modify rules is definitely present at other levels.

A 2016 paper by Torres-Rojo and colleagues comprehensively outlines the diverse timber harvesting methods and the ways that community forest enterprises (CFEs) in Mexico manage their forests for timber. Their insights are summarized below.

Communal forests under active timber management work under the form of CFEs to protect, restore, harvest, log, and industrialize forest lands. Therefore, while the official procedure is called a 'timber harvesting permit', this is only one aspect of the wide-ranging management activities that communities undertake, which is why the term community forestry is an appropriate description. Obtaining a harvest permit is not an easy task: there are many transaction costs including a large volume of associated paperwork and complicated bureaucratic processes. Decisions such as use of resources, harvesting rules, definition of conservation criteria and areas, and logging systems to be used for extractions are prepared by

[2] Benefit distribution processes are discussed in more detail in Section 4 for five study communities.

a professional forestry consultant and presented to the community's assembly for discussion and approval before submitting it to SEMARNAT for official authorization[3].

At the national level, CFEs use about 60% of their forests for timber production, and they tend to have lower harvest levels than private owners. This has been linked to the fact that forest management objectives in a community forestry context are broader than profit maximization, and can involve the improvement of community wellbeing, the creation of jobs, conservation of special places or specific species, and the combination and promotion of different economic activities jointly with forestry activities. Furthermore, in many cases, timber production is seen as a seasonal and temporary activity that uses some of the community's forest resources to supplement their income or finance the development of other economic, social or cultural activities. In most cases, communal territories comprise different land uses, including rotational agriculture and grassland areas. Thus, forest management is just one component of a broader use of a wooded landscape. These points resonate strongly with the findings from Sections 4 and 5.

Also relevant to the themes that will be discussed in this thesis is the fact that timber management in Mexico faces a wide variety of instruments of public policy and incentives related not only to the production of timber, but also nontimber products and 'ecosystem services'. According to Torres-Rojo and colleagues, "The emergence of carbon markets and compensations for avoided deforestation such as the REDD+ initiative have introduced new quasi-products to be considered in forest management decisions" (Torres-Rojo et al., 2016, p. 101). Income from subsidies such as PES and other incentives aimed at reducing land-use change and increasing carbon sequestration and storage add to the set of alternatives to be considered by the forest owners, as we explore in a case study in Amanalco (Zaga-Mendez et al., 2026) and in three other regions of Mexico (Alatorre et al., 2021). As will be described in Section 0, accessing these emerging markets requires forest owners to reduce harvest areas or volumes, delay harvests, or even change silvicultural systems (Haya et al., 2023; Kaarakka et al., 2021; Karlsson et al., 2020; Torres-Rojo et al., 2016).

[3] This process is similar for other programmes and projects that communities participate in, and is described in greater length in Section 4, particularly in 4.3.4.

### 1.4. Payments for ecosystem services in Mexico

Incentive-based conservation strategies were born from the belief that people must be given a direct economic interest in the survival of their local environment (Vaccaro et al., 2013). Within this most recent conservation phase, the ecosystem services (ES) framework has dominated research, government, and organizational agendas by means of its utilitarian and positive framing of human-nature relationships (Lele et al., 2013). The ES concept took wings in the late 1990s with emblematic publications by Daily, Costanza and other high-profile academics (Kull et al., 2015a) just as concerns grew about the economic sustainability and long-term viability of 'fortress' conservation through protected areas (Vaccaro et al., 2013). The political process of measuring and abstracting from nature to facilitate exchange has succeeded (Robertson, 2012): over two thousand journal articles contain ES as a keyword, and all major international environmental organizations have incorporated ES into their programmes, so that even those who may be sceptical of the term must use it to access policy audiences (Kull et al., 2015a).

The predominant definition of ES sees natural capital as the stock that generates different kinds of benefit flows (Lele et al., 2013). Some of these services, also called nature's contributions to people, are tangible things like fuelwood and other forest products which can be readily priced and traded like any other commodity. However, for many, no formal markets exist, including water regulation, carbon sequestration, and so-called cultural ecosystem services. By abstracting these ecosystem functions, they too can be commodified through payments for ecosystem services (PES) programmes (Kull et al., 2015; Robertson 2012). The Millennium Ecosystem Assessment (MEA, 2003) operationalized and mainstreamed this approach in 2003 (Fairhead et al., 2012). In essence, PES are policies based on contractual conditionality, where the owners of lands that provide a given ES voluntarily agree to manage them in ways that preserve or increase the quality or quantity of said ES in exchange for positive, often monetary, incentives (Kaiser et al., 2021). Given the difficulty in measuring and monitoring ES flows, many PES programs rely on ill-defined ES or ES proxies to estimate compliance and additionality (Kaiser et al., 2021). More than 550 such programs now exist worldwide (Salzman et al., 2018), and they are expected to continue growing.

Payments for ecosystem services have been embraced by governments, multilateral organizations and international and national NGOs as means to solve environmental (and sometimes social) problems (Córdoba et al., 2021; Pischke & Wellstead, 2020). In Mexico, the

political context and neoliberal ethos at the turn of the century facilitated the early and enthusiastic adoption of PES as it intersected with the established system of subsidies and served as an additional means to secure political capital with rural populations (Shapiro-Garza, 2020a). While those in power may have originally been attracted to the marked-based nature of PES, over time it has "drifted" away from market development towards a subsidy for the needs and contributions of rural communities by incorporating wellbeing components (Córdoba et al., 2021; Denham, 2017; Gómez Bonilla, 2017a; Pischke & Wellstead, 2020). This section summarizes the origins and development of Mexico's version of PES.

In what follows, I will use the Spanish abbreviation (PSA – *pago por servicios ambientales*) to identify Mexico's programmes, and PES when referring to the general term. The World Bank originally funded the pilot PSA programme in 2001-2003 and later contributed to fund it through a loan to the Mexican government (Pischke & Wellstead, 2020). The original payments for hydrological services (PSA-H) programme exists since 2003, addressing water resources and deforestation as part of a broader policy framework encompassing all forestry programmes – ProArbol (Pischke & Wellstead, 2020). In 2004 it expanded to include other components, namely biodiversity and agroforestry conversions, in response to lobbying from various interest groups (Pischke & Wellstead, 2020), as described in more detail below. A matching funds PSA was launched in 2008 to transition from the reliance on government and international-donor finances in the national programme to a local-scale mechanism that would be financed by the government in combination with the private sector and other partners, such as NGOs and municipalities, who would contribute 50% of the funds (Córdoba et al., 2021). However, the matching funds modality remains quite limited in its scope, accounting for only 11% of all PES contracts (Izquierdo-Tort et al., 2025). Together, this "constellation of national-scale PES programs" constitutes one of the largest state-led PES initiatives in the world both in terms of coverage and funding (Arriagada et al., 2018; Izquierdo-Tort et al., 2025; Shapiro-Garza, 2020a). By 2023, Mexico's national PSA programmes had been implemented in 7.4 million hectares, or 4.5% of Mexico's territory (Izquierdo-Tort et al., 2025; Figure 1). For contrast, Mexico's federal and state protected area network covers 11% of the country.

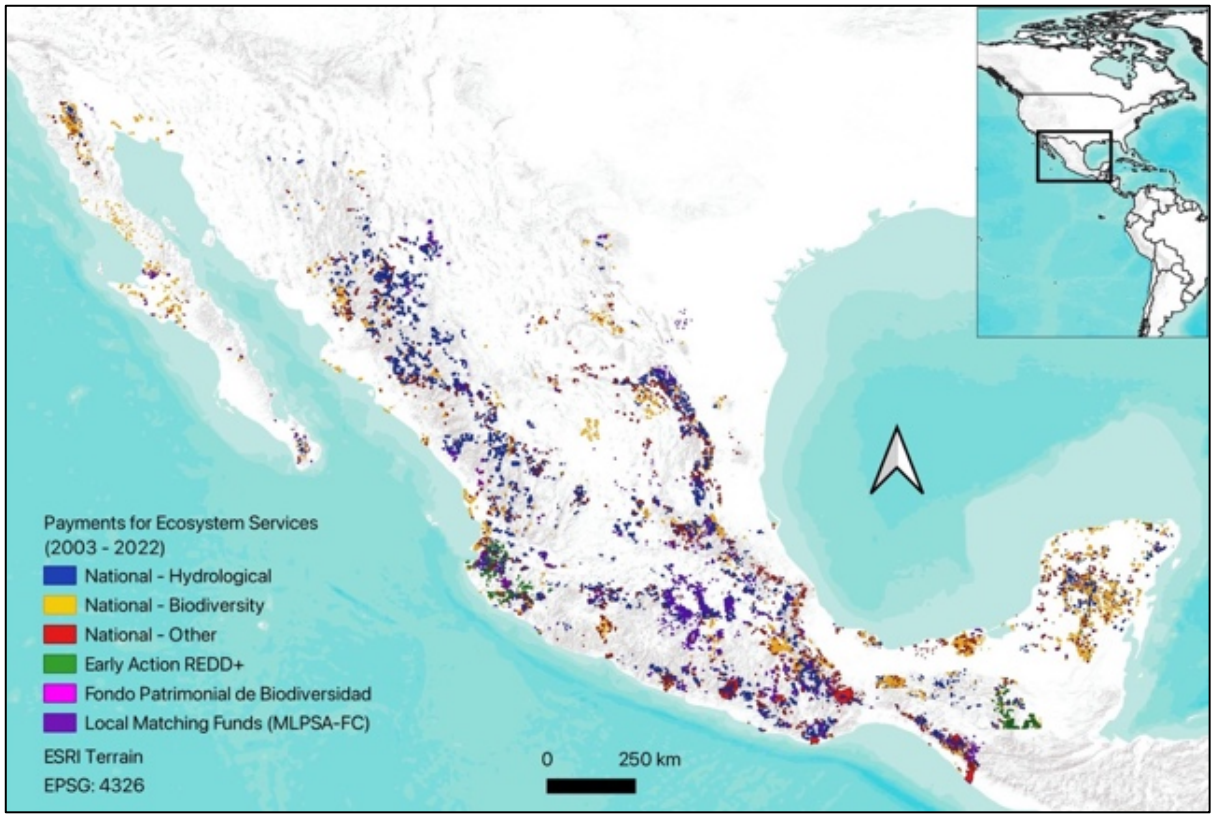


*Figure 1. Implementation of payments for ecosystem services in Mexico over a 20-year period.*

Ezzine-de-Blas et al. (2016) and others have described the "confrontation of agendas" that led to the design of PSA selection criteria. While the original World Bank pilot was designed with a focus on establishing a market for ES to complement other initiatives in locations where commercial forestry was less profitable than land conversion (Pischke & Wellstead, 2020), this met with resistance from the federal government, civil society and rural social movements (Córdoba et al., 2021; Denham, 2017; Shapiro-Garza, 2020a). The eligible area, settled at federal level after consulting different government and non-government stakeholders, has therefore increased along the years as a result of the integration of more objectives. The National Forest Commission (CONAFOR) originally awarded contracts by order of arrival before a scoring system was implemented through an ongoing tension between ecological and social indicators. Over time, the influence of hydrological and deforestation risk in the total score has declined as a result of pressure from different actors. For example, the National Commission of Natural Protected Areas (CONANP) demanded that the programme support communities in protected areas in order to compensate them for the costs of complying with conservation rules, while the World Bank convinced CONAFOR to add areas that are close to cities, and the National Commission for the Knowledge and Use of Biodiversity (CONABIO)

lobbied to include mangroves and biodiversity corridors (Ezzine-de-Blas et al., 2016). Overall, the trend has been for selection to rely mostly on social criteria, with priority given to municipalities with high degrees of poverty or percentage of Indigenous population (J. M. Alix-Garcia et al., 2015; Arriagada et al., 2018).

The general structure of Mexico's PSA programmes has been to enrol smallholder private and communal property owners who voluntarily apply to enter the programme, and to then pay them set amounts per hectare annually for the life of the contract to maintain forest cover in areas of the landowners' choosing (Shapiro-Garza, 2020a). Beneficiaries also receive access to capacity building activities such as training and workshops on forest management and certification (Arriagada et al., 2018). All PSA programmes require participants to elaborate of a "manual of good management" committing to a number of activities they can choose from a list (Denham, 2017). A technical consultant, usually a forester, is employed by participant individuals or communities to elaborate the management plan and fulfil the programmes' requirements (Arriagada et al., 2018). In relation to land certification through PROCEDE or FANAR[4], CONAFOR made access to PSA directly contingent on land certification, as was common for other state subsidies or development projects (Osborne, 2013). This challenges the interpretation of land certification as a completely voluntary practice (Ibid.).

To date, over 70% of PSA programme participants are communally held and governed agrarian nuclei including *ejidos* and *comunidades*, representing 90% of enrolled hectares (Izquierdo-Tort et al., 2025). However, the ways in which communities participate in PSA are not homogeneous. *Ejidos* that have chosen to fully privatize through PROCEDE have divided their formerly communal properties into individual parcels, and each member can choose to enrol parts of their property in PSA as part of their livelihood strategies (Córdoba et al., 2021; Izquierdo-Tort et al., 2022). *Ejidos* that have not privatized under PROCEDE, and most Indigenous *comunidades*, retain a more egalitarian worldview and may enrol parts of their forest commons in PSA if approved by their internal assemblies (Córdoba et al., 2021). Section

[4] As described in detail in Section 1.2.1, following reforms in the late 1980s, the government encouraged the voluntary privatization of *ejidal* common use lands as well as renting and selling to third parties through the Program for Certification of Ejidal Rights (PROCEDE).

3.2 contains more detail about the titling and certification process and the outcomes in terms of land privatization.

In Mexico, PES has been theorized as *compensation* for ecosystem services (CES), with a focus on the "recognition" of the value of the labour, cultural knowledge and practices of the traditional stewards of nature, basing the interaction between providers and buyers on trust (Shapiro-Garza, 2020a). This is also the case in other contexts, particularly in Ecuador (Farley et al., 2011) but also in Guatemala, where PES programmes do not explicitly value or measure a chosen ecosystem service, but rather provide a “subsidy” incentivizing “forest health” (vonHedemann & Osborne, 2016). According to analysis by Shapiro-Garza (2020), national-level political shifts have allowed for the CES discourse to influence PES design in the case of Mexico, both from policy making and academia and from long-term engagement with rural communities. These policies were seen as a means to counter the neoliberal reforms of the 80s and 90s that had greatly impacted rural communities, notably the North America Free Trade Agreement, while acknowledging the value and necessity of keeping people on the land. CES advocates for a policy design that compensates according to the holistic suite of values for the territory and integrates other approaches beyond incentives, allowing and encouraging active productive management. This differs markedly from the original definition and intentions of PES policies, exemplifying how they have “drifted” or “hybridized” upon encounters with local realities (Pischke & Wellstead, 2020; Shapiro-Garza, 2020a). As will be discussed in Section 3.5.2, this conceptualization of a compensation rather than a payment may have contributed to a gradual erosion of Mexico’s PES programmes in terms of funding, which has in turn decreased its attractiveness to all but a few committed reapplicants.

Another important source of academic debate with regards to PES to which the Mexican case has contributed centres on the notion of motivation crowding-out (Agrawal et al., 2015; Rode et al., 2015; Underhill, 2016; Van Hecken et al., 2019). However, as is the case for price incentives for community forestry (D. B. Bray, 2020), PES do not seem to significantly reduce collective action around forest conservation or management (J. M. Alix-Garcia et al., 2018; Kerr et al., 2014; Nieratkaa et al., 2015; Rodríguez-Robayo et al., 2016). In fact, markets, as well as supportive state policy, can be considered the most important dimensions of Mexican community forests that have contributed to their success (D. B. Bray, 2020).

### *1.4.1. The next generation of incentive-based policies: Forest-based carbon offsets*

As Mexico's PSA programmes demonstrate, forest conservation has historically been financed through public funding, with few instances of private support or philanthropy. But a recent trend has emerged in which organizations of all shapes and sizes and even individuals or governments turn to carbon markets in their attempt to meet emissions reduction goals, such as net-zero targets, at a lower cost than mitigation alternatives (Haya et al., 2023). Two types of carbon markets have emerged, which differ in terms of their legal frameworks (Probst et al., 2024). In voluntary carbon markets, buyers do not have a legal obligation to reduce emissions, while in compliance markets there is a legal obligation or binding commitment to offset their own emissions (Ibid.). In this vision, nature must "pay its way" by producing the values that keep it afloat or be replaced by nature somewhere else that produces such products and services more efficiently, such that the global environment should be cared for only where this is cheapest, or where what is foregone costs less (Fairhead et al., 2012).

Among the types of projects that can be developed for the voluntary carbon markets, forest- or forestry-based carbon offsets (FBCOs) have been promoted as having particularly high potential adaptation and resilience co-benefits[5] as compared to other approaches such as carbon capture and storage due to trees' biophysical properties, relatively low production costs associated with forest management, the high maturity of the industry in terms of technology and knowledge distribution, and the potential to reduce various climate vulnerabilities concurrently (Chenyang, 2023). However, the long time horizon (30 to 100 years) necessary to guarantee credits sold through voluntary markets has led to accusations of 'green grabbing', the environmentally-driven appropriation of land and resources (Fairhead et al., 2012; Osborne, 2013).

Within the broad category of projects covered by FBCOs, improved forest management (IFM) projects are designed to increase the resilience of forest ecosystems by transforming pre-existing practices in ways meant to reduce the risk of carbon losses from disturbances while increasing carbon stocks in forests and forest products and producing additional benefits (Climate Action Reserve, 2022; Haya et al., 2023; Kaarakka et al., 2021; Karlsson et al., 2020). This is meant to be achieved by implementing activities such as increasing the harvest rotation

[5] These concepts will be explored at greater length in Section 4.

age, doing harvest selection while thinning, controlling stocking to manage competition, increasing stocking in understocked areas, and reducing litter and surface fuels in fire-prone ecosystems (Climate Action Reserve, 2022). By the end of 2025, the Voluntary Registry Offsets Database listed 1,039 IFM projects around the world (Haya et al., 2025), a significant increase from the 293 projects listed in 2023 (Haya et al., 2023) and representing around 50% of FBCO and 10% of all registered carbon offset projects. More than a third of these IFM projects (415) have been implemented in Mexico, almost exclusively under the Climate Action Reserve's (CAR) Mexico Forest Protocol (Haya et al., 2025).

The Voluntary Registry Offsets Database does not list the type of land tenure where each project is implemented; however, based purely on the 'Project Owner' column, we can identify at least 324 IFM projects in Mexico that are happening on communal lands (78%). This is consistent with the fact that around 50% of the country's forests are held under community-owned and governed structures, which include *ejidos* and *comunidades* (Bonilla-Moheno et al., 2013; Madrid et al., 2009b).

As described in Section 1.2.2 above, within the territories of *ejidos* and *comunidades* in Mexico there are distinct areas with specific land use designations. Usually, individuals who are rightsholders and their households will own their homes and agricultural parcels in or around the town or towns. Forested lands, on the other hand, are considered common use areas under the 1992 Agrarian Law, and decisions about these territories must be made by the assembly (Barnes, 2009; Valsecchi, 2014). Under CAR's Mexico Forest Protocol (version 3.0), the 'project area' for communities must include the entire common use land (Climate Action Reserve, 2022). Inside the project area, different 'activity areas' are designated, which are defined as explicit areas where forest owners implement management actions. In the case of IFM projects, the activity area is limited to areas with a government-approved forest management program for commercial timber harvest (Climate Action Reserve, 2022).

## 2. ANALYTICAL FRAMEWORKS AND RESEARCH OBJECTIVES

This thesis is being written to fulfil the requirements of a joint PhD degree in Ecological Economics (UQO) and Development Studies (UA). As such, it must be considered relevant and appropriate by both study programmes. My approach to this challenge is not try to find or propose a unifying framework, but rather to take a single topic – communities in Mexico and their participation in forest management and conservation programmes – and view it from different scales and lenses, proposing that each way of exploring this rich issue will be informed by and in turn inform the others.

Mirroring the observations by Lund et al., (2018) that a comprehensive understanding of forest or forestry decentralization policies cannot be informed by one single strand in the literature, but should be informed by all of them, my research directly addresses three of the four puzzle pieces they identified through a review of the literature: Assessing impacts (Section 3), contextualizing (Section 4), and unpacking power in forestry decentralization (Section 5)(Lund et al., 2018). All empirical chapters also indirectly address the fourth puzzle piece, decentralization as democratization, by looking at whether these policies empower local institutions. Each of these puzzle pieces or strands reflect disciplinary differences in values, epistemologies and methods preferences (Lund et al., 2018), which is a core principle of the ePEStemology project[6] in which my research is partly embedded. An explanatory sequential mixed methods approach, which I explain in the Methodology section below, was chosen as it adequately captures my intent to use both qualitative and quantitative methods in a complementary way where one dimension of inquiry partly explains what can be observed in another, while no single approach can get to the whole picture.

In the next chapter (Section 3), I describe in detail a wide array of quantitative geospatial data that builds a picture about communities in Mexico, their forests, and the paths they can take with regards to voluntary and regulatory forest conservation and management approaches. For the second empirical chapter (Section 4) I identify how different communities perceive and describe the components of resilience and their associated threats, the roles played by an intermediary organization when making decisions around FBCO implementation and funding allocation, and how FBCO activities and funding allocation address perceived threats to

[6] More information on the ePEStemology project can be found in https://epestemology.com

resilience. The last chapter (Section 5) turns to the newly proposed institutional jelling framework to identify the formal and traditional institutions that come into contact through communities' participation in such programmes and policies, and the strategies that two study communities have developed to align or jell their institutions around collective action and forest uses.

An overarching trend in this thesis is a vision of Mexican community forests as social-ecological systems (SESs). As stated by Ostrom (2009), a core challenge in diagnosing why some SESs are sustainable whereas others collapse is the identification and analysis of relationships among multiple levels of these complex systems at different spatial and temporal scales. Through a multiscale and transdisciplinary approach, this thesis will make a significant contribution to our understanding of SESs, resilience, and institutional jelling, and offer an integrating perspective on the conditions under which jelling or unjelling can contribute to transformative resilience under what Bray (2020) calls "a national SES focused on community forests" (p. 5).

### 2.1. The Mexican community forest social-ecological system (SES)

Section 1 outlined the history of collective land tenure in Mexico and how this resulted in a set of governance rules for collective action that communities have adopted and adapted and that dictate their ability to participate in productive activities and programmes such as forestry and PES. The outcome is a SES where the forest commons are collectively owned and managed through a legal framework that has facilitated their use in ways that are mostly sustainable, resilient, and profitable (D. B. Bray, 2020; Cubbage et al., 2015; Frey et al., 2019; Hernández-Aguilar et al., 2017; Orozco-Quintero & Berkes, 2010).

The SES analytical framework proposes that "environmental problems" are complex adaptive systems where social and ecological components are deeply interconnected and coevolve across space and time (Ostrom, 2009). Section 3 will demonstrate this interconnectedness in physical terms by analysing national-level data on land tenure and programme implementation. But beyond evidencing spatio-temporal coevolution, this thesis describes the conditions under which resilient outcomes can occur and the governance adaptations that become necessary under a particular set of conditions often unmentioned by the SES literature (D. B. Bray, 2020): markets and price incentives in the form of PES and community forest enterprises. Using the terminology proposed by Ostrom (2009), the Mexican community forest SES is made up of

the following subsystems: The ‘resource system’ is a community’s legally recognized territory; the ‘resource units’ are the trees, wildlife, and other ‘ecosystem services’ present within communities’ territories; the ‘governance system’ is made up of the applicable laws and regulations related to the use and management of communities territories but also communities’ internal governance bodies and statutes; and the ‘users’ are the community members.

### *2.1.1. Resilience in SES*

#### 2.1.1.1. Background

Resilience conceptualizations in forest conservation and management contexts exist along a continuum from narrow engineering perspectives to more holistic social-ecological frameworks. Engineering resilience focuses on the time required for a system to return to its pre-disturbance state, often measured through recovery metrics such as basal area increment and vegetation cover (Nikinmaa et al., 2020). This approach emphasizes recovery rate (Seidl et al., 2016) and is suitable for short-term assessments (Nikinmaa et al., 2020), but may not be applicable in the face of ongoing climate change and multiple disturbances (Strickland et al., 2024). In contrast, ecological resilience concerns the persistence of systems and their ability to absorb change while maintaining relationships between components (Ibid.), emphasizing the maintenance of function, structure, identity, and feedbacks (DeRose & Long, 2014). Socio-ecological resilience extends this further by considering the interaction between natural and social systems, focusing on adaptive capacity, transformation (Nikinmaa et al., 2020), and the ability to reorganize and adapt through social-ecological interactions (Seidl et al., 2016). Here, resilience is characterized as the capacity of a social-ecological system to absorb or withstand change while maintaining its structure and functions, with key components including self-organization, learning, and adaptation (Lecina-Diaz et al., 2024). A social definition of resilience defines it as the ‘getting by’, protection, care and mutualism that ensure survival in circumstances that disallow changes to the frameworks that dictate survival (DeVerteuil & Golubchikov, 2016). Of course, survival is very different to transformation or thriving, as discussed below.

The nestedness of resilience concepts suggests they are complementary rather than contradictory (Nikinmaa et al., 2020). Engineering resilience can be viewed as a component of ecological resilience, which in turn is part of social-ecological resilience. Likewise, the temporal and spatial scales at which resilience is considered vary significantly across approaches, with engineering resilience suitable for short-term assessments while ecological

and social-ecological resilience better serve longer-term evaluations (Ibid.). However, others have proposed that there is a resilience spectrum, wherein some approaches emphasize only the ability to "bounce back" from shocks and stresses while others can convey more transformative and equitable ways to "bounce forward" (HLPE, 2025). In the forest management context, Fuller and Quine concluded that no single definition of resilience can be sufficient due to system complexity, instead identifying four essential components: resistance, recovery, transformation, and adaptation (Fuller & Quine, 2016).

A review of the definitions of 'community resilience' used in the academic literature found 57 unique versions, which generally agreed on certain main elements such as local knowledge, networks and relationships, health, governance and leadership (Patel et al., 2017). Meanwhile, some Indigenous scholars have proposed definitions of resilience that contain themes such as: accountability, cooperation, sharing, and caring for the vulnerable (Steele, 2020); language, culture and collective agency (Kirmayer et al., 2011); and the inter-related connected relationships in a specific place (McGuire, 2010). Overall, a resilience approach "stresses the importance of assuming change and explaining stability, instead of assuming stability and explaining change" (Berkes et al., 2008) and recognizes that there is no single stable state in a socioecological system, but that the system is exposed to different 'shocks' that challenge its fundamental identity and make it dynamic (Barnes, 2009).

#### 2.1.1.2. Criticisms and limitations of resilience frameworks

For the last two decades or so, resilience has become a buzzword in academic and policy circles, and has generated important critiques, mainly from the field of critical geography (DeVerteuil & Golubchikov, 2016). Part of the concern lies in the fact that definitions of resilience are vague and inconsistent, given that different disciplines employ it in different ways (Nikinmaa et al., 2020). Multiple definitions and approaches create divergence on whether resilience is a system property, process, or outcome (Ibid.). But it has also been accused of nullifying transformative action while lacking conceptual rigor (DeVerteuil & Golubchikov, 2016), and there are critical decolonial approaches that conceptualize resilience as a problematic and western-centric notion (Amo-Agyemang, 2021).

In a 2016 paper, DeVerteuil and Golubchikov summarize the various critiques under three rubrics. Firstly, resilience is not ideologically neutral but necessarily props up the dominant system. Therefore, resilience becomes fundamentally about how best to perpetuate, sustain and reinforce a status quo in the face of an external disturbance, glossing over the existence of

social divisions and inequalities. This gives those in power the ability to provide a set of fixes to ongoing problems, thus discrediting alternative strategies that could disrupt the dominant system. Secondly, resilience is inherently conservative and lacks progressive potential. This is directly linked to the first point, as it can then serve powerful interests to protect against a dynamic or adaptive strategy. In this view, the fact that resilience cannot be constructed as a verb implies passivity, "a condition but not a process to secure a better future advocated" (DeVerteuil & Golubchikov, 2016). And thirdly, a resilience framework allows the poor and marginalized to be cast off under the pretence that they are resilient, therefore absolving the state of responsibility.

#### 2.1.1.3. Justification and applicability to the study context

As described by DeVerteuil and Golubchikov, the resilience metaphor is powerful enough to capture the essence of important social processes and yet flexible enough to work for a variety of systems and temporal frames (DeVerteuil & Golubchikov, 2016). While acknowledging the many criticisms levied against the concept from within their own discipline, these authors argue that resilience can be redeemed by articulating the essential components of a 'critical resilience'. In their words, this would prevent "intellectual capitulation over a seemingly fruitful and important conceptual terrain that holds much emancipatory promise and is a powerful and capacious metaphor to not only decipher a range of important geographical practices, but also their coexistence, interpenetration and co-constitution—which would otherwise require bringing together a whole bundle of alternative concepts" (DeVerteuil and Golubchikov, 2016, p. 145). They therefore firstly argue, based on numerous case studies, that resilience can sustain alternative practices orthogonal to dominant ones. In their view, resilience is neither inherently positive nor inherently negative and can therefore be deployed to enhance alternative and previous practices that challenge the status quo. This implies that resilience dos not simply mean to bounce back to a previous, steady-state position, but that there is always the possibility of articulating an alternative reality after the disturbance. There is no pre-ordained trajectory, hence the role of power in shaping resilience outcomes is unquestionable.

Secondly, they propose that resilience is not a passive condition but is actively produced. Beyond a notion of resilience as something that is externally induced and that represents an end point or steady-state condition, resilience can be internally produced, adaptive, and capacity-building. The authors note that producing resilience requires considerable effort and

strategy, meaning that resilience can be more proactive than reactive. In this way, "resilience can be deployed in instances when resistance and transgressions do not make sense, because the agents in question are too weak, disorganized or simply not interested. In this way, resilience can be a middle ground between victim and vanguard, when social actors cannot alter circumstances but still show agency, self-organization and adeptness in coping and adaptation" (DeVerteuil and Golubchikov, 2016, p. 147). Resilience is therefore political, it can be actively produced by people who are not simply victims, they have their own voice. It is also relational because it can stimulate social activism, social movements and networks that can lead to transformative change. And resilience is also spatial because it occurs through engagement with the real world, where calls for change can be articulated. This leads to the third and final argument by DeVerteuil and Golubchikov, who note that resilience acts as the precursor to resistance and transformation.

The arguments put forth by De Verteuil and Golubchikov have been echoed by more recent publications, notably the 2025 report by the High Level Panel of Experts (HLPE) on Building resilient food systems, which argues for an approach to resilience that entails the capacity to "bounce forward" rather than "bouncing back", or what they term 'equitably transformative resilience'. This perspective recognizes the need to support transformation to a state that is different to the pre-disturbance status by enabling agency, capacity building and the exercise of local values (HLPE, 2025). In Section 4, we present findings from a case study that are consistent with the recently proposed equitably transformative resilience approach, where "institutions, policies, people, ideas and practices [in this case an inter-community organization and FBCOs] uphold the capacity of individuals, communities, nature and socioecological processes [in this case, five study communities in Oaxaca and their forests] to prevent, absorb, adapt and transform in the context of multiple uncertainties compounded by structural and contingent shocks, stresses and differential vulnerabilities" (HLPE, 2025). In this work, we are not asking these communities to *be* resilient, we are observing how they *produce* resilience through a mixture of internal and external inputs and processes that ICICO, an inter-community organization and project developer, facilitates in the course of the implementation of FBCO projects.

In the context of the study presented in Section 4, it is important to note that we did not use the term resilience (or its Spanish translation, *resiliencia*) in any of the interviews or workshops that informed the analysis of the role of FBCOs and intermediaries in socio-ecological

resilience. Instead, we asked broad questions about people's visions for the future of their communities and their forests, the factors that threaten these futures, and the strategies they and their communities employ to address those perceived threats. The full interview guide is in Appendix IV. However, we do employ the concept of resilience in the paper itself, including using it prominently in the title. Besides the reasons outlined in Section 2.3.3 below, including funding sources and publication outlets, we chose to use the resilience framework because we agree with DeVerteuil and Golubchikov that this concept can adequately express the ways in which people in our study communities use their experience, expertise and agency to construct their own visions for the future of their small societies and territories in the face of climate change and other significant shocks and stresses such as the lack of economic opportunities and deficient infrastructure. These visions may in some ways conform to the dominant narratives of productivity and provision of 'ecosystem services', but they are also significantly reliant on traditional institutions and values that they are strongly attached to and want to preserve.

One key perspective to which this thesis contributes is the role of markets and livelihood diversification in building resilience (Ávila-Foucat et al., 2021; Kimengsi et al., 2019; Sunderlin et al., 2005; Villavicencio Valdez et al., 2012). In this case, communities are selling timber, which is a relatively high-value and price-stable good (D. B. Bray, 2020; Torres-Rojo et al., 2016), but also non-timber forest products such as bottled water and ecotourism, as well as 'ecosystem services' in the form of carbon offset projects and the national PSA scheme[7]. The income they are generating from these sales or from programme participation will directly impact their capacity for resilience, both in terms of bouncing back after a disturbance and bouncing forward to a different, more desirable state. The integration with these markets is made possible by the "top-down supply of governance institutions" (Bray, 2020, p. 4) that resulted from Mexico's agrarian reform, as outlined in Section 1, which according to Bray (Ibid.) had the direct effect of reducing transaction costs for communities that wanted to get involved with forestry, but also due to the action of intermediaries, who still play a vital role despite the facilitative legal framework. Hence, as we describe and explore in Section 4, the role of ICICO as an intermediary becomes all the more important for their ability to simultaneously introduce new market paradigms while striving to preserve and strengthen the

[7] The national PSA (*pagos por servicios ambientales*) and carbon offset schemes are described in Section 1.4.

institutions that communities associate with resilience. Additionally, Section 5 of this thesis will highlight the ways in which such top-down schemes interact with bottom-up self-organization of community forest enterprises and the potential of these interactions for achieving resilient outcomes.

### *2.1.2. Institutional jelling in SES*

The term 'institution' can be understood as a system of socially embedded rules and norms (Hodgson, 2006). The existence of local institutions, many of which are deeply rooted in the culture, norms, and traditions, are instructive in explaining the persistence of community managed resources around the globe (Hartanto et al., 2008). While formal institutions are enacted, documented, and mostly sanctioned by the state, informal (also referred to as endogenous, customary or traditional) institutions are passed over generations and remain largely uncodified (Colding et al., 2003; Hodgson, 2025). The interplay between the relative roles of and the interactions between formal and informal institutions and the outcomes linked to such interactions has been the subject of much debate and theorizing (Kimengsi et al., 2025). Here, I describe how the institutional jelling framework emerged from these schools of thought, and its applicability to my case study (Section 5).

#### 2.1.2.1. Background

In the context of rural livelihood strategies, the diversification of income generating activities, including through the participation in incentive-based policies, is a common way to manage risk (Ávila-Foucat et al., 2021; Kimengsi et al., 2019; Sunderlin et al., 2005; Villavicencio Valdez et al., 2012). As they diversify their sources of income, communities must incorporate new requirements and processes that may be misaligned with their preexisting governance structures (de Koning, 2014; Fairhead et al., 2012; Hajjar et al., 2021; Taylor & Cheng, 2012), requiring a process of adaptation. Such interactions between formal and pre-existing informal or traditional institutions for natural resource management have been described in diverse contexts, including Asia (Hartanto et al., 2008; McDougall et al., 2013), Africa (H. C. P. Brown & Lassoie, 2010; Mogende & Kolawole, 2016; Walters et al., 2015), Latin America (Cisneros, 2019; Garcia et al., 2024; Taylor & Cheng, 2012) and elsewhere in Mexico (Ellis et al., 2015).

Explaining the origin of enduring institutions for natural resource governance has long been of interest to those seeking to uncover the dilemma of collective action, notably the work of Ostrom and other proponents of what has been termed mainstream institutionalism. Her proposed design principles, explained in Section 1.1.2, were key contributions (Ostrom, 1990,

2005), but so is her work on social norm formation, where she finds that collective action situations can be resolved successfully, at least in part, depending on how social norms are taught and evoked, how individuals learn about others' behaviour, and the reward mechanisms for the use of social norms (Ostrom, 2000). While the rigorous empiricism of mainstream institutionalism is appealing due to the ease with which it can be translated into policy and project documents, there are areas that have raised concerns, particularly around the rigidity of this approach. Two contemporary works by Cleaver, Hall and others describe the main critiques that have been directed at Ostrom's design principles and mainstream institutionalism (F. D. Cleaver & de Koning, 2015; Hall et al., 2014). As outlined by Hall and colleagues (2014), the three main critiques can be grouped under the headings of the 'homogenous community', the avoidance of politics, and socially inadequate analyses (Hall et al., 2014).

Critical Institutionalism sought to address issues of complexity, power and other structural issues by explaining how institutions dynamically mediate individual or societal relationships with regards to SESs (F. D. Cleaver & de Koning, 2015). Of particular interest are concepts such as institutional fit, interplay and scale, adaptive management, and institutional or organizational change. Vatn and Vedeld (2012) summarize key contributions by Young on what they term the fit-interplay-scale triad (Vatn & Vedeld, 2012). Institutional fit refers to how well governance systems match or are congruent with biophysical systems, which will inevitably depend on the context: an institutional arrangement that is an "excellent match for one resource" may fail for another. Institutional interplay concerns the ways in which the interaction between two or more institutions can influence their respective outcomes. These interactions can be symmetrical, when two institutions affect each other in a similar way, or unidirectional, when one affects the other in a much greater degree. For instance, Corbera and colleagues find important sources of institutional interplay in the case of Mexico's PSA, including local property rights which result in low transaction costs, and international guidelines for carbon forestry activities (Corbera et al., 2009). Lastly, institutional scale is the degree to which institutional arrangements are comparable across local to global levels of organization, with moves from local to higher levels of organization predicted to lead from homogeneous to more heterogenous institutions, few to many institutions, and from simple to complex systems of interplay (Vatn & Vedeld, 2012).

With regards to institutional or organizational change, de Koning (2014) analyses the local-level effects of institutional changes in the Amazon that aimed to create opportunities for

communities, with limited effectiveness (de Koning, 2014). She makes use of institutional bricolage as a theoretical approach, which depicts a process through which resource users consciously or unconsciously piece together or adapt different institutional provisions (F. Cleaver, 2001), drawing on existing rules, practices, beliefs, norms, relationships and symbols (F. Cleaver, 2017). In this theoretical approach, the interactions between informal and formal institutions create partially enduring institutions. Haller and colleagues (2016) then advanced the constitutionality theoretical approach, which emphasizes the conditions that are necessary for successful bottom-up institution building around SESs (Haller et al., 2016).The adaptive management literature is also concerned with analysing the ways in which new rules and practices modify local institutions (Hajjar et al., 2021). For example, a study of REDD+ interventions across 14 countries found that restrictions on local forest practices and rigidity in rules have limited communities' ability to practice adaptive management and governance (Ibid.), while a case study in Indonesia documents how state interventions around community forestry evidenced the dynamic adaptation potential of traditional *adat* institutions, leading to the strengthening and expansion of customary institutions and authorities over natural resources (Hartanto et al., 2008). A related field known as adaptive comanagement brings together a body of inquiry concerned with system linkages (comanagement) with adaptive management's concern with problem solving and learning-by-doing (Whaley & Weatherhead, 2014).

Institutional jelling as a theoretical lens was conceived as a means to analyse the outcomes linked to the careful, tactful, and systematic process of aligning provisions of formal and informal institutions, to create a new, acceptable, and unifying institutional setting, which enjoys legitimacy from SESs in both the formal and informal domains (Kimengsi et al., 2025). The use of the term "jelling" comes from team building and conflict management studies, where jelled teams (with well-bonded members) realize efficient outcomes as opposed to unjelled teams (Kimengsi et al., 2026). As explained by Kimengsi and colleagues (2026), compatibility and goal consistency are key traits in jelled teams, which translates as alignment of institutional arrangements wherein actors in the endogenous (or informal, traditional) and exogenous (or formal, legal) domains seek to jointly attain the goal of "sustainable community-based forest resource management". Therefore, this jelling process can come simultaneously from the top down, or, as I demonstrate through my case studies, from the bottom up, as communities modify their institutions around collective action and the uses and values of the forest commons in the course of their interactions with forest policies and programmes.

Institutional jelling can be seen as complementing Haller's constitutionality approach for determining the components of institutional durability, where the non-recognition of endogenous rules by exogenous entities has been found to lead endogenous institutions which initially worked well at the community level to eventually disappear (Haller et al., 2016, 2018). It aims to provide a novel theoretical lens through which to identify the conditions under which jelled or unjelled institutions yield positive or negative outcomes (Kimengsi et al., 2026).

#### 2.1.2.2. Justification and applicability to specific chapter goals

As mentioned previously, and as explained in detail in Section 2.3.2, each of the three papers that make up this thesis has its own objectives and approaches which come from the interplay between my own positionality and interests and those of the communities, organizations and academic colleagues I partnered with (all listed in Table 2), as well as the sources of funding that enabled the research to take place, and the target publications to which my work will contribute. In the case of Section 5, the institutional jelling framework was suggested to me during a critical moment when I was starting to write-up my findings for an academic audience (having already produced and delivered written reports and videos to the two communities in this case study). It resonated strongly with my findings about the changes to internal governance structures and institutions that became necessary to fulfil the requirements of forest programmes and activities. And while other, more established theoretical frameworks may also have been appropriate, the opportunity to contribute an empirical chapter to an upcoming book on the institutional jelling framework was too good to miss.

The institutional jelling framework proved to be useful for my analysis as it provided a way of structuring the governance adaptations that so many interviewees and workshop participants had articulated. By directly linking each formal institution to the perceived misalignments in terms of governance structures, uses and values of the forest, communities' strategies for alignment became clear and were properly contextualized. By further associating specific outcomes to the different types of institutional arrangements (jelled, quasi-jelled and unjelled), I was also able to reflect on the fact that these will be contingent on community power dynamics, and it is not possible to classify them as possible or negative. Here, an unjelled traditional institution is defined as a rule set in place by a community through the exercise of their legal rights for self-governance that is perceived to be incompatible with the formal rules and regulations of the forest enterprises and programmes that the community interacts with. Accordingly, a quasi-jelled arrangement is one that is partly perceived to be compatible but

where some trade-offs remain in place, while a jelled arrangement is perceived to be fully or mostly compatible with the requirements and expectations of programmes and policies. Importantly, it is the perceptions of participants from the two communities which informed my interpretation of institutions as either traditional or formal, jelled, quasi-jelled or unjelled, while a broader discussion about the degree to which these classifications can or should apply to the Mexican context is presented in the General Conclusions (Section 6.2).

### 2.2. Research objectives

While the term 'payments for ecosystem services' is prominent in the title of this thesis, a key qualifier is the use of the word 'around'. This careful choice highlights the fact that this thesis looks beyond PES in its quest to answer the following research question: *How do the dynamic interactions between historical land-use patterns and participation in decentralized forest policies influence lands, visions and institutions in Mexican communities?* By answering this question, this thesis aims to fulfil three specific research objectives (RO), each with its own scale of analysis and methodological approach:

RO1: To describe and explore the patterns around land-use and livelihood strategies that Mexican communities have experienced during the past two decades and how they relate to participation in decentralized forest policies and programmes through national-level geospatial data.

RO2: To study how community governance bodies and project developers match local visions for transformative resilience with targeted investments of funds from decentralized forest policies and programmes in five Indigenous communities in Oaxaca through qualitative data.

RO3: To explore the governance challenges faced by La Trinidad Ixtlán and San Juan Lachao when implementing decentralized forest policies and programmes and how they modified their traditional institutions in response through qualitative data within an institutional jelling framework.

### 2.3. Methodology and epistemic approach

Recognizing the complexity of social-ecological systems, transdisciplinary mixed methods have been increasingly employed by researchers from many different backgrounds. Mixed methods can be defined as a procedure for collecting, analysing and integrating quantitative

and qualitative data within a single study, with the goal of improving our understanding of a research problem (Creswell, 1998). Mixed methods can be employed concurrently or sequentially according to the research design. Within the latter category, explanatory sequential mixed methods design is a popular approach that implies collecting and analysing first quantitative and then qualitative data in consecutive phases within a single study (Ivankova et al., 2006). The quantitative data and their analysis are meant to provide a general understanding of the research problem, while the qualitative component is intended to refine and explain the results obtained by exploring participants' perspectives in more depth (Tashakkori & Teddlie, 2003). As a researcher whose background is in the natural sciences, but who has spent the second half of her academic career in the social sciences, mixed methods are a natural fit for the way my brain thinks about problems. Neither approach by itself can get to a full understanding of a specific process or outcome, and taking advantage of the strengths of each can provide more nuanced and rich findings. Below, I describe how I implemented an explanatory sequential mixed methods approach in an innovative way by first collecting and analysing national-level data on forests, communities, and the policies that involve them, and then integrating these findings with rich qualitative data from a regional-scale and then a local-scale case study approach.

Table 2 summarizes the many collaborators, data and methods that I used to address each research objective, and the academic and non-academic outputs associated with each stage. Each objective also entails its own analytical framework, as described above, and forms a piece of the puzzle that should collectively increase our understanding about the ways that communities in Mexico interact with the policies and programmes that are meant to support them in their role as forest stewards. I take the opportunity here to reflect on the fact that I was lucky to receive sufficient funding throughout my doctoral studies to support the production and delivery of all the non-academic outputs described in Table 2. This is not something that can be taken for granted. More details on the methods are provided in each of the following chapters of this thesis.

*Table 2. Research objectives and the groups or individuals that participated or collaborated at each stage, as well as the sources of data and specific methods employed, and the outputs produced and delivered.*

| | **Objectives** | **Research participants and collaborators** | **Material sources** | **Methods** | **Outputs** |
|---|---|---|---|---|---|
| RO1 | Describe and explore the patterns around land-use and livelihood strategies that Mexican communities have experienced during the past two decades and how they relate to participation in decentralized forest policies and programmes | - Academic collaborators (Duke University, UNAM and The University of Manchester) | - Multiple shapefile and raster geospatial data (listed in Appendix I)<br>- Global Forest Change dataset v.1.9<br>- Academic literature | - Geospatial analysis<br>- Descriptive statistical analysis<br>- Documentary and literature review | - Maps and figures used throughout this thesis as well as in academic publications (Izquierdo-Tort et al., 2025) and community reports<br>- Thesis (Chapter 3)<br>- Upcoming article in Geoforum |
| RO2 | Study how community governance bodies and project developers match local visions for transformative resilience with targeted investments of funds from decentralized forest policies and programmes in five Indigenous communities in Oaxaca | - ICICO<br>- The comisariados of San Juan Lachao, Santa María Peñoles, Santa María Jaltianguis, Santiago Xiacuí and La Trinidad Ixtlán<br>- Current or former community leaders, forest managers and representatives from interest groups from each of the 5 communities<br>- Academic collaborators (Duke University, NC State University, and UNAM) | - Minutes of workshops and assembly meetings outlining decisions made about funding allocation in Santa María Peñoles, Santa María Jaltianguis, Santiago Xiacuí and La Trinidad Ixtlán<br>- Academic literature | - Semi-structured interviews<br>- Documentary and literature review | - Posters and leaflets summarizing the main findings delivered to communities in person (San Juan Lachao and La Trinidad Ixtlán) and through ICICO<br>- Written report delivered to ICICO<br>- Thesis (Chapter 4)<br>- Upcoming article in special issue of Ecology & Society |
| RO3 | Explore the governance challenges faced by La Trinidad Ixtlán and San Juan Lachao when implementing decentralized forest policies and programmes, and how they modified their traditional institutions in response | - ICICO<br>- The comisariados of San Juan Lachao and La Trinidad Ixtlán<br>- Adult inhabitants of the two communities<br>- Video editor (Maximiliano Cuevas)<br>- Research assistant (Jimena Deschamps Lomelí) | - 1995 aerial images from INEGI<br>- 2023 satellite images from ESRI<br>- Book of internal statutes of La Trinidad Ixtlán<br>- Academic literature | - Semi-structured interviews<br>- Timeline focus groups<br>- Participatory mapping workshops<br>- Participant observation<br>- Field visits<br>- Documentary and literature review | - Large-scale printed aerial and satellite images with community polygons<br>- Intermediary results delivered through presentations with the *comisariados* and leaflets distributed to participants<br>- Final results in full written report delivered to the *comisariados* of San Juan Lachao and La Trinidad Ixtlán, and presented in community centres<br>- Short video documentaries about the history and present of each community, delivered to the *comisariados* and presented to the public through screenings in the town plaza<br>- Written report delivered to ICICO<br>- Thesis (Chapter 5)<br>- Upcoming book chapter on institutional jelling |

### *2.3.1. National-level analysis*

Based on my work on a systematic review of the literature on PES in Mexico, which was recently published (Izquierdo-Tort et al., 2025), as well as my previous experience researching

PES and their interaction with other land uses and policies by consulting community members and other key actors (Alatorre et al., 2021), I began my research with a preliminary understanding of the factors that affect communities' ability to use and manage their forest resources. I gathered national-level data on a variety of land cover, land use, and registered activities using communities (*ejidos* and *comunidades*) as the unit of study. The full list of datasets that I gathered, cleaned, compiled and mapped can be found in Appendix I. These diverse datasets all have dates associated to them. For example, for PES, it will be the date that the contract was established, from which we can infer the period of enrolment (the year of establishment plus five). For timber authorizations, the data will list the year of establishment and the end year. These dates were instrumental in constructing a database of all 30,382 Mexican communities, indicating their status with regards to their land use types as well as the contracts they have established between 2000 and 2025.

I then used the Global Forest Change dataset v.1.9 (Hansen et al., 2013), a high resolution and publicly-available dataset that shows tree cover loss as 30x30m pixels for every year between 2000 and 2023 (at the time of writing). By adjusting pixel size to account for projection error (closer to 25x25m for Mexico), and iterating across the full community polygons database (30,382 communities), I was then able to associate forest loss data to each community and for each year or time period. All the data cleaning and all the analysis was done using Python.

Assembling this database was a huge undertaking that happened very intensely during the first year of my PhD and then less so but still constantly during the rest of my studies. The next chapter (Section 3) describes the overarching trends that I was able to identify through these data, and reflects on more than twenty years of changes in communities' territories without attempting to evaluate the impact of any policy in particular. The goal is that, after publishing the paper, an anonymised version of the database will be made available to the academic community, like we did with the coded literature review of Mexico's PES (Alatorre et al., 2024).

### *2.3.2. Case studies: Descriptions*

Below I describe the case studies, starting with an overview of Oaxaca as the region where this research took place, then describing the organization that I collaborated with as part of a long-term research partnership, and the communities that I partnered with. I then describe my participatory methodology and how it contributes to community-engaged scholarship.

#### 2.3.2.1. Oaxaca

The state of Oaxaca, in the south of Mexico, is regarded as a success story for community-based natural resource management worldwide (Martin et al., 2011). Its forests cover 64% of the state's 9.5 million hectares (INECC et al., 2018). While it has been estimated that 82% of forested areas in the state are communally-owned (Velasco Murguía et al., 2015), my analysis shows that in 2020 only 54% of Oaxaca's forests are in *ejidos* and *comunidades*, which is close to the national average of 52%. Unlike the rest of the country, where communal lands exist mostly in the form of *ejidos*, land in Oaxaca is predominantly held by Indigenous *comunidades* (Figure 2), with about 30 percent of the state's population belonging to one of 16 different ethnic groups (Oviedo, 2002).

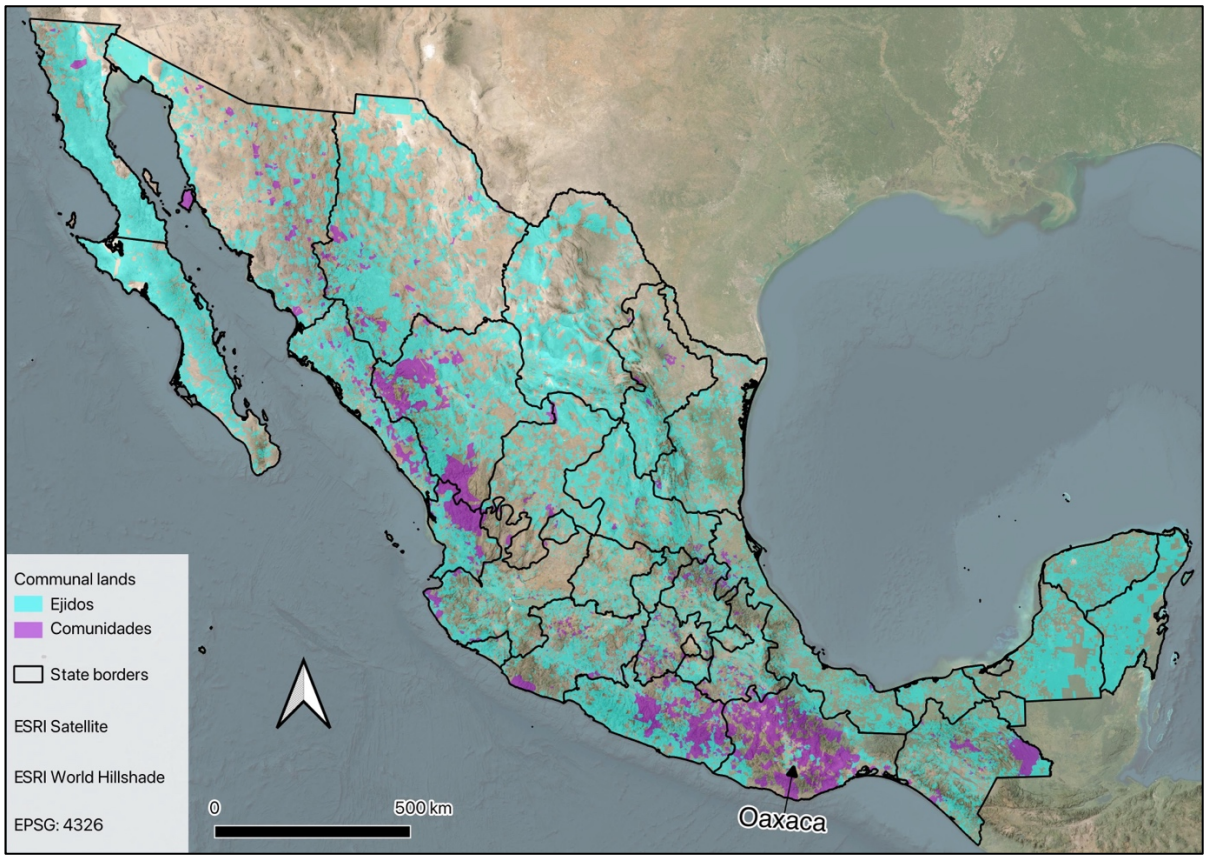


*Figure 2. Distribution of communal lands across Mexico. Oaxaca is home to the majority of Indigenous comunidades, including the study sites. Source: Own elaboration based on data from the National Agrarian Registry (RAN, 2021)*

The state also has a history of resistance to government overreach. As described in Section 1.3, at the height of the concessions era, a public-private partnership with a Canadian paper company based in the neighbouring state of Veracruz gave rise to FAPATUX (*Fábrica de Papel de Tuxtepec*), which received the exclusive right to harvest roundwood from designated

areas during 25 years in exchange for a stumpage fee paid to the communities who owned the forests (Merino-Pérez, 2004). FAPATUX operated mostly in the Sierra Norte region of Oaxaca (also called *Sierra de Juárez*), in 250 thousand hectares of pine forests across nine ethnically Zapotec communities, including La Trinidad Ixtlán (Merino-Pérez, 2004). It was also awarded important concessions in ethnically Chatino municipalities in the Sierra Sur and Costa regions during the 1970s, including San Juan Lachao (Emanuel & Greenberg, 2000). In 1980, when the 25-year concession was coming to an end, communities from the Sierra Norte formed the Organization for the Defence of Natural Resources and Social Development of the Sierra de Juárez (ODRENASIJ), which called a labour strike against FAPATUX (Pérez Avendaño, 2017). In 1982, then president José López Portillo issued a decree that renewed the forest concessions indefinitely (Merino-Pérez, 2004); in response, ODRENASIJ took the government to court and won a legal protection that eventually led to the repeal of the presidential decree (Pérez Avendaño, 2017).

#### 2.3.2.2. The Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO)

ICICO is a grassroots organization that seeks to develop local capacities within its member communities for sustainable natural resource management through forest-based carbon offsets and other forest activities and programmes (*ICICO AC*, 2026). The history of ICICO is detailed in (Osborne & Shapiro-Garza, 2018a), and it is noteworthy due to its long-term engagement with the voluntary carbon market as well as its community-centric governance. In 2002, the precursor to ICICO (Environmental Services of Oaxaca – SAO) began to pilot a government-led FBCO initiative with twelve communities, and in 2008, ten of these communities began selling offsets in a national voluntary market under the name CARBIOIN (Indigenous Carbon, Water and Biodiversity). In 2012, the ten communities selling CARBIOIN offsets formed ICICO, seeking greater participation and accountability: “Mimicking the governance structure of indigenous communities, ICICO created a general assembly of elected members from each of the participating communities to provide guidance and oversight” (Osborne & Shapiro-Garza, 2018, p.99). Its technical services arm also integrates community knowledge in project planning and implementation by training and employing extensionists from member communities.

The original ten ICICO communities were those that were already interested in and committed to forest management and carbon offsets as economic strategies within their broader

environmental (conservation, water provision, biodiversity) and social objectives (employment, capacity building, education). In 2014, ICICO began to engage with the international voluntary carbon market, securing ISO 14064 and CAR certification. The first pilot IFM project in Mexico was developed by ICICO in the community of San Juan Lachao in 2014 (Haya et al., 2025; Osborne & Shapiro-Garza, 2018a). Currently, ICICO is made up of 16 official members (Figure 3), all of which are represented in the organization's internal governance, and it works with an additional five communities in Oaxaca and neighbouring states as a technical advisor and services provider in forestry, carbon offsets, and other management approaches. To date, ICICO has developed 20 IFM projects under the CAR Mexico Forest Protocol, 18 in Oaxaca and two in Puebla, for a total of 639,311 issued credits (Haya et al., 2025).

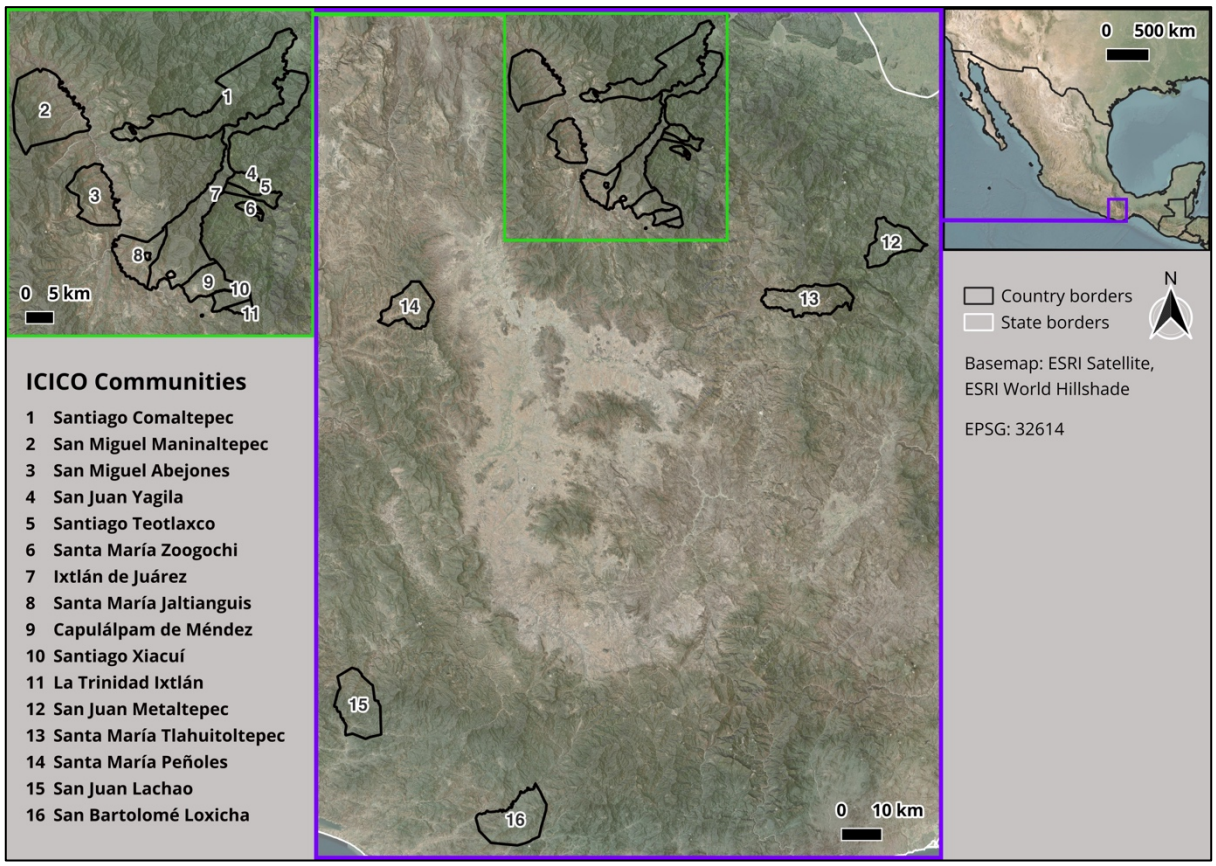


*Figure 3. Map showing the location of all members of the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO). Source: own elaboration based on data from the National Agrarian Registry (RAN, 2021) and ICICO.*

I first partnered with ICICO in 2018, when my coauthors and I conducted fieldwork in four of its member communities, including La Trinidad Ixtlán, San Juan Lachao and Santiago Xiacuí (Alatorre et al., 2021). This was in the context of the research I conducted under the supervision

of Elizabeth Shapiro-Garza when I was a master's student at Duke University. Shapiro-Garza has a 20-year partnership with ICICO, and the trust she has developed with them and their member communities was instrumental in paving the way for me to continue engaging with them as a doctoral researcher. In 2024, Shapiro-Garza brought together a group of like-minded researchers committed to community-engaged scholarship, including myself, to form the ROSES team (Researching Oaxaca's Socio-Ecological Systems). Our goal is to co-create knowledge with ICICO and its member communities, using our multidisciplinary toolbox to jointly address concerns raised by them. In Section 2.4 I reflect on my positionality as a member of the ROSES team and my relationship with ICICO and ICICO communities.

For the regional case studies on FBCOs and resilience, ICICO's technical services team worked with my ROSES co-authors and I to select the case study communities, in their role as intermediaries between our research team and the communities' leadership bodies. This helped ensure we were encompassing a variety of contexts, perspectives and experiences with FBCOs, as explained below. I also consulted their technical services team to select two case studies with contrasting experiences for the detailed case studies on community governance adaptation to forest policies and programmes (Section 5). More detailed descriptions of Santiago Xiacuí, Santa María Peñoles and Santa María Jaltianguis can be found in Section 4.2 as well as in (Rose & Arcila, 2025), the masters' project written by Brooke Rose and Melissa Arcila, who worked on the resilience case study. The communities of La Trinidad Ixtlán and San Juan Lachao are described in Section 5.3.1.

### *2.3.3. Case studies: A participatory and community-engaged approach*

The two case study papers included in this thesis are part of a long-term collaboration between a multidisciplinary group of researchers, the ROSES team (Researching Oaxaca's Socio-Ecological Systems), and ICICO. While strongly interlinked, each chapter (Sections 4 and 5) has a very particular focus dictated by the interests of the communities and ICICO, in line with the ROSES team's commitment to community-engaged scholarship. Furthermore, the sources of funding that made the research possible and the publications that they will be a part of also played a non-negligible role in dictating specific concepts or frameworks.

In Section 4, the methods employed were designed to answer concerns by ICICO around community members' perceptions of FBCOs and the organization's ability to distribute information about FBCOs broadly across communities, and also to address the perceptions by many community leaders and foresters that the ROSES team has interacted with that their forest

stewardship should be promoted and supported due to its ability to generate significant benefits within their communities. The ROSES team therefore designed an interview guide (Appendix IV) that was applied only to current and former community leaders and individuals involved with the decision-making process around FBCOs (including forestry technicians but also members of community committees that participated in ICICO's workshops) in five ICICO communities, with the goal of using the data obtained to design a survey instrument that will be applied to a wider range of people within different communities at a later date. The choice of communities was suggested by ICICO with the goal of maximizing variability in terms of their experience with FBCOs. This research was mainly financed by Duke University's Climate Resilience Innovation Seed Program (CRISP), which is why it was framed around the (at times conflicting) concept of resilience since the beginning. Additionally, we decided to prepare this paper for submission to a special issue in the journal Ecology and Society that will be titled 'Forests as pillars of socio-economic resilience', based on a recent report (Allen et al., 2025) further reinforcing the need to engage with this term. However, it is important to note that we did not make use of the term resilience in the interviews or workshops, instead asking much broader questions about what participants perceive to be important in supporting their communities and their forests into the future, and what threats may stand in the way. In writing this paper, we included findings from the more in-depth case study work that I did in two of the five communities, as described below.

In Section 5, the methods were also co-constructed with ICICO and the comisariados of La Trinidad Ixtlán and San Juan Lachao. During planning meetings with ICICO, I expressed interest in working with the communities of La Trinidad Ixtlán and San Juan Lachao based on my previous experience during my masters in 2018. They confirmed that they saw them as excellent case studies to contrast different histories of engagement with forestry and forest programmes, and that my findings would be particularly helpful for ICICO to understand why the assembly in Lachao voted to suspend the forest management plan. As described in Section 5.3, I held preliminary meetings with the *comisariados* of both communities to jointly reflect on the methods and deliverables. In both cases, *comisariados* reflected on the fact that they did not have any written or otherwise registered accounts of their communities' histories and saw my research as an opportunity to advance in this direction. In La Trinidad, they particularly requested that I interview the oldest people in their communities and that I invite them to participate in a short video documentary, so that their stories would be kept for future generations. In Lachao, they emphasized that I should interview people from different localities

within their vast community, to avoid specific narratives dominating over others. I incorporated their needs into my research design and managed to interview 10 people over the age of 80 in La Trinidad alone, and interviewed people in seven different localities in Lachao. The full list of interviewee characteristics can be found in Appendix III.

The bulk of my fieldwork in La Trinidad and Lachao was financed by the ePEStemology project, a Quebec-Flanders collaboration that was the reason I undertook a joint PhD programme. This grant influenced my focus on payments for ecosystem services and on "the epistemic positions deriving from communities of actors involved in the day-to-day experience of PES projects and human-nature interactions on the ground" while "recognizing the cultural, historical, ecological and political complexity of human-nature connections" (ePEStemology project outline, 2021). This project, however, did not impose a particular theoretical framework, which gave me the freedom to conduct my research in an exploratory way and to evaluate the suitability of different frameworks once my findings started to emerge from my analysis. During this time, I was offered the opportunity to contribute a book chapter for an upcoming work that aims to compile empirical backing for the recently proposed institutional jelling framework (Kimengsi et al., 2025). Therefore, once again, the chapter included as Section 5 of this thesis is the result of different converging pressures and opportunities that interacted with my own interests and capabilities.

#### 2.3.3.1. Community-engaged scholarship and participatory methods

Research is participatory when data is collected and used for purposes that are defined by the community to serve community desires and interests, and this is done in an inclusive, equitable and non-discriminatory manner, by or in conjunction with community members, and remains under the community's ownership and control (Biangalen-Magata et al., 2015; FPP, 2017). Numerous umbrella terms have been proposed to describe this type of process (Biangalen-Magata et al., 2015), including that of *community-engaged scholarship*, wherein "community and academic partners are peers and co-producers of knowledge" (Gelmon et al., 2013). Broadly conceived, community-engaged scholarship encompasses a variety of ways through which communities can participate in scientific research, including terms such as practice-based research, participatory action research, citizen science, and knowledge co-production (Bell & LewisJr, 2023). The core principles of community-engaged scholarship have been defined as: research that addresses real-life problems that are defined with or by the community and are investigated in scholarly ways through community–researcher partnerships that are

collaborative and mutually beneficial, wherein institutional resources are utilized to address these real-life issues (Gordon Da Cruz, 2017). I describe my approach as applying participatory methods within a framework of community-engaged scholarship.

Community-engaged and participatory research can generate encounters, dialogue and discussion to build new knowledge, perspectives and forms of management between academia and communities (Álvarez Larrain et al., 2022; Gordon Da Cruz, 2017). This has been a guiding principle for the work that the ROSES team have been doing over the past three years, as we seek to produce scientific knowledge that serves the needs of communities in Oaxaca and of ICICO as their representative. An example of the way we work with ICICO and its member communities is a wildlife monitoring workshop we co-organized in May of 2024, which was in response to a growing interest by many ICICO communities to initiate or expand on their own monitoring projects, and to explore the types of tools and techniques that they may be able to incorporate. The three-day workshop was facilitated by experts from Natura y Ecosistemas Mexicanos, another organization with which some ROSES members have a long history of collaboration, and from Duke University, and was funded by a research grant that the ROSES team developed. Representatives from 11 different ICICO communities attended the workshop. We conducted surveys at the beginning and at the end to assess peoples' interests in pursuing wildlife monitoring, in a similar way to what we had done in a previous study in the state of Chiapas (Izquierdo-Tort et al., 2024). From these preliminary data, the ROSES team went on to assist two neighbouring ICICO communities, Santa María Jaltianguis and San Miguel Abejones, in the development of a pilot biological corridor project, which is ongoing.

#### 2.3.3.2. Semi-structured interviews

Semi-structured interviews were a key source of data for the case studies presented in Sections 4 and 5. Interviewing is a widely implemented tool for obtaining qualitative data (Denzin & Lincoln, 1994). Unlike the highly-structured interview format that is common in health-related disciplines, semi-structured interviews place the interviewee more as a participant in a guided conversation rather than a source from which information is extracted (DiCicco-Bloom & Crabtree, 2006). This type of interview is organized around a series of predetermined open-ended questions, with the possibility that more questions will emerge during the dialog. They are usually on a one-on-one format, but it is also possible to interview larger groups. The full interview guides can be found in Appendices II and IV.

Unlike a survey, where designing a random and representative sample is crucial for the validity of the data, interviewee selection is based on finding the people able to provide the desired information (Tremblay, 1957). Individuals known as key informants are selected for interviews based on their accessibility, knowledge and social position (DiCicco-Bloom & Crabtree, 2006). The objectives of each study will determine who is considered a key informant. In the case of exploring the role of FBCOs in strengthening or hindering communities' visions for resilience (Section 4), we chose to interview current and former community leaders and individuals involved with the decision-making process around FBCOs, as previously described. However, for the case of exploring governance challenges related to forest management and conservation programmes (Section 4), I specifically sought to interview people from more marginalized groups in each of the two communities, including women, youth, elders, and non-native Spanish speakers. Seeking to include all groups within a community, some of whom may not have equal access to decision-making as a result of internal community dynamics, is considered an essential component of participatory research (FPP, 2017).

#### 2.3.3.3. Participatory visual methods: Timelines and mapping

The term 'participatory visual methods' (PVM) encompasses a wide range of techniques that involve individuals or groups taking part in the production of creative outputs that are used to convey their knowledge, experience, opinions, and ideas (Black & Chambers, 2019). Their power and potential for empowerment stem from the fact that they can transcend barriers of language and literacy, and enable those who are marginalized and often excluded from discussion and debate about research - such as women, youth, less-able people, and the elderly - to take part meaningfully (Black & Chambers, 2019). It is also an important opportunity for those who may not be able (physically or otherwise) to participate in fieldwork, to share their knowledge about traditional lands and activities, and to share the history of the area (FPP, 2017). During my work with San Juan Lachao and La Trinidad Ixtlán, I implemented two different PVM techniques: timeline focus groups (Tolentino et al., 2015) and participatory mapping (Álvarez Larrain et al., 2022; Appel et al., 2012; Chambers, 2006). More details about how these methods were employed can be found in Section 5.3, and the consent forms and guides can be found in Appendix II.

The idea to conduct timeline focus group workshops came from a paper by Tolentino et al., (2015), where they work with an *ejido* in the state of Quintana Roo to describe how it has engaged in the creation of two community-conserved areas, an ecotourism venture, and two

PES projects, all with the ultimate goal of trading carbon offsets in the voluntary market, and how this has allowed them to diversify their sources of income. Their methods are directly applicable to my own research questions, so I adopted their use of timelines as a qualitative research instrument that "attempts to capture events, actors, relationships, mechanisms, and spaces for participation that—in our case—influenced in the decisions that resulted in the implementation of a project" (Tolentino et al., 2015). They adapted their methods from the timeline interview approach developed by Adriansen and explained in detail in (Adriansen, 2012). Note that while Tolentino and colleagues specifically sampled *ejidatarios* (rightsholders) that were "working in the conservation initiative" and employed this technique to discern the "important events" that contributed to the establishment of a biodiversity PES scheme, my approach was less normative in that participants included a wide variety of events that were important to them within a broad framing around the history of the community and the changes in the ways their land is used and managed.

For its part, participatory mapping entails a map-making process that is undertaken by a group of non-experts who are associated with one another based on a shared interest, and that reflects the perceptions and knowledge that people or communities have about their spaces, landscapes or territories (Álvarez Larrain et al., 2022; Appel et al., 2012; Chambers, 2006). While participatory mapping can yield useful data of high quality and accuracy for all sorts of practical purposes, it can also be an done through so-called 'perception mapping'. This type of participatory mapping is generally not intended as a geographically accurate record of the area, but rather is intended to elicit key values of the community, local knowledge, and areas and activities of importance, along with their rough positions in relation to one another (FPP, 2017).

Perception mapping can also be used for non-spatial purposes, by analysing the discussions that occur during the map-making process (the group may deliberate over how to best represent the place in question, share their observations as they go along, and tell personal stories and anecdotes) as a research tool for exploring social relationships (Emmel, 2008). This type of mapping may not explicitly be aimed at affecting change and/or challenging power relationships but can start to build more extensive dialogue and relationships (Amsden & VanWynsberghe, 2005). For the purposes of my research, the goal was to elicit further reflections about the transitions that had occurred by visualizing how the landscapes have changed over time. The conversations that transpired were always new and enriching, and I believe it would have been hard for them to come about without the mapping process. For

example, in many interviews and during the timeline exercise in La Trinidad Ixtlán, some of the discussion had centred around the damage inflicted by FAPATUX (the paper company that held a concession in the region for 25 years) on their forests. Later, when mapping the activities of FAPATUX, some participants reflected on the fact that these had been quite limited, and one exclaimed that these had even benefitted them by building the same roads that they now use in their forestry works.

#### 2.3.3.4. Thematic analysis

Interviews were audio recorded whenever consent was given, and notes were always taken. All workshops were audio recorded. All audio files were converted to text using a semi-automatic transcription method (Braußе et al., 2022) through which I corrected the outputs generated by Open AI's Whisper Large model (Spiller et al., 2023). This method has been found to reduce manual transcription time by a factor of three to six, depending on noise levels (Braußе et al., 2022). The Whisper model was chosen because it runs on the researcher's computer, therefore data privacy issues arising within many other solutions do not apply (Tolle et al., 2023). The Whisper Large model took a total of 9,960 minutes to transcribe 61 audio files, and I spent a similar amount of time reviewing and correcting the outputs, which were riddled with errors and hallucinations.

I then carried out a thematic analysis with a grounded theory approach, which emphasizes the generation of theories that are directly grounded in the data itself (Charmaz, 2006). This is done by inductively deriving categories, themes, and patterns directly from data (Bryant & Charmaz, 2010) through an iterative process where themes are continuously developed and refined at successive levels of detail until the body of evidence can be coherently presented (Snilstveit et al., 2012). This involved a process of noting recurring themes, which began while cleaning and transcribing interview notes at the end of each day during fieldwork. Later, all transcripts and notes were analysed through thematic coding using NVivo 14. I entered the following case attributes for each file: type of file (e.g., interview notes, interview transcript, workshop transcript); location (the place where the interview or workshop took place); and demographic characteristics in the case of interviews (e.g., age, sex, occupation, positions occupied within communities' internal governance). The full list of interviewee characteristics can be found in Appendix III.

High-level codes were developed as markers for the main themes, with conceptual definitions where necessary, followed by a process of lumping, splitting, or more precisely defining the

different codes in an iterative process until they form a coherent conceptual set (Boyatzis, 1998; Snilstveit et al., 2012). Robustness and replicability in thematic analyses have nothing to do with what codes are developed, which is related partly to the scope and focus of the study, but rather with whether the codes are applied consistently (Boyatzis, 1998). In this case, given that the coding was done by a single researcher, consistency can be considered to be high although it may fall short on replicability.

### 2.4. Positionality

In this section I will discuss how my identity as a Mexican researcher, as a woman and mother, as a collaborator with ICICO and a member of the ROSES team, all influenced the way I carried out the work that informed this thesis, including my choice of theoretical frameworks and the way I interpret local dynamics and interactions. I will also reflect on the influence of my academic background, and how I have come to unlearn some of the more problematic narratives that are embedded in 'conservation' as a discipline.

In the Foreword to this thesis, I describe my upbringing and my multicultural identity, and how this manifests itself in the course of my interactions with the people that participate in my research. In this sense, I identify with what Bayeck calls an 'in-out-sider' (Bayeck, 2022) and Chavez refers to as a 'partial insider' (Chavez, 2015). Both emphasize that a researcher will "experience various levels of insiderness and outsiderness at different moments" (Chavez, 2015) and that "these identities are manifested, shaped, and enhanced in relation to the context and space of the study" (Bayeck, 2022). During my research, I often felt that my identity was contingent on the context and the space in which my interactions took place. For instance, during long car rides with the ICICO technical team, we had conversations about many different aspects of life in Mexico, such as the shows we used to watch when growing up, or the bureaucratic nature of universities and other organizations. Likewise, when having conversations with young people, particularly young parents in the communities, there was much we shared in terms of the challenges posed by modern technology and how to navigate that with our children. On the other hand, many cultural references, particularly with regards to religion, often left me feeling exposed as an outsider during conversations with community members.

As Chavez explains in detail, there are advantages and disadvantages associated with being perceived as more of an insider or an outsider as a researcher. On the one hand, being an insider

can: provide a nuanced perspective for observation, interpretation and representation; facilitate building rapport; provide legitimacy and facilitate acclimatation in the field; facilitate insight into the linguistic, cognitive, emotional, sensory and psychological principles of participants; and aid in detecting nonverbal gestures and hidden behaviours (Chavez, 2015). On the other hand, 'insider' researchers can: find their role and objectives constrained by social roles or expectations; be subject to requests to take sides in community political and moral issues or to attend events; experience value conflicts because of their research and their role as community members; and face difficulty recognizing patterns due to their familiarity with the community (Ibid.).

I believe that being perceived as an outsider had some advantages for the type of research I conducted, which was part of a long-term research collaboration with ICICO and carried out with genuine commitment to participatory or community-engaged scholarship. As such, I had to balance my own needs and interests with those of ICICO and of the communities themselves, including having to operate within the appropriate and well-established governance and customary mechanisms. This meant being introduced to community leadership bodies by ICICO staff, and then introducing myself to interviewees as having received the approval of the comisariado to conduct my research there with them, as well as all the other usual disclosures mandated by the ethics committee. However, I think that interviewees did perceive me as an independent party, not as a member of ICICO and certainly not as someone involved in internal community power dynamics, and I felt that our exchanges were frank. And while these communities remain profoundly patriarchal in the way that they conceive of the role of women in society (although many do work in the forest enterprises and have assumed leadership positions), as an external, educated woman, a *maestra*, I felt that I was automatically placed under a different social construct. Men related to me not primarily as a woman, but as a researcher.

Of course, this does not mean that power dynamics were not present. As a privileged and relatively wealthy person coming from a foreign university, my presence may have been intimidating to many. I did my best to put people at ease, and to assure them that they were free to refuse to participate in my research or to answer any of my questions, but cultural politeness and hospitality mixed with potential shyness or fear of refusal meant that I never had anyone refuse to be interviewed. I did, however, get people who asked not to be audio recorded, and definitely not everyone wanted to participate in the video documentaries.

Regardless of whether people perceived me as part of ICICO's team, it cannot be denied that my association with this organization influenced my positionality, as did my affiliation with the ROSES team. Since its origins, ICICO has had a clear vision and agenda around community sovereignty and natural resource management, wherein communities could work together to increase their bargaining power with regards to forest programmes and their collective capacity for forest management. As such, choosing to work with ICICO as a research partner and as a liaison between me and communities' leadership bodies, already biases my sample of Mexican communities towards those that have embraced (to different degrees) a vision for their territories as means to obtain income and utilities beyond basic subsistence or non-use values. This issue is further discussed in Section 6.3. However, within the broad objective of learning about forest decentralization policies in community contexts, conducting research in places where such policies have been implemented is justified. Furthermore, my decision to continue working with ICICO after my initial experience as a master's student responded to my profound respect for their technical services team, in whom I have always seen a genuine respect towards the specific workings and idiosyncrasies of the communities they work with, and a commitment to justice, equity and transparency. This is not to say that other organizations do not work in this way, but to explain why ICICO is such a compelling case study that has inspired a growing number of researchers to commit their time and resources to their cause.

In line with this, Professor Elizabeth Shapiro-Garza led the formation of the ROSES group (Researching Oaxaca's Socio-Ecological Systems), of which I am a founding member. Our group shares a commitment to community-engaged scholarship, wherein ICICO and its member communities help dictate our research efforts. We have developed a written agreement that each new ROSES member will be required to sign, and which outlines the nature of our partnership, including the need to share our findings with the communities themselves in ways that are useful and appropriate. From an academic perspective, such an approach can present problems. For instance, many funding applications to which we have submitted proposals expect a pre-determined objective and hypothesis, whereas we intentionally want to leave space for these aspects to evolve and be informed by our ongoing interactions. Additionally, while this has not yet been an issue, I can foresee that questions may be raised by reviewers and editors about ICICO's involvement in the research process and whether that can be considered a conflict of interest or decrease its external validity. This struggle is not unique to our situation, but has long been faced by the supporters of community engaged scholarship (Bell & LewisJr,

2023). I believe that continuing to develop and share this type of work will contribute to making it more mainstream and accepted by the academic community at large.

With regards to my positionality, another aspect that requires attention is how my academic background has shaped my worldview with regards to the issues raised in this thesis, particularly around what forests are and what their 'best' use would be. In this regard, my PhD experience has profoundly changed the way I see the world in many ways. My background is in the natural sciences, specifically a bachelor's degree in biology and a Master of Science in conservation science. While there are a variety of views and opinions within these broad fields, and I was exposed to many of them, the overarching approach to 'environmental problems' was one of seeing local communities as harmful and directly responsible for a decline in 'ecosystem services'. During my early research experiences for my bachelor's and master's theses, I gave a lot of weight to the perspectives and opinions of protected area managers in Mexico with regards to the role of PES programmes in strengthening their conservation mandates, and while I did interview *comisariados* from participating communities, this was mainly done to assess their compliance with programme rules and activities. At this point, I strongly believed that no-touch or 'fortress' conservation was the only way to protect forests and biodiversity and viewed PES as a very interesting and promising tool to bring people on board with that vision.

This perspective started to change during my time at Duke University, where I undertook a second master's under the supervision of Elizabeth Shapiro-Garza, who I already admired based on her extensive research into Mexico's PES. While the environmental economics and policy concentration within the Master of Environmental Management study programme was mainly focused on building data collection and analysis skills and strongly relied on the United States as a study context, I used my masters' project as an opportunity to continue learning more about the social dynamics behind conservation in Mexico. While initially focused on understanding the interactions between PES and protected areas from the perspectives of a variety of actors, including communities as well as government and non-government organizations, this research opened my mind with regards to other ways of using and caring for nature while obtaining direct benefits that can significantly address the basic needs of communities that should be the responsibility of a well-functioning state. This is particularly the case for community forestry, but also other community forest enterprises such as ecotourism and water bottling. I gained a great deal of respect for communities as stewards of

the places I valued so much, and came to see the importance of listening to and transmitting their visions for the land.

Early on in my PhD, I was encouraged to read the excellent book titled Ecology and power in the age of empire (Ross, 2017), which helped me put conservation thinking into dialogue with historical evidence of land management over time and uneven relations of power. While this thesis does not go deep enough into issues of power to be considered as a significant contribution to political ecology, this perspective has profoundly influenced how I see the world and the way I write about it. For example, in a chapter I published as part of the Routledge handbook of cultural ecosystem services (which I chose not to include as part of this thesis because the focus is very different to the stated goals of my research proposal), titled 'Paying for cultural ecosystem services: How and for whom?' (Alatorre, 2025), I analysed the PES literature and found there is no widespread recognition of plural values of nature, and in cases where PES have been designed to incorporate participants' traditional livelihoods and other aspects of their relationships with nature, the evaluation of the effects of these policies as either positive or negative depends greatly on who you ask, when you ask, and how you ask. I concluded that "The prevalence of examples from the Global North, as well as the overwhelming number of studies focused on aesthetic and recreational CES, point towards the fact that only a limited set of values are currently being considered within PES design and implementation. It remains to be seen whether this framework is compatible with other worldviews, and whether less marketable CES can or should be incorporated into the prevailing incentive-based approach to conservation." (Ibid.)

I include the above self-quote to demonstrate that I no longer believe that PES is this wonderful solution to environmental problems. Not unlike the other sources of financial and technical support for community forest stewards that I describe throughout this thesis, I believe that PES are positive and appropriate only in so far as they can support communities to attain their own visions for the future, which can be called resilience, sustainability, or otherwise. While acknowledging that communities are highly heterogeneous, and different people will have different visions and goals, I also believe based on my numerous encounters with community members over the past 15 years that they are not as individualistic as those of us who are not part of such a collective structure. They therefore do have a more or less shared sense of the common good, the things they need to make everyone better off. And PES can and do support this, at least in some cases. I will also say that, in an ideal world, where the government is able

to provide for the basic human rights of all their inhabitants, communities would be freer to turn away from PES and forest enterprises, as their basic needs would be met.

In summary, the experience of conducting a joint PhD in ecological economics and development studies has implied, for me, a process of unlearning as well as learning and refining knowledge. I have strived to conduct my research with awareness of the importance of context, history, power and justice, and while I don't claim to have achieved what for me are the ideals of participatory or community-engaged research, I have certainly been guided by them and have done my best to steer away from the more extractive and normative ways of working *with* communities that used to seem so normal to me.

# 3. LANDSCAPE TRAJECTORIES OF MEXICO'S FOREST STEWARDS

This chapter will be submitted for publication in Geoforum as:
Alatorre, A., Izquierdo-Tort, S., Dupras, J. 2026. *Landscape trajectories of Mexico's forest stewards*.

## 3.1. Introduction

This introductory chapter describes a novel, national-level database of multiple aspects of Mexican communities and their forest landscapes, and presents an analysis of the trends and connections between them. The goal is to highlight the complexity of the context in which community decision-making around land use and livelihoods takes place, and to set the stage for the following chapters. This work is a continuation and significant expansion of previous research (Alatorre et al., 2021), where we described the ways in which multiple policies can interact at the community level in Mexico. Here, the focus is on understanding the ways in which community's biophysical conditions and governance institutions influence their likelihood of participating in external interventions that compete for limited allocations of time (contracts) and space (forest hectares) in the forest commons. This 'competition' is due to the fact that a single plot of land that is enrolled in a given programme may not then be officially eligible for another use or activity until after the first contract is finished. Over time, however, the same area can host a combination of policies and practices, which will influence each other and the development pathways of participating communities.

As an example, Figure 4 shows the land-use transitions for the Calakmul Biosphere Reserve in the state of Campeche. This case highlights the complexity of attributing causal effects to any single program or strategy, when land is often enrolled in an overlapping array of land-use types, and the necessity for a comprehensive database of programme participation to elucidate any significant temporal interaction effects.

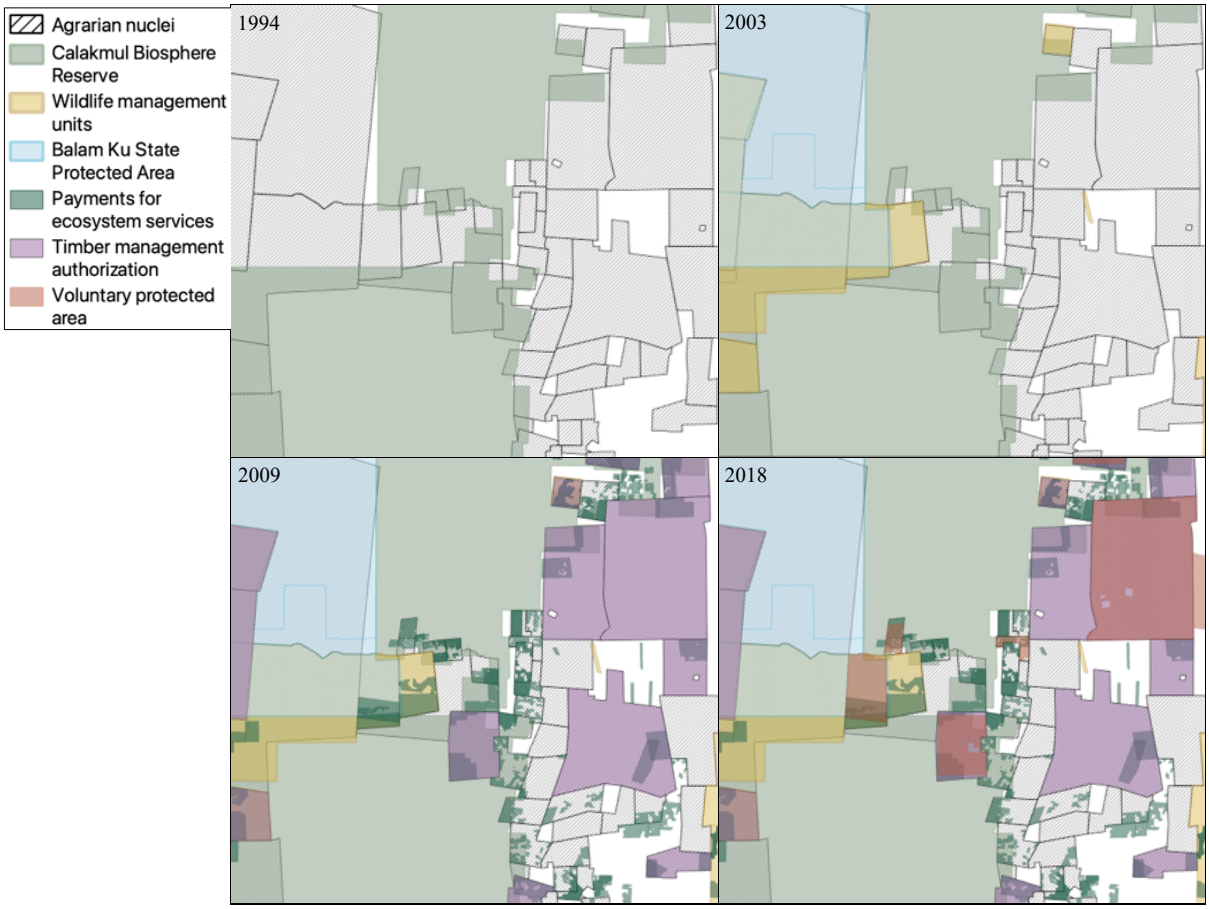


*Figure 4. Land-use transitions around Calakmul Biosphere Reserve. 1994: Reserve is established, communities are displaced from the core zone. ~2000: some register wildlife management units (hunting or other extraction permits), state protected area (PA) is established. ~2009: some participate in national PES, some get timber management permits. ~2017: some establish certified voluntary PA. Source: CONANP, CCMSS, CONABIO, CONAFOR.*

The national-level data of land-use designations presented in this chapter are restricted to those activities that are government-approved and registered, therefore ignoring other internally designated uses of the forest, such as community conserved areas, sacred sites, non-timber forest product extraction and recreational uses. However, it is important to understand what policies have been implemented by the state in community lands, and where, as it elucidates the ways in which these territories are seen and valued by the Mexican government. The idea is for the case studies in the following chapters to complement and build on the piece of the puzzle that is introduced here by exploring how people living in communities that have been targeted by forest conservation and management policies perceive these interventions, and the outcomes that can occur when they adopt and adapt to them.

### 3.2. Land-use dynamics start with land

As described in Section 1.2, common or 'social property' in Mexico is prevalent and relatively secure, demonstrating the first design principle of clearly defined boundaries for the commons (Ostrom, 2005). These structures were recognized (in the case of Indigenous *comunidades*) or established (in the case of *ejidos*) during the agrarian reform of the 20th century. Today, 93.5% of the 30,382 registered agrarian nuclei are *ejidos*, and they represent 87% of the land held under communal ownership. Less than 2,000 agrarian nuclei are *comunidades*. However, while *comunidades* are in theory Indigenous, and *ejidos* are groups of peasants by design, many *ejidatarios* are Indigenous (Assies, 2008) and some *comunidades* no longer consider themselves (or are considered by the state) as Indigenous when criteria rely mainly on the proportion of speakers of Indigenous languages.

In the 1990s, the Mexican government embarked on a title regularization campaign that encouraged the voluntary certification or titling of community lands that would enable renting and selling to third parties (Valsecchi, 2014). This process happened in three waves through the establishment of programmes aimed at implementing the Agrarian Law and its amendments. First, the Programme for Certification of Ejidal Rights (PROCEDE) operated from 1993 to 2006 (Procuraduría Agraria, 2010). The equivalent for *comunidades* was the Program for Certification of Communal Rights (PROCECOM). It was replaced by the FANAR programme (Support Fund for Non-regularized Agrarian Nuclei), which operated from 2007 to 2016. The RRAJA programme (Regularization and Registration of Agrarian Juridical Acts) then replaced FANAR in 2017 and is ongoing. By far, the majority of *ejidos* and *comunidades* were certified between 1993 and 2006 through the PROCEDE programme, as evidenced in data from the National Agrarian Registry (RAN). In the 2022 dataset of 30,382 registered agrarian nuclei, which includes a Programme column that indicates how the *ejido* or *comunidad* was certified, only 1,834 were certified through FANAR. None are listed as having been certified through RRAJA, despite the programme being in place since 2017. Here, the state of Oaxaca is an outlier, since it has the highest concentration of agrarian nuclei that were certified by FANAR.

The RAN dataset does not indicate the date in which the certification happened, but the National Council for Development Policy Evaluation (CONEVAL) published a breakdown of the number of agrarian nuclei that were certified during the first 7 years of the FANAR program (CONEVAL, 2013): only 312 during the first four years, and 1,252 between 2011 and 2013.

This shows that there is a significant time lag between when the programme was put in place and when agrarian nuclei started participating, which we can assume was also the case for the PROCEDE programme. Both *comunidades* and *ejidos* participated in PROCEDE or PRODECOM, but by analysing RAN's parcel data we find that only 29% of *comunidades* went on to subdivide part of their formerly communal properties into individual parcels, compared to 43% of *ejidos*. The degree to which communities' territories are privatized varies greatly, with Barnes (2009) estimating that 30% of *ejidos* are fully privatized while 7% retain full communal ownership (Barnes, 2009). Currently, 39% of all formerly communal land has been subdivided into parcels, as estimated by overlaying the RAN parcel data with the community polygon data.

After the overwhelming success of PROCEDE in its goal of 'regularizing' the lands owned by communities, there were fears that this would lead to large-scale land sales, thus eroding social property in Mexico. However, this does not seem to have been the case. Data presented in Barnes (2009) shows that by the year 2000 *ejido* tenure covered approximately 105 million hectares, or 52% of the Mexican territory. Then, a paper by Madrid et al. (2009) used RAN data from 2006 to estimate that 51.4% of Mexico's territory is under social property (this corresponds to 1,008,303.3 $km^2$) (Madrid et al., 2009b). This matches findings that less than 10% of ejidal lands had been converted to private property by 2007 (DiGiano et al., 2008). Using RAN data from 2022, we can estimate that the current percentage of the Mexican territory that is under communal ownership is 49.9% (958,748.2 $km^2$). So there has been a reduction, but it has been very small.

### 3.3. Communities and their forests; forests and their communities

The issue of forests within communities' territories is central to this thesis, as indicated in the title. Given the undeniable importance of forests, and the many competing uses and values that they can be subject to, it is crucial to first understand the prevalence of communities as forest stewards. Just as the claim that 80% of the world's biodiversity is found in the territories of Indigenous Peoples circulated widely around the academic and practitioner community for 20 years without any basis on scientific evidence (Fernández-Llamazares et al., 2024), so too have similar claims circulated for decades about Mexico's forested landscapes. At the start of this century, several influential publications claimed (without providing evidence) that 80% of remaining forests were in common properties (J. Alix-Garcia et al., 2005; D. B. Bray et al., 2003; Klooster & Masera, 2000). According to Bray et al. (2003), the 80% figure comes from

INEGI, the Mexican statistical agency, although its empirical basis is not documented (D. B. Bray et al., 2003). More recent publications started to converge around 60% (Madrid et al., 2009b) or 50% of Mexico's forests being held by communities (Barsimantov & Kendall, 2012) based on data from the 1993 National Forest Inventory (NFI), which is a vector dataset of land cover types, and a 2005 land use and land cover vector dataset published by INEGI. This statistic is due for an update.

Remarkably, the percentage of Mexico's forests that are under communal ownership has remained practically unchanged since the last published analysis, which was based on low resolution data from 2005 (Barsimantov & Kendall, 2012). Using high resolution (30x30m) raster datasets published by the Commission for the Knowledge and Use of Biodiversity (CONABIO) for 2010 and 2020 (Figure 5, see Appendix I for data sources), and the RAN community polygon dataset, it is possible to estimate that communities held 52% of all forests in Mexico in 2010, and 51.7% in 2020, using a broad definition that includes seven different 'natural' land cover categories from this dataset (five forest types, one shrubland and one scrubland category). This was done by using the rasterstats module in Python to calculate the number of pixels of each land cover type within the entire Mexican territory and within each community polygon, multiplying the pixels by their resolution (30x30m) and adding up the areas with values corresponding to each land cover category. The surface of the seven different forest cover types was then added to obtain a total value of forest cover for Mexico and for communal lands. This was done separately for the 2010 and 2020 raster datasets (Figure 5).

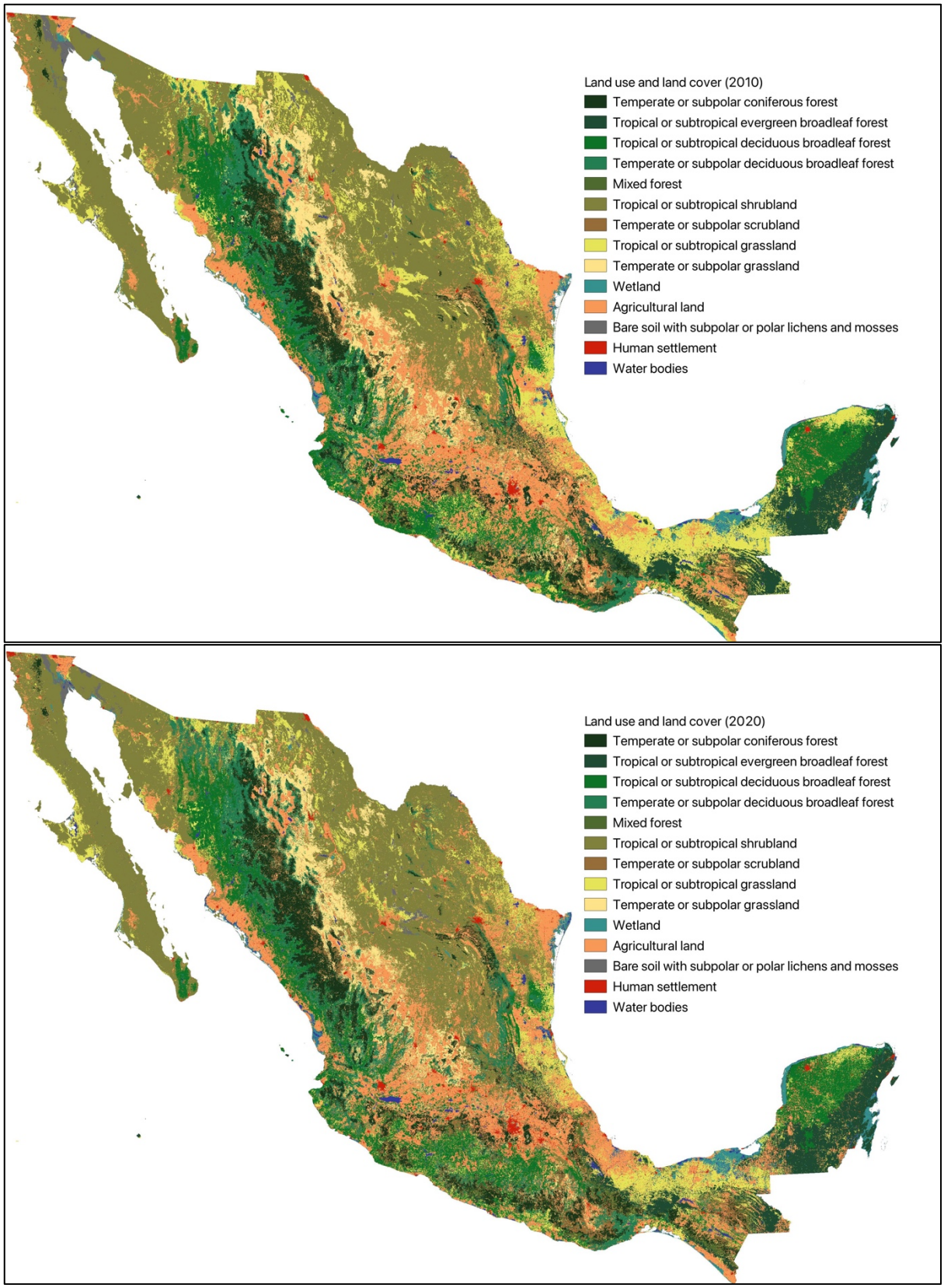


*Figure 5. Land use and land cover for 2010 and 2020. Source: Own elaboration based on data from CONABIO.*

Also remarkable is the fact that, contrary to the prevailing narrative of deforestation and forest degradation in Mexico (D. B. Bray & Klepeis, 2005), total forest cover (as defined above) actually increased between 2010 and 2020 by 9.8% overall and 9.1% in communal lands. This finding is in line with predictions of a 7% increase of forest cover by 2035 based on data from 1994 to 2015 (López-García et al., 2024), and other local studies showing significant forest recovery in different Mexican contexts during similar periods (Hernández-Aguilar et al., 2021; Honey-Rosés et al., 2018; Klooster, 2003b). This measure does not account for phenomena such as replacement of primary forests with secondary forests or plantations, or forest fragmentation, and does not mean that forest loss is not occurring, but is still a noteworthy observation. Some of the drivers for this forest recovery trend in Mexico that have been described in the literature include the national payments for ecosystem services (PES) programmes (López-García et al., 2024), as well as out-migration and the corresponding abandonment of agricultural plots, the prevalence of shade coffee, community forest management for timber, and protected areas (D. B. Bray, 2010).

A similar figure of 80% common property forests has long circulated specifically for the state of Oaxaca. It appears that this is based on an estimate made using data from the 1993 NFI, which found that Oaxaca has by far the highest percentage of common property forests out of eight states tested, at 79.8% (Barsimantov & Kendall, 2012). The picture obtained from the present analysis of updated data is drastically different. For 2010, *ejidos* and *comunidades* in Oaxaca account for 53.6% of forested areas, which remains stable for 2020 (54.2%), and is not far from the national average of 52%. This makes the state of Oaxaca less of an outlier in this regard.

### *3.4. Whose forest cover loss?*

The next time someone sets out to evaluate forest cover at the national and community level in a fixed point in time, they may find very different results. This is because the years after 2020 have seen extraordinary levels of forest cover loss, in ways that seem to have come as a surprise even for those in charge of predicting future deforestation. One of the criteria that the National Forest Commission (CONAFOR) has consistently employed to evaluate and rank applications for its PES programmes is the index of economic pressure on deforestation (IRDef), developed by the National Institute of Ecology and Climate Change (INECC). This is a value between 0 and 1 that indicates the relative risk of deforestation that each pixel of forest possesses based on a comprehensive list of variables associated with forest loss, such as forest type, altitude,

slope, agricultural productivity, distance to population centres, and presence of protected areas (Instituto Nacional de Ecología, 2014). The latest available version of the IRDef was published in 2018, and it is based on data from 2014-2017.

The IRDef index is classified into five risk categories by an equal counts method, meaning that each category (Very High, High, Medium, Low and Very Low) contains 20% of all forested pixels. Using a publicly available layer of the 2018 IRDef (see Appendix I) and the rasterstats module in Python, it is possible to calculate the number of pixels of forest within each community polygon, and the risk values of each pixel. Multiplying the pixels by their resolution (250x250m) and adding up the areas with values corresponding to each risk category according to the values in the file metadata yields the total area under each level of risk for each community. Each community is then classified according to the largest risk category:

| **Pixel value** | | |
|---|---|---|
| **Lower bound** | **Upper bound** | **Risk category** |
| -3000 | 3043 | Very Low |
| 3043 | 3535 | Low |
| 3535 | 3984 | Medium |
| 3984 | 4503 | High |
| 4503 | 9767 | Very High |

To use a (simplified) real example, if a community polygon has 500 hectares under Very Low risk, 230 under Low, 125 under Medium, 60 under High and 90 under Very High, it would be classified as Very Low risk for the purposes of our analysis. Figure 6 shows that, although a majority of communities were classified as having Very High deforestation risk in 2018 (20.2%), it was actually those that had been classified as having a Low deforestation risk that incurred the most forest cover loss in the years immediately following the assessment, followed by those under Medium risk (Figure 6).

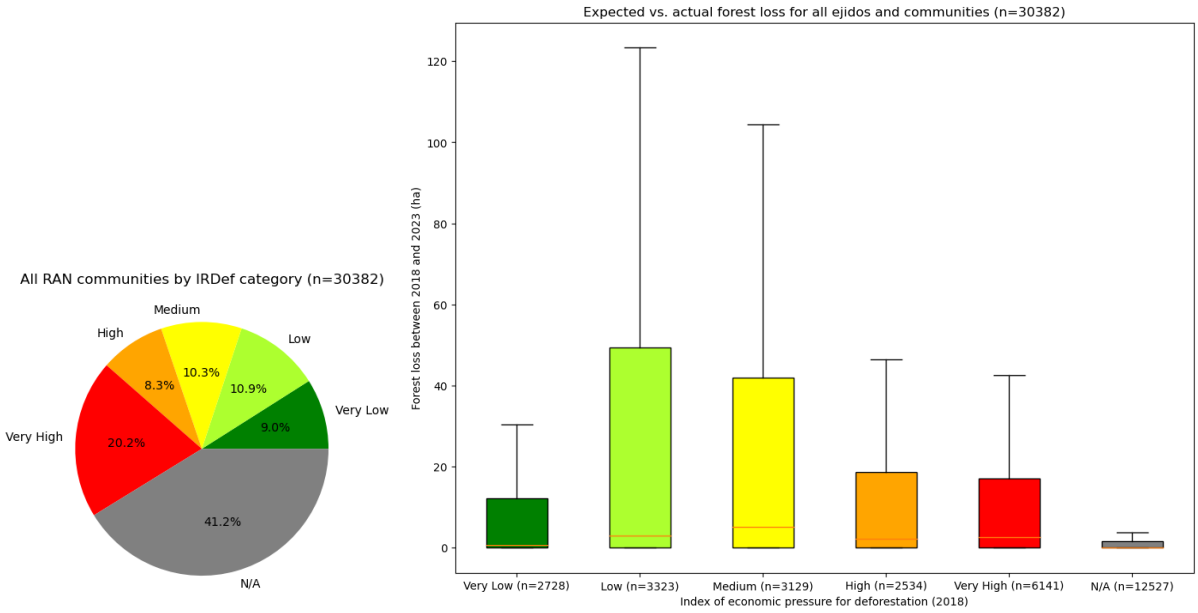


*Figure 6. Distribution of all communities in Mexico according to their estimated deforestation risk (left) and boxplot showing the actual forest loss that occurred from 2018 to 2023 for each category of risk. N/A refers to non-forested communities. Source: Own elaboration based on data from INECC.*

The patterns of recent forest loss are driven by multiple complex variables that are worth speculating on here, even though a causal analysis falls outside the scope of this study. Firstly, at the national level, we see a trend of increased forest cover loss starting around 2017 and rising until reaching a peak in 2019 (Figure 7). Then, in 2021 and 2022, forest loss decreases drastically, before restarting in an upward trend in 2023. This may be due to the COVID-19 pandemic, which seriously disrupted livelihoods and supply chains across Mexico. Interestingly, this disruption is linked to increased forest cover loss in other contexts (Singhal et al., 2024). This pattern at the national level is mirrored within community lands (*ejidos* and *comunidades*; Figure 7).

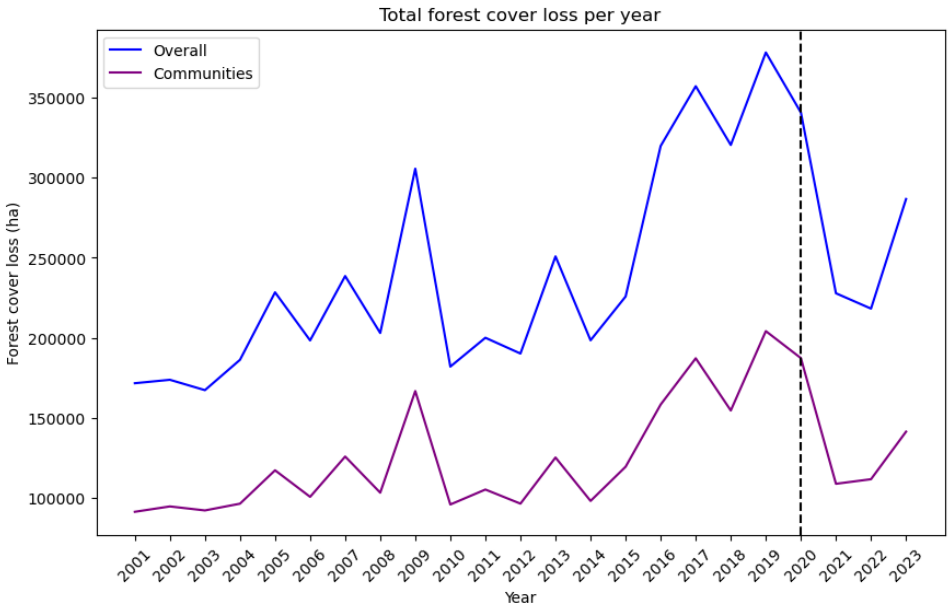


*Figure 7. National-level forest cover loss from 2001 to 2023, highlighting the onset of the COVID-19 pandemic (2020). Source: Own elaboration based on the Global Forest Change dataset v.1.9 and RAN (2022).*

This forest loss is not occurring homogeneously across the country, but is driven by a few locations where deforestation has skyrocketed in recent years, mainly the states of Campeche (which lost more than 220,000 hectares between 2020 and 2023) and Chiapas (153,000 hectares lost during the same period). Figure 8 shows the total forest cover loss for each of Mexico's 31 States and one Federal District (*Distrito Federal*, which is currently named *Ciudad de México*), with the labels ordered according to the number of hectares lost between 2020 and 2023. The Yucatan Peninsula, made up of Campeche, Quintana Roo and Yucatán, is the region with the highest levels of recent forest loss, coming up at nearly 400,000 hectares, slightly bigger than the province of Liège in Belgium. The trends driving forest loss in this region are a combination of pre-existing pressures such as the expansion of the agro-industrial production model, driven in large part by Mennonite private property (Ellis et al., 2017) and more recent large-scale pressures driven by the political agenda of the administration of former president López Obrador, including the controversial *Sembrando Vida* agricultural subsidy and the *Tren Maya* project. While no papers have been published that address these issues directly, there have been a number of recent theses on the subject of *Sembrando Vida* and its associated deforestation trends (Avila Vasquez, 2023; Gonzalez Moctezuma, 2025; Pérez Ponciano, 2023).

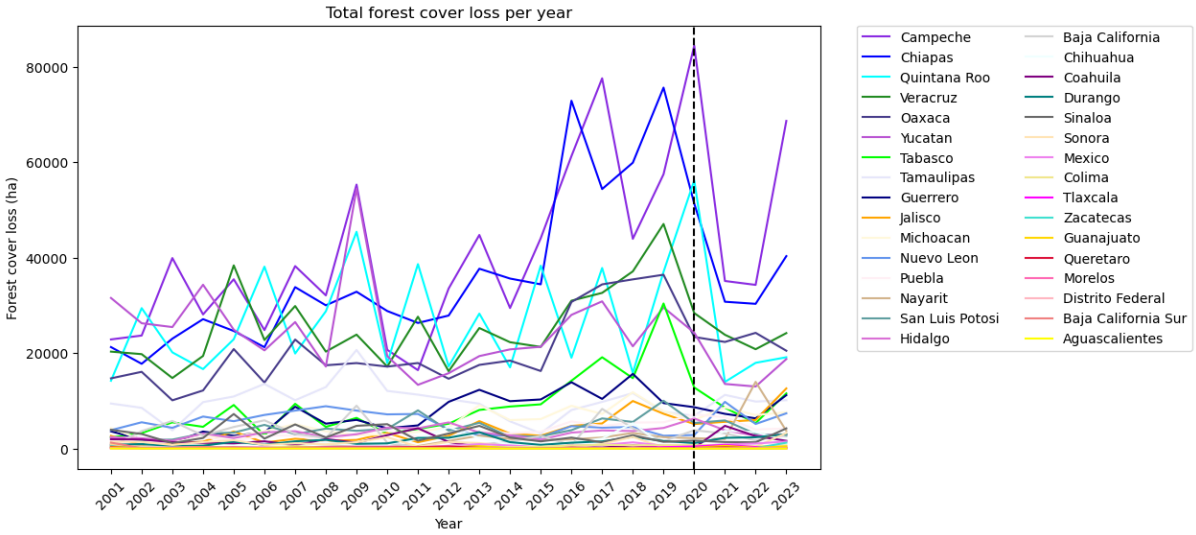


*Figure 8. Forest cover loss for each state, ordered by amount of forest cover loss from 2020 onwards. Source: Own elaboration based on the Global Forest Change dataset v.1.9.*

In 2017, Ellis et al., found that forest cover loss in the Peninsula region was significantly higher in private and federal property compared to communal property (Ellis et al., 2017). However, this no longer seems to be the case, as forest loss across the Peninsula but particularly in Campeche is concentrated in *ejido* lands (60%; Figure 9). This, along with the clear linear patterns of forest loss that match the route of the new mega-infrastructure Tren Maya project, points to policy-driven causes of increased forest loss in the Yucatan Peninsula.

Having forests within their territories has a lot of implications for communities. Apart from providing them with essential resources such as firewood, food, medicinal plants and construction materials, as well as supporting cultural or religious uses and values, they also determine their eligibility for certain important sources of income or funding. With the goal of increasing the capacity and economic sustainability of community forest enterprises, CONAFOR promotes a number of support programmes, including providing funding for improvements of roads and other infrastructure for management, harvest, transport, and processing, acquisition of timber harvest equipment, and training of employees (Antinori & Rausser, 2007; Frey et al., 2019). Communities in Mexico also have access to other sources of funding, which they tend to mix-and-match as needed with more targeted funding to support all their forest-related activities (Alatorre et al., 2021; Zaga-Mendez et al., 2026). These sources include one of the world's largest and longest-lasting payments for ecosystem services (PES) programmes (Izquierdo-Tort et al., 2025), and a burgeoning voluntary market for forest-based carbon offsets (FBCOs). Other paths available to communities are more in line with

conservation, including establishing voluntary protected areas. The next section describes how these pathways have played out for Mexico's forest communities.

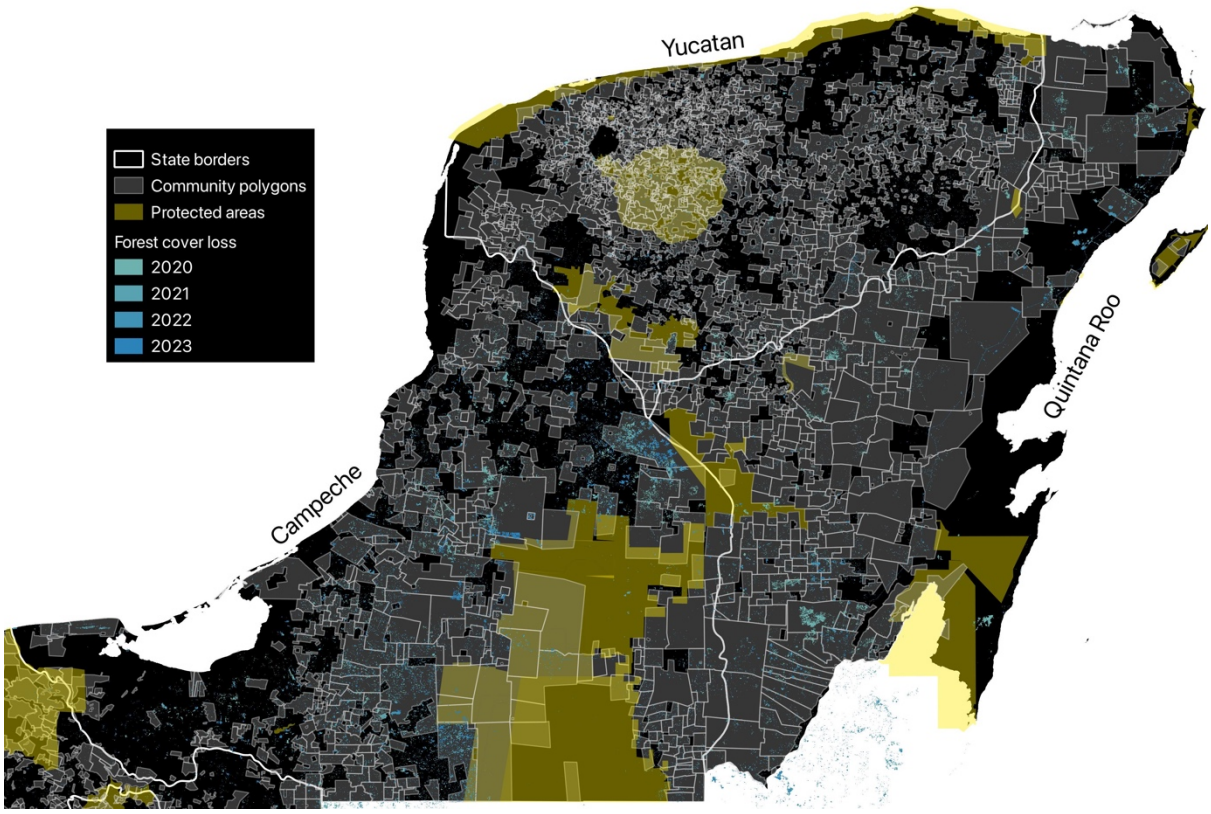


*Figure 9. Forest loss patterns in the Yucatan Peninsula seem to be associated with increased agricultural activity in ejidos and the Tren Maya, while protected areas remain largely unaffected (except for the Tren Maya route across Calakmul Biosphere Reserve). Source: Own elaboration based on data from RAN, CONANP, and the Global Forest Change dataset.*

### 3.5. The ideal forest: Policies that overlap conservation with timber harvesting

#### *3.5.1. Community forestry: Bigger than we thought, but not growing*

Community forestry or community-based forest management are umbrella terms that can be defined as forest conservation and management activities that are carried out by people living within rural communities and on the basis of local norms and interests (Wiersum, 2004). This means that specific practices can be adapted to the context with regards to forest type, local livelihood strategies, and community institutions (Ibid.). In the context of Mexico, the sale of timber and other forest products can only be legally done under a harvesting permit (*permiso de aprovechamiento forestal*) emitted by the Ministry of the Environment (SEMARNAT). This requires submission of forest management plans (*plan de manejo forestal*) that deal not only with logging itself by setting locally appropriate harvesting volumes but also include additional

management activities such as restricted harvesting areas, wildlife corridors, reforestation, and monitoring (Barrón Sevilla, 2016; Ellis, 2016; Torres-Rojo et al., 2016)[8]. For a community to obtain a timber harvesting permit, the forest management plan must be approved by the community's assembly, which is the highest decision-making governance body[9]. During this process, the assembly can incorporate modifications to the forest management plan to ensure that certain aspects of forest uses or values are considered and respected[10].

A 2013 paper by Hodgdon and colleagues estimated that 9,000 *ejidos* and *comunidades* hold commercially viable forests. Among them, nearly 45% had timber harvesting permits, but they varied in terms of their level of involvement with the timber production chain. Around 32% of communities have no direct participation in timber harvesting and instead establish contracts with third parties who carry out the forestry tasks, while 992 (11%) were considered primary producers and only 1% were producers with secondary transformation, industrialization and commercialization capacity (Hodgdon et al., 2013). Those 992 community forest enterprises (CFEs) were estimated to be mostly profitable and sustainable, based on a small sample and data from 2011 (Cubbage et al., 2015). Ten years later, studies were still publishing findings based on a subset of 673 CFEs that had timber harvesting permits between 2001 and 2012 (Blackman & Villalobos, 2021). Based on data from the National Forest Commission (CONAFOR), complemented with lists compiled through information requests by the Mexican Civil Council of Sustainable Silviculture (CCMSS), a more comprehensive dataset of timber harvesting permits awarded to communities was assembled, which includes 4,717 observations belonging to 1,900 *ejidos* and *communities* between 1995 and 2023 (see Appendix I). As is evident from Figure 10, after 2012 there was a significant increase in the number of permits awarded per year, reaching a high of 798 permits in 2014. Since then, the number of permits per year has steadily decreased. The average length of permit validity is 10 years, while the maximum is 40, which means that most of the communities that obtained permits during the peak years are probably still harvesting timber, so the decline in Figure 10 may not necessarily correspond to a decline in overall timber production if communities continue to renew their permits.

[8] More details about timber harvesting regulations and processes in Mexico can be found in Section 1.3.2.

[9] Community governance is explained in more detail in Section 1.2.2.

[10] Sections 4 and 5 explore how projects and programmes are adapted to local conditions.

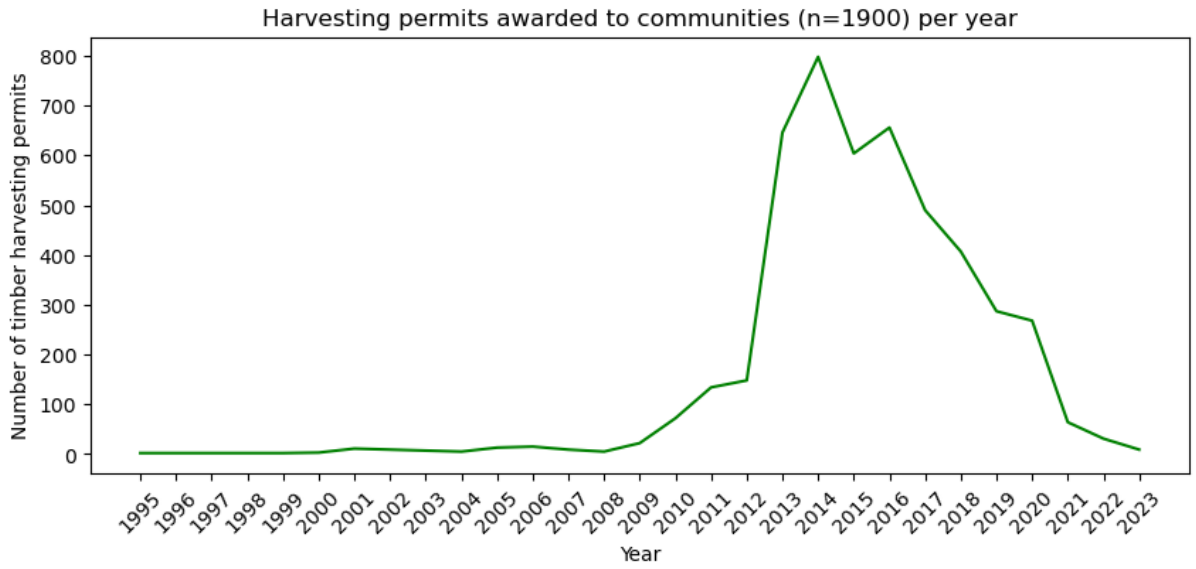


*Figure 10. Number of timber harvesting permits awarded to communities each year. Source: Own elaboration based on data from CONAFOR and CCMSS.*

While Oaxaca is probably the best-known state for community forestry, with countless publications on the subject, currently the distribution of permitted communities is mostly concentrated within the northern states of Chihuahua, Durango, Jalisco and Michoacán, which together account for 45% of all permits in the national-level database (Figure 11). Oaxaca, on the other hand, only has 226 permits within 121 different communities, or 9% of it 1,341 agrarian nuclei. This apparent contradiction had already been noticed by (Barsimantov & Kendall, 2012), although the rate has certainly increased from the 2.6% they had estimated. The northern states where the majority of community forestry is taking place seem to be underrepresented within the academic literature: a quick Google Scholar search reveals only 88 publications with the words Chihuahua and forest (or forestry) in the title, while there are 347 hits for Oaxaca. We noticed this same spatial bias in the academic literature on Mexico's PES programmes, where 11 states accounting for 24% of all PES contracts have no published case studies, while Oaxaca, Veracruz and Chiapas jointly have 68 publications, and even within the states themselves, most publications are concentrated around one or two municipalities (Izquierdo-Tort et al., 2025). In our review of the PES literature, we hypothesise that this bias (to which we are actively contributing, including through the next two chapters of this thesis) is due to researchers' relationships with local institutions and networks, key ecological and socioeconomic attributes of academic interest (e.g. Indigenous communities, tropical forests, endangered species), as well as logistical and safety conditions in the least studied regions. In

the case of this thesis, all these reasons contributed to the decision to continue working in Oaxaca.

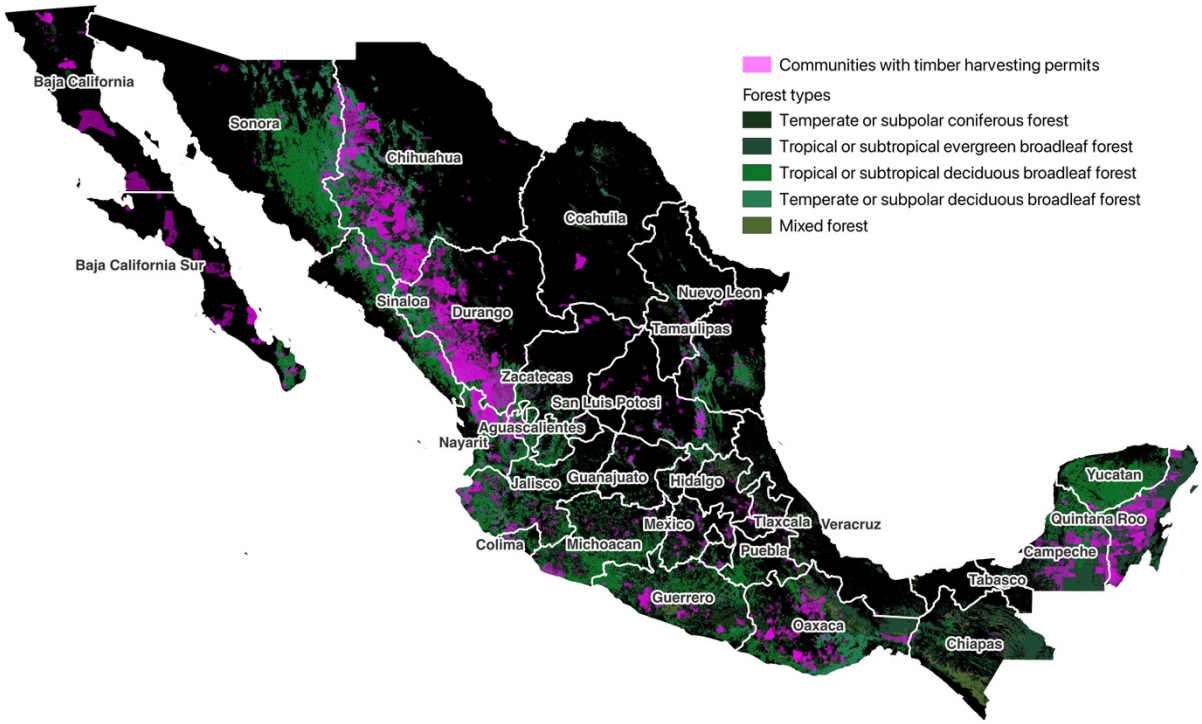


*Figure 11. Map of communities that have had timber harvesting permits at any point between 1995 and 2023, and the distribution of forests across Mexico. Source: Own elaboration based on data from RAN, CONAFOR, CCMSS and CONABIO.*

### *3.5.2. Payments for ecosystem services: An increasingly irrelevant subsidy*

Another path available to Mexican communities with forests within their territories is applying to one of many modalities of payments for ecosystem services (PES) programmes[11]. In Izquierdo-Tort et al., (2025), we describe in detail the implementation and research patterns of Mexico's PES between 2003 and 2022. Here, the focus is on how communities have interacted with PES across its 20+ year history. CONAFOR has long had a policy of transparency and data sharing (perhaps too open, as they include private participants' full names and information about how much money they were paid per year through PES), which made it possible to compile a complete list of applications per year, the results of those applications, and for those approved, all the spatial data pertaining to the polygons enrolled. With regards to applications, there are three main types of responses: approved and funded, approved but not funded, and

[11] Section 1.4 of this thesis introduced Mexico's PES programmes.

not approved. Each year, CONAFOR's budget allocation determines how many contracts will be established, and they use a points-based system to decide who gets awarded funding. Applicants that were approved but not funded fulfilled all the eligibility and technical requirements for the programme, but they missed out on funding due to budgetary constraints. Applicants that were not approved had missing elements in their application or were otherwise ineligible.

Over time, the eligibility and targeting criteria have changed, sometimes significantly, as a reflection of broader political priorities. Appendix V contains a summary table of the rules and eligibility criteria for PES and how they have changed over time since 2008. These criteria will undoubtedly impact the ways in which communities engage with PES and help explain some of the enrolment patterns described throughout this chapter. For instance, with regards to the interaction with timber harvesting and protected areas (analysed in Section 3.5.4 below), we can see that having an active forest management plan was used as a general tiebreaking criterion by CONAFOR since at least 2008 and up until 2020, and being located within a protected area has consistently awarded points for all PES modalities. Applications with larger areas have also been prioritized, which may explain why the size of PES polygons has tended to increase over time (Figure 12). Other criteria, such as obtaining more points if they are women or, for the case of communities, if they have women in their leadership bodies, which came into effect in 2023, can impact communities' internal institutional arrangements, according to the findings presented in Section 5.

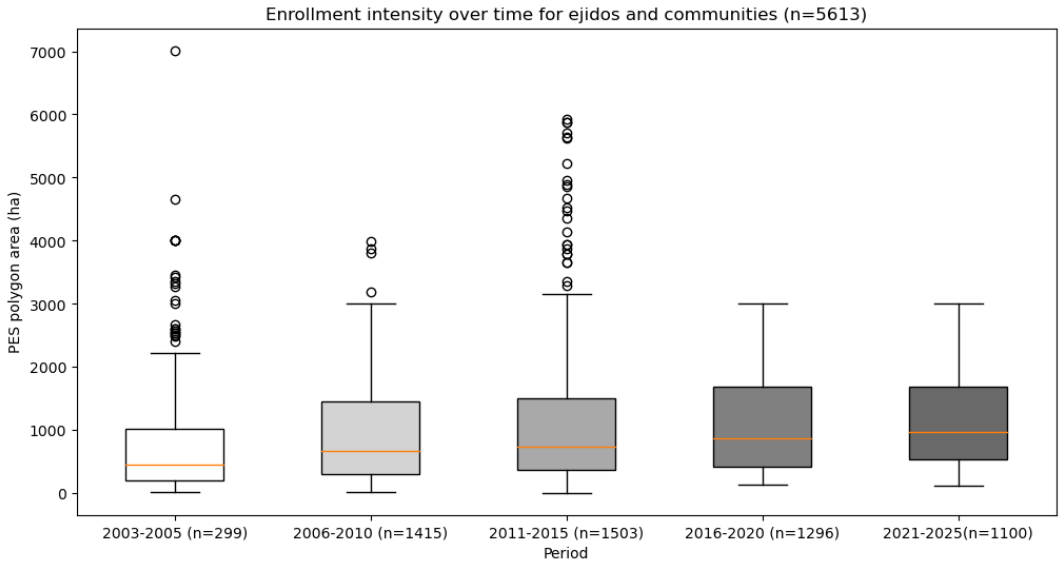


*Figure 12. Box plot showing the change in the intensity of enrolment in terms of the size of PES polygons over time.*

One thing that has not changed is, incredibly, the payments per hectare per year that participants receive. When the programme was first established in 2003, the maximum payment was fixed at $450 MXN per hectare per year. This maximum payment is reserved for cloud forest ecosystems, and the vast majority of participants receive less than that. In 2010, the payment levels were adjusted to account for opportunity costs, setting the maximum payment to $1,100 MXN (approximately $50 USD) to correspond to the expected returns from planting maize in an equivalent area (again, most participants receive less than the maximum). Since 2010, the payment levels have remained unchanged, which means that their relative value has basically halved when accounting for inflation (Figure 13). For comparison, it is estimated that one hectare could currently yield around $200 USD worth of maize, between $1,000 and $4,000 USD worth of timber under commercial logging (Cubbage et al., 2015; De la Vega-Rivera & Merino-Pérez, 2021), between $2,000 and $3,000 USD of cattle and dairy products, and between $16,000 and $36,000 USD of avocado (De la Vega-Rivera & Merino-Pérez, 2021). It is probably not a coincidence that interest in participating in PES has decreased in a way that mirrors the drop in relative value of the payments themselves. Since 2018, the number of applications per year has remained constant at around 1,500, down from an average of 4,000 between 2009 and 2013.

This sharp drop in interest, however, seems to have been mostly driven by non-communal landowners, including private individuals and others such as associations and civil societies, as shown in the second pane of Figure 13. Communities may be motivated to continue reapplying given their higher probability of approval, which is based on the fact that communal landowners and particularly Indigenous applicants have been consistently favoured in CONAFOR's ranking system (Appendix V) due to social and poverty alleviation objectives but also because communal territories tend to be much larger than private plots, so it is strategically advantageous to enrol them for landscape connectivity purposes. *Ejidos* and *communities* jointly hold 72% of PES contracts and nearly 90% of historically enrolled hectares.

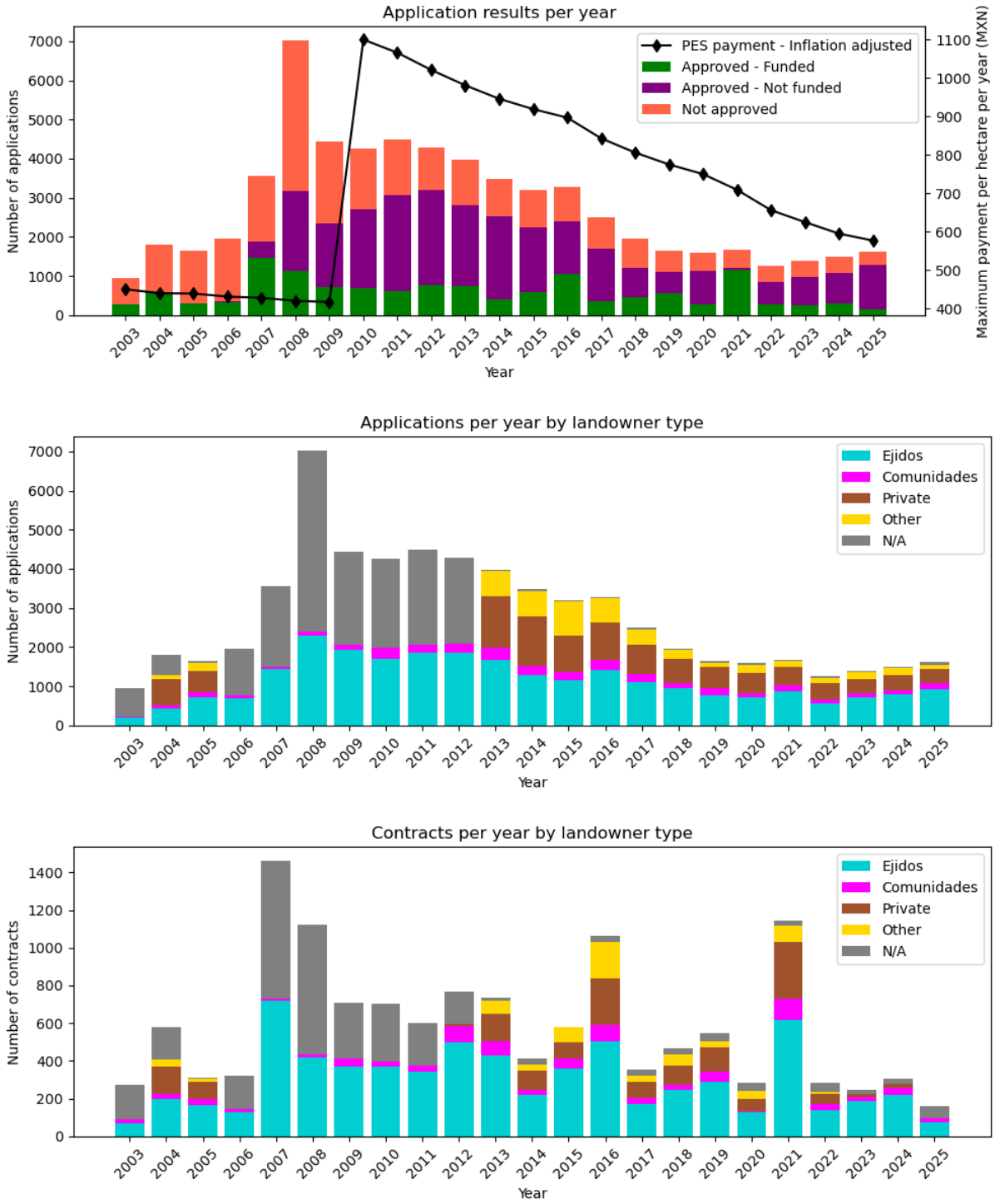


*Figure 13. Temporal patterns of PES applications and contracts. Results of applications for all modalities of enrolment and all applicant types and the inflation-adjusted maximum payment levels (top); proportion of applicants by landowner type (middle); number of contracts awarded (approved applications) per year by landowner type (bottom). Source: Own elaboration based on data from CONAFOR.*

Another crucial aspect for understanding communities' interactions with PES programmes is the frequency with which they tend to reapply. Under PES rules, communities are free to submit

new applications, where they may propose to enrol a similar polygon or a completely different part of their land, provided it also meets eligibility criteria. At the national level, around 17% of all PES hectares overlap with formerly enrolled polygons. Figure 14 shows that 3,985 (13%) of the 30,382 communities in Mexico have participated in PES, with the majority having participated only once. However, if we consider only the 16,213 forested communities (which I define as having at least 100 hectares of forest in 2000, according to the Global Forest Change dataset's definition of forested pixels), we get that nearly 25% have participated in PES at some point in time. Note that there are some clear clusters of communities with multiple contracts; some potential explanations will be discussed in the next section.

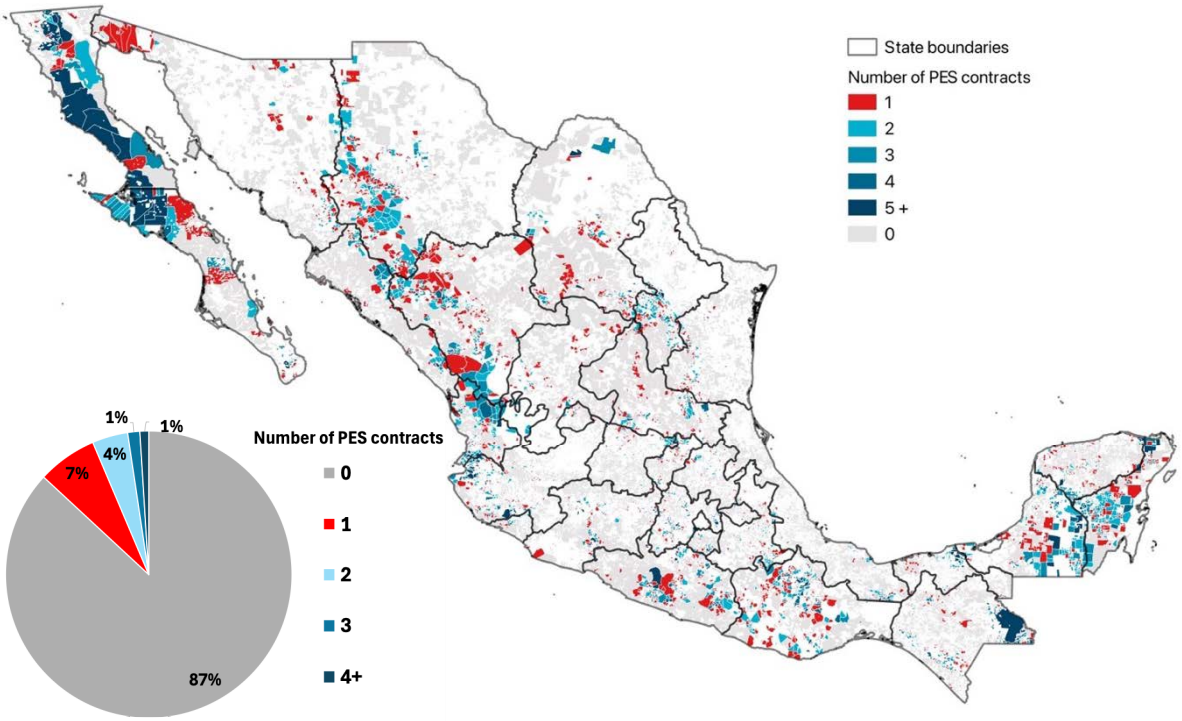


*Figure 14. Map showing the communities that have participated in PES according to the number of contracts they have established and accompanying chart of the proportion of communities that have established a given number of PES contracts. Source: Own elaboration based on data from CONAFOR and RAN.*

These data do not tell the whole story. By combining the spatial RAN data with the applications from CONAFOR and matching them by name (considering that if an applicant is in the same state and municipality and has the same name, they are the same applicant), applicants can be followed over time to understand whether they stop participating due to lack of interest or due to non-approval. For a subset of those communities that had demonstrated an interest in the programme by participating at least twice by 2018 (n=656), 83% went on to reapply to stay in

the programme over the next five years (n=553), of which 63% were successfully funded at some point (n=352).

It may seem puzzling that communities remain interested in a programme that pays so relatively little and that imposes a number of restrictions and mandatory activities that take substantial time and effort to undertake. One clue may lie in participants' behaviour with regards to forest cover change. If the programme was effective in curtailing deforestation, as has been suggested elsewhere (J. M. Alix-Garcia et al., 2012, 2015; Costedoat et al., 2015; Honey-Rosés et al., 2011; Jones et al., 2020; Saavedra Díaz & Perevochtchikova, 2017; Scullion et al., 2011; Von Thaden et al., 2019), then we would expect that communities that were funded would have less forest cover loss than those that were not funded, and probably that those that voluntarily dropped out of the programme (did not reapply) would have even higher deforestation, as they must have been at least partly motivated by the opportunity for land-use change. However, through simple statistical testing (T-tests) and after propensity score matching, no significant difference is found between the forest loss incurred after dropping out of PES compared to a similar time period for those that stayed enrolled (successful reapplicants). If anything, communities that were funded have slightly higher levels of forest cover loss (Figure 15). Importantly, this analysis considers forest cover loss within the entire community polygons, not only in the parcels enrolled in PES, to account for potential leakage and to control for the fact that different parts of the territory are included in each new contract. This suggests that, as the only article to date that has evaluated the permanence of Mexico's PES states: "evaluating the impact of a program on protected land and solely during the time an area is under conservation may lead to strongly overestimating the program's impact" (Le Velly et al., 2017).

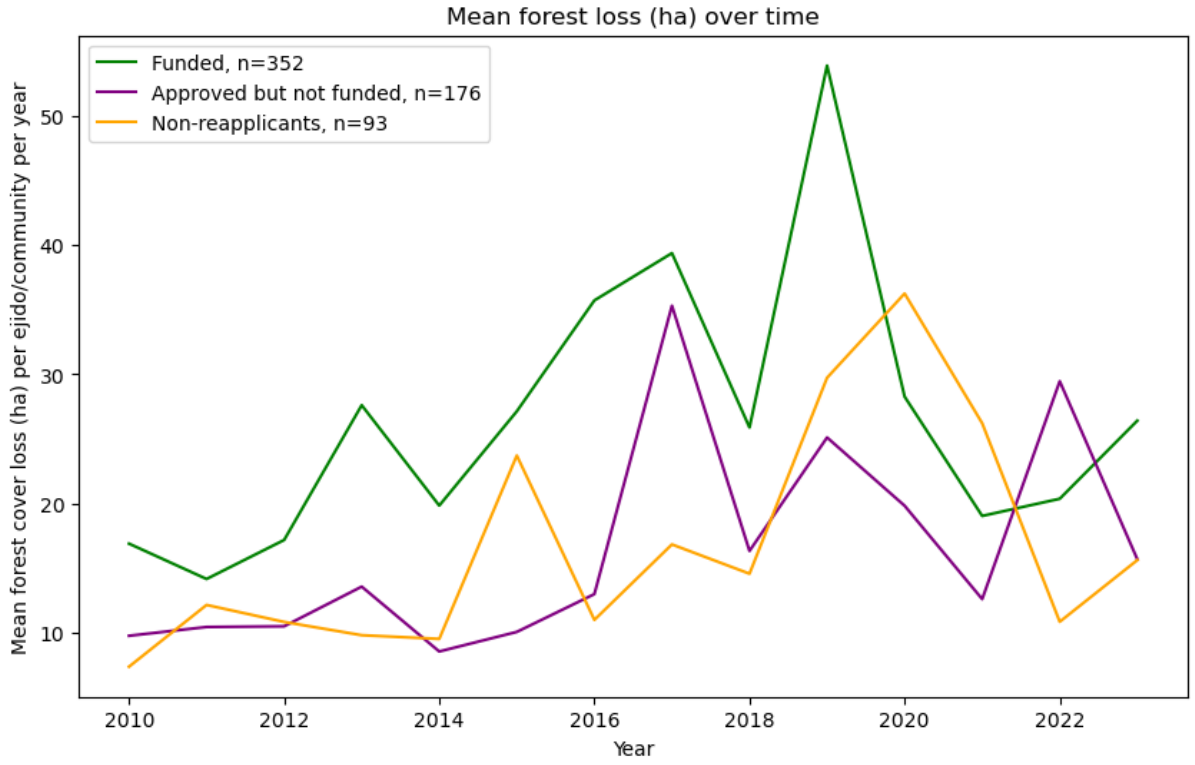


*Figure 15. Average forest cover loss for communities with a history of participation in PES and that were continuously funded or dropped out after 2018.*

Previous studies point at two (potentially complementary) hypotheses for the fact that forest cover loss continues at similar rates regardless of PES enrolment: the programme is not adequately targeting forests that are at risk of being cut down (Ezzine-de-Blas et al., 2016; Mayer et al., 2022), or there is significant leakage occurring as PES payments reduce credit constraints (J. Alix-Garcia et al., 2012; Le Velly et al., 2017). Both hypotheses are consistent with the reduced interest in participating in PES (Figure 13), as it seems that PES are no longer competing with other forms of land use due to the reduction in their relative value, but instead are only continuing to be implemented in cases where they can easily coexist with other land uses. One of these interactions is with community forestry, as will be explored in Section 3.5.4, or increasingly with forest-based carbon offsets. Section 5 highlights the case of two communities in Oaxaca where PES are only one of a number of programmes and activities being undertaken within the forest commons.

### *3.5.3. Protected areas: The ultimate command-and-control instrument goes participatory*

Just like community forestry replaced timber concessions as a more decentralized approach to forest management (D. B. Bray et al., 2006; Hodgdon et al., 2013; Merino-Perez, 2013;

Merino-Pérez, 2004), as outlined in Section 1.3, so too has protected area policy in Mexico seemingly left behind its approach of imposing strict limits on the livelihoods of local populations in favour for more decentralized approaches that integrate local participation in their establishment, design, and management (Havard et al., 2015; Peña-Azcona et al., 2022; Ruiz-Mallén et al., 2014; Velázquez et al., 2009). Firstly, it is important to clarify an important fact about protected areas in Mexico. While many contain public lands, usually in core zones, save for a few small examples they all also overlap with communities' territories. According to data from 2007, 60% of the surface of federal protected areas is under communal property, while 20% is public land and around 12% is in private hands (Bezaury-Creel et al., 2009). Mostly, particularly for older protected areas, these communities were not consulted when new protected areas were decreed, but simply faced new restrictions, enforcement and sanctions. This combination between communal tenure and government protected areas seems to have resulted in some significant synergies in terms of avoided deforestation, as we speculated in Alatorre et al. (2021). Through the updated community polygons, land use and land cover data described above, as well as protected area polygons (see Appendix I for data sources), we find that 12% of communities have territories that overlap with protected areas, and that these account for 30% of communal forest cover. Only 42% of the forest outside protected areas is in community lands.

Since 2002, Mexico's National Protected Areas Commission (CONANP) began promoting the establishment of 'areas voluntarily destined to conservation' (ADVCs), which can be proposed by any landowner for a minimum duration of 15 years and up to 'in perpetuity' (Peña-Azcona et al., 2022). The landowner must develop and submit a management plan, which can include mixed-use areas and others with more strict restrictions, at the landowner's discretion (Ibid.). By 2021, CONANP had certified 458 ADVCs across the country, 51% of which have been established by communities. Here, again, the state of Oaxaca is an outlier as it contains the largest number of ADVCs (173), more than double that of the next state (Guerrero, 74). The state also has relatively few federal or state protected areas, as shown in Figure 16.

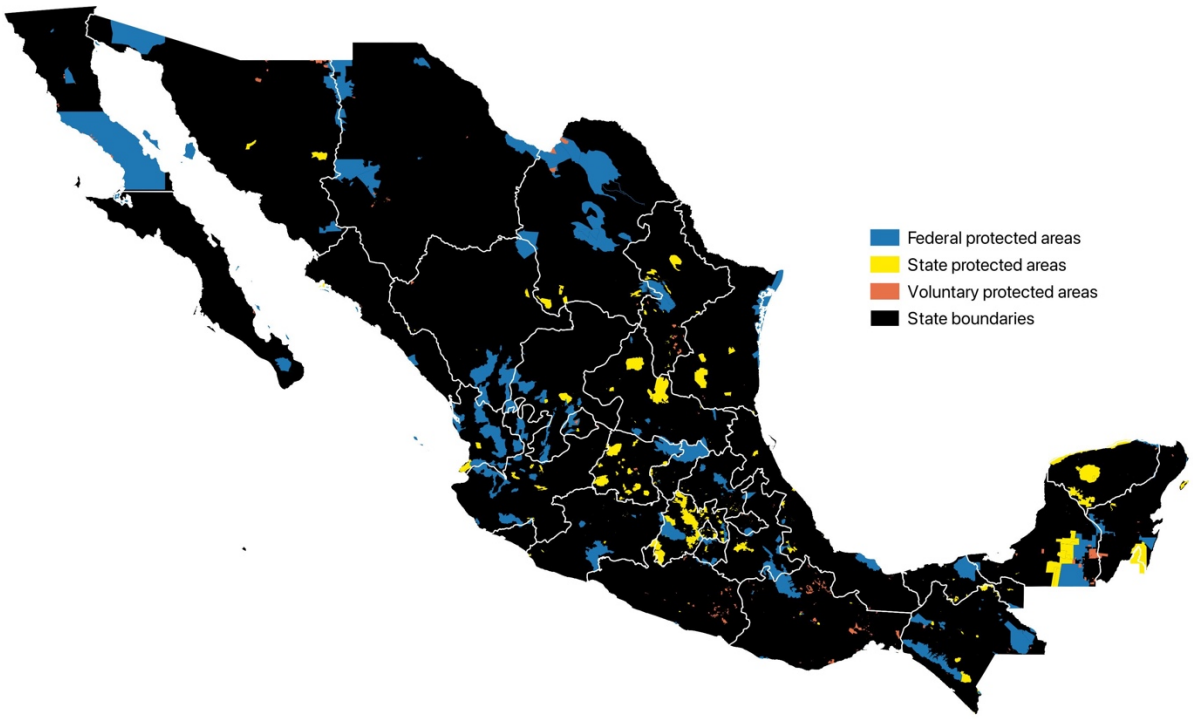


*Figure 16. Mexico's protected areas. Source: Own elaboration based on data from CONANP.*

Of course, many communities and other landowners have been practicing conservation within their territories for generations (McDermott et al., 2026). What, then, would make them want to have their lands certified by CONANP, given that this requires hiring someone to develop a management plan, and given the risk that their territorial needs might change in the future? One of the motivations, at least initially, was to facilitate access to PES (Bezaury-Creel et al., 2009), since one criterion that has consistently been highly ranked by CONAFOR is whether the applicant is in or near a protected area (see Appendix V). More recently, some studies have suggested that landowners are motivated by the prospect of selling carbon offsets in the international voluntary market (Alatorre et al., 2021; Tolentino et al., 2015), despite the fact that this is not a requirement (although it is also not forbidden under the CAR Mexico Forest Protocol version 3.0, provided that the management plan of the protected area allows commercial timber harvest).

### *3.5.4. "Like meat and beans on the same plate": Where does one end and the other begin?*

The above quote is from an interview conducted back in 2018, as part of our research on the interactions between PES, protected areas, carbon offsets and community forestry (Alatorre et al., 2021). The interviewee, a young man from an *ejido* in the Calakmul Biosphere Reserve, was reflecting on the connections between CONAFOR's PES programmes and the biosphere

reserve[12]. Through more than 60 interviews we conducted in three different regions of Mexico as part of that work, and the 139 other interviews conducted as part of this thesis, it has become increasingly clear that the boundaries between forest management and conservation, between regulatory and incentive-based, between production and preservation, can be very fuzzy in the case of Mexico and through the eyes of community members. Analysis of geospatial data corroborates this finding (Figure 17). Of the 3,930 communities that have participated in PES, 24% have also obtained timber harvesting permits, and 39% have at least 100 hectares that overlap with protected areas (voluntary or not). And while there are currently no publicly-available geospatial data for forest-based carbon offset projects, at least 324 of the 415 registered improved forest management (IFM) projects in Mexico are occurring in community lands (Haya et al., 2025), and we know from CAR's Mexico Forest Protocol (where 413 of these IFM projects are registered) that having an approved timber harvesting permit is a prerequisite for these projects. And given that 50% of communities who have obtained timber permits have also participated in PES, there is a high probability that IFM projects overlap with PES, and perhaps also with protected areas.

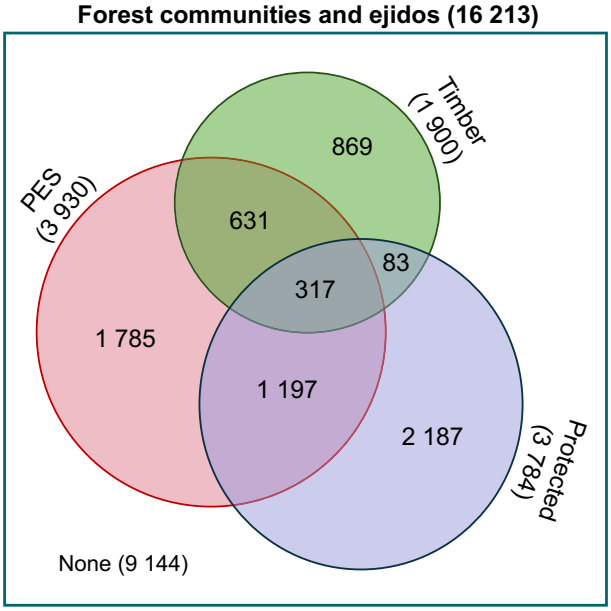


*Figure 17. Overlap in participation in payments for ecosystem services, timber harvesting and protected areas for communities with forests.*

[12] The full translated quote is: "Look, for me it has a connection because what the Reserve does is conserve, and PES searches for [conservation], only that now it's like what they say, how there is both meat and beans in the same plate, and in the end they're almost the same."

The compiled database allows for tracking changes in participation over time, which can be used to estimate correlations between the order in which communities chose to undertake PES, timber permits of voluntary protected areas. Simple multiple linear regressions were used, where the dependent variable is the change in land under each category (for example, the percentage change between the proportion of communities' territories that were under timber harvesting plans in 2020 compared to 2010, which will be positive if they increase or newly obtain a permit, negative if they let a permit expire without renewing, and zero if they maintained the same harvesting extent or if they never had permits) and the explanatory variables are all the other uses of the land and other social covariates, including having participated in PES, having a protected area or wildlife management unit, agricultural production, population change, etc. Having participated in PES prior to 2010 is strongly significantly correlated with having obtained timber harvesting permits after 2010, with each additional hectare of PES being associated with 2.34 hectares under timber harvesting plans ($p<0.01$). Of course, this correlation does not imply causation, and it is important to note that many communities were already doing timber harvesting for many years or decades before the advent of PES programmes. However, it is interesting that some communities are deciding to increase or newly undertake community forestry after having participated in PES. Additionally, there is a small but significant effect of having participated in PES after 2010 with having established a voluntary protected area during the same period (1 additional hectare under PES is associated with 0.15 hectares under ADVCs). Figure 18 shows the percentage change for each community in terms of PES surface and timber permitted or protected surface.

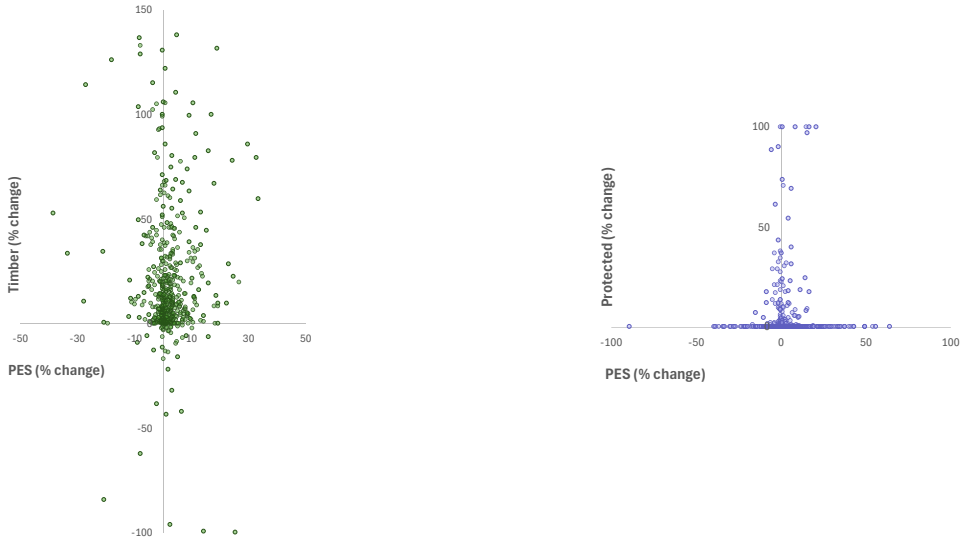


*Figure 18. Percentage change in PES enrolment and timber permits (left) or protected areas (right). Each point in the graphs is a community. In communities where PES has increased*

*between 2010 and 2020, the area under timber permits also tends to increase. For protected areas, the surface never decreases, and the communities where protected area is increasing during this period are mostly establishing voluntary protected areas.*

The goal of this chapter is not to evaluate the impact of any specific policy or combination of policies. However, since there is available data on forest cover loss from 2001 to 2023, it is interesting to look at how this narrow parameter which is often equated to programme effectivity manifests over time for communities that have participated in each policy or policy combination (Figure 19). First, in terms of total forest cover loss per year, we see that all combinations of participation have much lower levels of forest loss than the entire sample of communities with baseline forests. The next highest group are communities that have participated in PES at least once during this long period. Then, the rest of the combinations are practically indistinguishable from each other, although communities with timber permits and those in protected areas seem to follow a very similar trajectory, as do the combinations of PES and protected areas or PES and timber permits, which are the two categories with lowest overall levels of forest loss.

On the other hand, when plotting in terms of median hectares lost per community, the picture changes. Here, communities with PES and timber permits have the highest median levels of forest loss, followed by PES-only and timber-only. For the case of communities with timber permits, this is to be expected given that forest cover loss does not distinguish between 'deforestation' and the regulated, legal harvest of trees as part of a forest management plan. For the case of PES communities, this could be related to the leakage hypothesis discussed above, showing that receiving PES is associated with higher median levels of forest cover loss outside of protected areas. The combinations that include protected areas have the lowest median levels of forest loss.

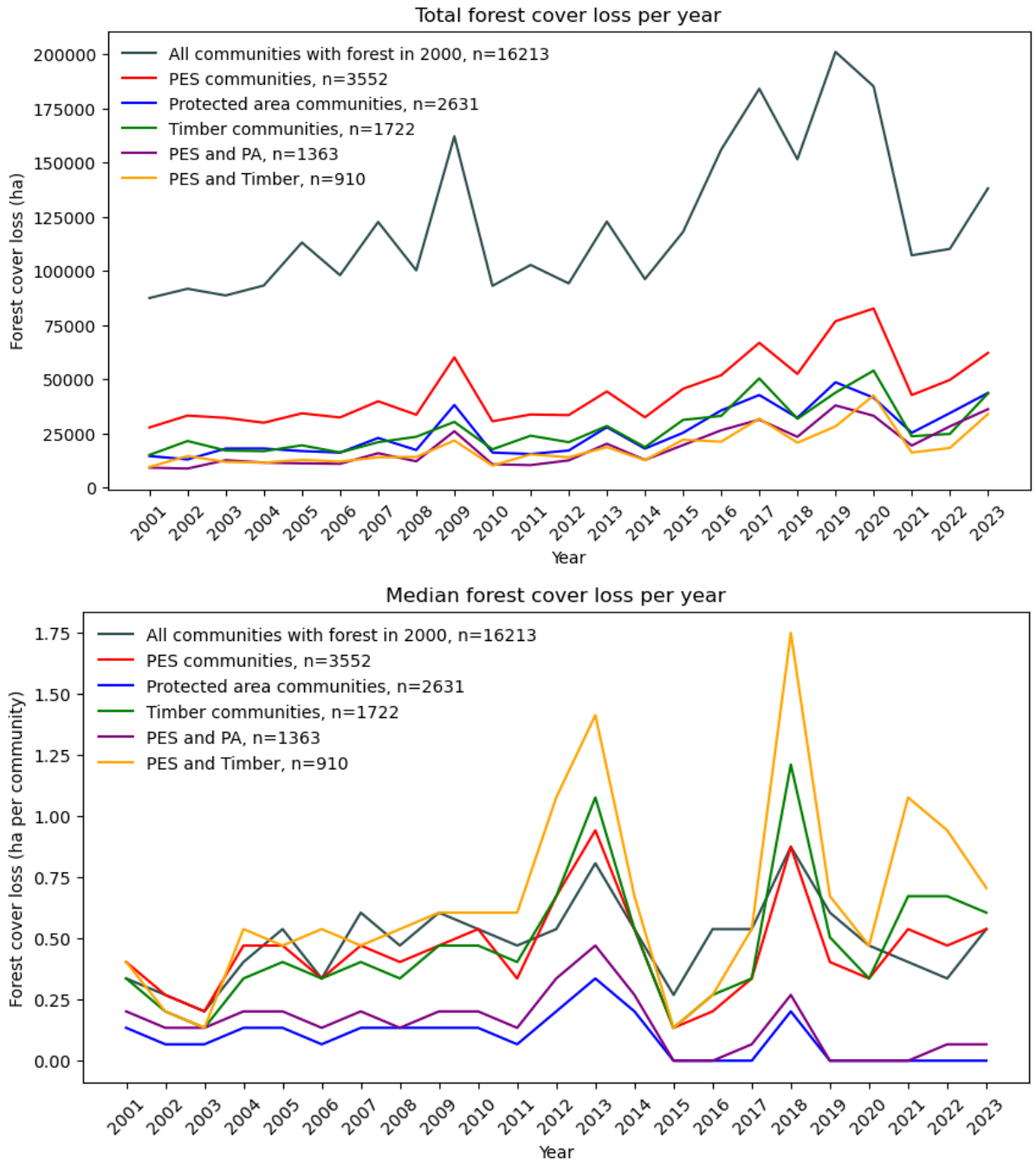


*Figure 19. Forest cover loss over time associated with communities that participate in payments for ecosystem services (PES), protected areas, timber harvesting, and combinations of the three.*

### 3.6. Final remarks

This long and (hopefully) didactic chapter presented many aspects of communities in Mexico: their lands, their forests, and their participation (voluntary or not) in an overlapping array of policies. The goal was to highlight the complex and dynamic context in which the specific processes that will be discussed in the next two chapters are taking place. 'Communal' lands

are not entirely communal, 'payments' for ecosystem services are barely payments, and 'conservation' is not always independent from financial motivations. These reflections are in line with some relevant academic debates. With regards to the commons, Hess (2008) concludes her review of the definitions of the term by stating that "some commons are free and sometimes not. […] They may be exhaustive or replenishable. They may be replaceable or irreplaceable. They may be global, local, or somewhere in between. And, commons, like common-pool resources, may have any combination of property rights" (Hess, 2008, p.37). Statements of this sort become necessary when attempting to define something so complex and for which different actors will have different visions. Section 5 of this thesis will explore in more depth the question of de jure versus de facto communal lands and the differences in uses and values that diverse groups of actors can hold for the same piece of land.

With regards to payments for ecosystem services, their conceptualization as 'compensation' rather than payments (McAfee & Shapiro, 2010; Shapiro-Garza, 2020a; vonHedemann & Osborne, 2016) seems particularly appropriate in light of this analysis that demonstrates how Mexico's flagship programmes have lost their economic relevance over time. However, even as symbolic compensations rather than amounts calculated to compensate for opportunity costs, Mexico's PES seem inadequate. This may be driving former participants to other, more profitable land use alternatives such as community forestry or, in some regions, the agricultural programme *Sembrando Vida*. In the case of the five Oaxacan communities where interviews were conducted (Section 4 and 5), all had participated in PES at some point in time, but all had transitioned towards a greater focus on timber harvesting and forest-based carbon offsets, which has turned out to be a profitable strategy.

With regards to the interaction between 'conservation' in the form of protected areas and financial incentives, this is a rich source of academic debate, often centred on the notion of motivation crowding-out (Agrawal et al., 2015; Rode et al., 2015; Underhill, 2016; Van Hecken et al., 2019). In the case of Mexico, the interaction is strong by design, since PES are seen as a way to compensate communities for the limitations imposed by protected areas (Alatorre et al., 2021). Some PES mechanisms have been specifically designed for this purpose, with differential payments assigned to land within core and buffer zones (Honey-Rosés et al., 2009, 2011; Manzo-Delgado et al., 2014). And some studies have found that PES do not seem to significantly reduce collective action around forest conservation or management (J. M. Alix-Garcia et al., 2018; Kerr et al., 2014; Nieratkaa et al., 2015; Rodríguez-Robayo et al., 2016).

The specific case of voluntary protected areas as a potential precursor to PES or FBCOs is something that should be explored in more depth.

There are many important limitations of this national-level component. It is not possible to claim that we can now understand everything that communities are doing with their forests, since the data is limited to official and publicly available sources. All sorts of things are invisible from this scale, including communities' connection to the land, the formal, informal and traditional institutions that regulate forest use and access, the degree to which they rely on the forest for their livelihoods, and what role their forests and any policy that they adopt may play in hindering or strengthening their strategies and visions for the future. As McDermott and colleagues suggest in their recent call for 'reversing the gaze' through which the contributions of Indigenous Peoples and local communities towards global conservation targets are measured, remotely sensed data "represent only a small tip of the iceberg of the contributions of place-based approaches to respectful and reciprocal human-nature relations" (McDermott et al., 2026). While estimating Indigenous ownership of forests and biodiversity provides some general indication of their role in protecting and stewarding certain landscapes (Fernández-Llamazares et al., 2024), by standardizing and aggregating data we lose the ability to consider the diversity within Indigenous and local communities, the complexity of their socio-ecological relations, the enduring and widespread protection and restoration of landscapes without externally recognized boundaries, and the importance of actions such as struggles for land rights, whose effects are difficult to quantify (McDermott et al., 2026; Wyborn & Evans, 2021).

In line with the above, this chapter presented a very general overview without going into details about the outcomes of forest policies and their interactions, and least of all about whether these outcomes are positive or negative, as these will be unique to each community and affect different members or groups in different ways. However, there are some overarching trends that are interesting to explore, even if it is mostly for speculation at this stage. The hope is that, while reading the next two chapters, some of the findings presented above will be helpful in positioning communities' experiences within the broader national context. In the next chapter, we will argue that learning about the perspectives of community members is the only valid means of assessing whether any 'co-benefits' can result from these forest policies, and whether they can play a role in addressing threats and building resilience. The last empirical chapter will explore yet another layer of outcomes for communities from their encounters with the

types of programmes described above, as they modify and adapt their traditional governance institutions and values to conform to programme rules and requirements. As explained in Section 1, this thesis attempts to build a more comprehensive understanding of decentralized forest policies that is informed by several different disciplinary perspectives, following the recommendations by Lund et al., (2018) of integrating different epistemologies and methods.

Beyond the general limitations of providing a vision of communities' territories 'from above' and through official records, there are also methodological limitations linked to the resolution of the data, the suitability of the Global Forest Change dataset for the specific forest types found in Mexico, particularly drier forests (Galiatsatos et al., 2020), and the inability to distinguish between forest loss that is due to timber harvesting, natural disasters, or land-use change. Additionally, since the dataset on timber permits was put together from a variety of different sources, as there is no comprehensive CONAFOR data (unlike for PES), it is possible that there are missing observations or data from multiple sources are being double counted. Great care was taken to avoid this last issue, but it cannot be guaranteed. Finally, whenever matching was done by name and not through spatial interaction algorithms, there will likely be several errors due to names being spelled differently in different datasets, or due to communities within the same small administrative area (municipality) having very similar names being grouped as one.

# 4. CAN FOREST-BASED CARBON OFFSETS CONTRIBUTE TO TRANSFORMATIVE RESILIENCE? EVIDENCE FROM AN INDIGENOUS-LED ORGANIZATION

This paper will be submitted to a special feature on Forests as Pillars of Socio-Economic Resilience in Ecology & Society, as:
Alatorre, A., Shapiro-Garza, E., Arcila, M., Rose, B., Izquierdo-Tort, S., Martin, M. 2026. *Can forest-based carbon offsets contribute to transformative resilience? Evidence from an Indigenous-led organization*.

**Abstract**

While there are legitimate concerns about the lack of effectiveness and adverse social implications of forest-based carbon offsets (FBCOs), their potential in generating social and ecological outcomes that contribute to transformative resilience remain understudied. In particular, little is known about the role of on-the-ground, boundary-spanning intermediaries in promoting community agency, capacity building and the exercise of local values and visions for resilience in FBCOs. Here, we explore how an Indigenous-led organization in Oaxaca, Mexico, works with partner communities to produce transformative resilience by selling carbon offsets in the international voluntary market. Our research draws on insights from long-term field engagement with the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO), including semi-structured interviews conducted in five partner communities with diverse histories of engagement in FBCO projects. We find consensus among community informants on the essential roles played by ICICO for successful FBCO project development, including building trust, facilitating participatory planning processes, and implementing strategies for conflict resolution. Yet our analysis reveals that ICICO's contributions extend beyond pre-defined carbon market standards, fostering contextually relevant implementation and revenue allocation processes that are consistent with and support broader visions for community and forest resilience that is transformative, including generating local employment for youth and women, strengthening capacity to fight wildfires, and increasing water security. Our results resonate with growing calls for FBCO mechanisms to recognize Indigenous and local forest stewardship practices and highlight the importance of participatory

project development and implementation in producing transformative resilience in vulnerable communities and ecosystems.

### 4.1. Introduction

The credibility of carbon offsets, particularly voluntary markets, as emissions-reduction strategies has been called into question by recent media and scientific publications documenting extensive over-crediting, lack of impact, and negative socio-economic outcomes in many forest-based projects (García & Moros, 2025; Milne et al., 2019; Probst et al., 2024; West et al., 2023). However, there is a growing focus on the potential of these mechanisms, particularly forest-based carbon offsets (FBCOs), to contribute to climate adaptation and 'resilience' by reducing various climate vulnerabilities concurrently at the sites of implementation (Chausson et al., 2020; Chenyang, 2023; Chia et al., 2016; Galik & Jackson, 2009; Lyons & Walters, 2021). Given that voluntary market-based schemes for carbon and other 'ecosystem services' are expected to continue to be a cornerstone of environmental policy globally (Haya et al., 2023), it is important to document the conditions under which locally-relevant and positive adaptation and resilience outcomes can result, just as it remains crucial to expose abusive or misleading practices throughout the industry. Furthermore, there is a need to inquire about the nature of the resilience outcomes generated, and whether they encourage vulnerable communities to "bounce back" to a state that reinforces the status quo, or whether FBCOs and the intermediaries that enact them can uphold the capacity of communities to "bounce forward" and prevent, adopt, adapt and transform in the face of uncertainty by enabling agency, capacity building and the exercise of local values (HLPE, 2025).

The term resilience has a positive connotation of endurance in the face of persistent stress or disruptive events such as climate change (Marchese et al., 2018). However, part of the difficulty in determining whether and how carbon projects can build resilience at the sites of implementation lies in who gets to determine what counts as positive (Cutter, 2016; Lele et al., 2013; Robertson, 2012). A review of the definitions of 'community resilience' used in the academic literature found 57 unique versions, which generally agreed on certain main elements such as local knowledge, networks and relationships, health, governance and leadership (Patel et al., 2017). Meanwhile, some Indigenous scholars have proposed definitions of resilience that contain themes such as: accountability, cooperation, sharing, and caring for the vulnerable

(Steele, 2020); language, culture and collective agency (Kirmayer et al., 2011); and the inter-related connected relationships in a specific place (McGuire, 2010).

The very concept of resilience has been criticised due to its vagueness and the inconsistency with which is it employed (Nikinmaa et al., 2020), its connotation as a means to perpetuate and reinforce a status quo, with its inequalities and vulnerabilities still in place, while protecting those in power from alternative, more disruptive strategies (DeVerteuil & Golubchikov, 2016), and its western-centric perspective (Amo-Agyemang, 2021). However, proponents of 'critical resilience' have highlighted the enduring power of the resilience approach and its ability to articulate an alternative reality after the disturbance, viewing it as something that can be internally produced, adaptive, and capacity-building, acting as a precursor to resistance and transformation (Ibid.). More recently, key publications such as the 2025 report by the High Level Panel of Experts (HLPE) on Building resilient food systems (HLPE, 2025) and the International Union of Forest Research Organizations (IUFRO) report on Forests as pillars of social and economic resilience (Allen et al., 2025) have sought to bring the resilience approach to the fore. The HLPE report proposes the notion of a resilience spectrum: from 'bouncing back resilience' that consists of resisting, absorbing, adapting, recovering or preventing shocks and stresses; to 'transformative resilience', where a system can bounce forward by enabling individual and collective capacities, agency and values, changing structures of power, and harnessing socio-ecological interdependencies; and finally to 'equitably transformative resilience', where bouncing forward is achieved by nurturing equity and justice, addressing inequalities while centring efforts in the knowledge, experiences and resistance of those made vulnerable and marginalized (HLPE, 2025). This typology of resistance can prove useful for evaluating the transformative potential of interventions such as FBCOs.

Fores-based carbon offset mechanisms have been designed for mitigation or decarbonization, which consists of lowering atmospheric concentrations of greenhouse gas emissions to prevent avoidable climate impacts (Chenyang, 2023). The process of accurately and precisely quantifying the changes that result from project activities, termed carbon accounting, usually relies on the calculation of baselines, additionality, leakage, durability, and carbon pools (Haya et al., 2023). Co-benefits, or projects' positive social and ecological outcomes beyond carbon sequestration, are not commonly considered (Karlsson et al., 2020). Recent reviews have highlighted the importance of 'strong' governance as an enabling condition for positive ecological and social outcomes in the lands of Indigenous Peoples and local communities

(IP&LCs) (Brittain et al., 2025; Dawson et al., 2024), which have been estimated to contain nearly 40% of the world's 'natural landscapes'[13] (Fa et al., 2020; Garnett et al., 2018). Studies have particularly pointed to IP&LC's ability to enforce their own rules and their mechanisms for organization and collective action (Brittain et al., 2025) as well as the presence of arrangements where IP&LCs are equal partners or co-managers (Dawson et al., 2024) as essential features of strong governance associated with positive conservation outcomes. However, the specific roles played by the organizations or bodies that partner with IP&LCs, usually termed intermediaries, in enabling locally desirable outcomes, has not been so thoroughly analysed. Theoretically, these partners, or what Haller et al., (2018) call 'catalysing agents', can play an important role by facilitating open debates and participatory institution-building processes for resilient natural resource management (Haller et al., 2018).

Intermediaries are a common feature of many market-based systems, including financial and technology markets as well as environmental ones (Coggan et al., 2013). They emerge or are put in place due to the existence of transaction costs between buyers, sellers and policy administrators, including imperfect information and uncertainty (Ibid.). In the case of global carbon markets, intermediaries have been described as playing a pivotal role in bridging the gap between policy and practice and fostering organizational collaborations, particularly in 'developing countries', which often face unique barriers to participation including inadequate regulatory frameworks and limited institutional capacity (Tanveer et al., 2024). Coggan and colleagues describe the main broad types of current or potential intermediaries in offset markets, which include: (1) information/knowledge providers; (2) brokers; (3) offset aggregators; (4) banks; (5) in-lieu-fee intermediary; and (6) clearing houses (Coggan et al., 2013). However, in practice intermediaries often span multiple roles, including the ones established by the carbon marketplace but also those of mediators, arbitrators, equalizers, representatives, watchdogs, developers of standards, and bridge builders (Pham et al., 2010). The roles of intermediaries can also change over time (Osborne & Shapiro-Garza, 2018a) and innovate through industry partnerships or technology (Tanveer et al., 2024). Within the context of IP&LC lands, intermediaries have been found to be particularly successful at facilitating the generation of local benefits when these relationships are rooted in trust, respect, personal connections, and shared worldviews (Garcia et al., 2024; Osborne & Shapiro-Garza, 2018a).

[13] See section 1.1.1 for a brief reflection about the meaning of 'nature'.

This work of takes significant time, effort, and nonmarket funding, and will greatly depend on the context of the communities involved (Osborne & Shapiro-Garza, 2018a; Otto, 2019; Pham et al., 2010).

In this study, we aim to understand how FBCO projects interact with communities' visions and strategies for social and ecological resilience, and the role that intermediary organizations can play in helping to align project planning and implementation with community visions and strategies. In doing so, we assess whether bouncing back, transformative, or equitably transformative resilience can possibly result from FBCOs in a context of Indigenous governance, boundary-spanning intermediaries, and social and ecological vulnerability. We address four specific questions: 1) What shocks and stresses do communities identify that make them vulnerable? 2) What strategies do they identify that can strengthen their ability to prevent, adopt, adapt and transform in the face of perceived shocks and stresses? 3) How do FBCO projects strengthen or hinder communities' strategies and their ability to work towards their visions for resilience? 4) What is the role of ICICO, an Indigenous-led organization, in enabling agency, capacity building and the exercise of local values by helping align FBCO rules and requirements with community strategies for social and ecological resilience?

## 4.2. Methods

### *4.2.1. Reference system: improved forest management (IFM) in Oaxaca, Mexico*

Within the broad category of projects covered by FBCOs, improved forest management (IFM) projects are designed to increase the resilience of forest ecosystems by transforming pre-existing practices in ways meant to reduce the risk of carbon losses from disturbance (Kaarakka et al., 2021) and produce additional benefits (Karlsson et al., 2020) while increasing carbon stocks in forests and forest products (Haya et al., 2023). By the end of 2025, the Voluntary Registry Offsets Database listed 1,039 IFM projects around the world (Haya et al., 2025), a significant increase from the 293 projects listed in 2023 (Haya et al., 2023) and representing around 50% of FBCO and 10% of all registered carbon offset projects. More than a third of these IFM projects (415) have been implemented in Mexico, almost exclusively under the Climate Action Reserve (CAR) Mexico Forest Protocol (Haya et al., 2025).

The Voluntary Registry Offsets Database does not list the type of land tenure where each project is implemented; however, based purely on the *Project Owner* column, we can identify at least 324 IFM projects in Mexico that are happening on communal lands (78%). This is consistent with the fact that around 50% of the country's forests are held under community-owned and governed structures, which include *ejidos* and *comunidades* or Indigenous communal lands (Bonilla-Moheno et al., 2013; Madrid et al., 2009). These legally-recognized entities follow a specific governance arrangement that was codified during Mexico's agrarian reform: a general assembly made up of all registered community members is the ultimate authority, where all aspects of internal rules and land use within common use areas are decided by consensus or majority vote; this includes electing the *comisariado*, a six-member commission (including deputies) that represents the community in official processes, and an oversight council (*consejo de vigilancia*) that has a supervisory role (Antinori and Rausser, 2007; Barnes, 2009; Bray, 2013; Bray et al., 2006). Beyond these leadership positions, assemblies may also assign different civic and religious responsibilities called *cargos* and convene people to work on specific tasks through unpaid communal labor or *tequios* (Antinori and Rausser, 2007). In the context of Mexico, the vast majority of IFM projects interact with these traditional community governance structures[14].

Within the territories of *ejidos* and communities in Mexico there are distinct areas with specific land use designations. Usually, individual households will own their homes and agricultural parcels in or around the town or towns. Forested lands, on the other hand, are considered common use areas under the 1992 Agrarian Law, and decisions about these territories must be made by the assembly (Barnes, 2009; Valsecchi, 2014). Under CAR's Mexico Forest Protocol (version 3.0), the *project area* for communally owned lands must include the entire common use land (Climate Action Reserve, 2022). Inside the project area, different *activity areas* are designated, which are defined as explicit areas where forest owners implement management actions. In the case of IFM projects, the activity area is limited to areas with a government-approved forest management program for commercial timber harvest (Climate Action Reserve, 2022).

[14] Section 1.2.2 contains more detailed explanation of the typical governance arrangements in Mexican communities.

### *4.2.2. The Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO)*

This work is part of a long-term collaboration between a multidisciplinary group of researchers, the ROSES team (Researching Oaxaca's Socio-Ecological Systems), and the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO), a grassroots organization that seeks to develop local capacities within its member communities for sustainable natural resource management through forest-based carbon offsets and other forest activities and programs (*ICICO AC*, 2026). The history of ICICO is detailed in (Osborne & Shapiro-Garza, 2018), and it is noteworthy due to its long-term engagement with the voluntary carbon market as well as its community-centric governance. In 2002, the precursor to ICICO (Environmental Services of Oaxaca – SAO) began to pilot a government-led FBCO initiative with twelve communities, and in 2008, ten of these communities began selling offsets in a national voluntary market under the name CARBIOIN (Indigenous Carbon, Water and Biodiversity). In 2012, the ten communities selling CARBIOIN offsets formed ICICO, seeking greater participation and accountability: "Mimicking the governance structure of indigenous communities, ICICO created a general assembly of elected members from each of the participating communities to provide guidance and oversight" (Osborne & Shapiro-Garza, 2018, p.99). Its technical services arm also integrates community knowledge in project planning and implementation by training and employing extensionists from several member communities. In 2014, ICICO began to engage with the international voluntary carbon market, securing ISO 14064 and CAR certification. The first pilot IFM project in Mexico was developed by ICICO in the community of San Juan Lachao in 2014 (Haya et al., 2025; Osborne and Shapiro-Garza, 2018). To date, ICICO has developed 20 IFM projects under the CAR Mexico Forest Protocol, 18 in Oaxaca and two in the neighbouring state of Puebla, for a total of 639,311 issued credits (Haya et al., 2025).

For the present study, ICICO's technical services team advised us with regards to the selection of case study communities, in their role as intermediaries between our research team and the communities' leadership bodies. This helped ensure we were encompassing a variety of contexts, perspectives and experiences with IFM (Table 3, Figure 20). In what follows we incorporate insights and translated quotes from all the interviews and workshops, identified by each community's initials (SJL for San Juan Lachao, etc.).

*Table 3. Characteristics of the study communities and their forest-based carbon offsets projects.*

| Community | Primary ethnicity | Population size | Total area (ha) | Forest area (ha) | Community forestry dates | Carbon project forest type | Start date for carbon project |
|---|---|---|---|---|---|---|---|
| San Juan Lachao | Chatino | 4 577 | 13 290 | 2 388 | 2000-2001; 2010-2017 | Pine-oak | 2014 |
| La Trinidad Ixtlán | Zapotec | 754 | 789 | 777 | 1993-present | Pine-oak, cloud forest | 2019 |
| Santiago Xiacui | Zapotec | 1 893 | 1 871 | 1 567 | 1990-present | Pine-oak, cloud forest | 2019 |
| Santa María Peñoles | Mixtec | 8 967 | 9 336 | 4 878 | 2000-2003; 2023†-present | Pine-oak | 2020‡ |
| Santa María Jaltianguis | Zapotec | 583 | 5 670 | 1 324 | 1993-present | Pine-oak, cloud forest | 2020 |

† Under development since 2019

‡ First payments came until after forest management plan had been approved in 2023

As described above, having an approved commercial timber harvesting program is a prerequisite for establishing an IFM project, as the protocol relies on demonstrating additionality through the implementation of forestry practices that resiliently increase carbon capture compared to the baseline forest management plan. In the words of a former community leader: "*Forest management itself does generate resources to invest in the forest, but it is limited, therefore when you have an additional source of revenue you have the means to address more of what the forest needs to maintain itself, things that are more expensive like building roads and fighting plagues*" (SX). This means that interested communities must either already be involved in commercial timber harvesting or they must go through the process of designing and getting government approval for a forest management plan.

All five study communities were already involved in forest management before the IFM project, but they had varying degrees of experience. While LTI, SX and SMJ are considered pioneers of community forestry in Mexico, having established their forest management plans almost as soon as they became legally able to do so in the late 1980s and early 1990s, SJL and SMP are relative newcomers (**Error! Reference source not found.**). They both established a forest management plan in the year 2000 but later abandoned it and did not restart until much later. In the case of SJL, forest management restarted in 2010 once the community had joined ICICO and as part of a suite of activities they undertook as community forest enterprises, but it was suspended by the assembly in 2017 due to internal conflict, which also led to the suspension of the IFM project. In SMP the process of restarting forest management occurred concurrently with the development of the IFM project, starting in 2019, and was driven by the community's motivation to establish a carbon project, according to ICICO's technical services

staff. Furthermore, SMP, LTI and SX had already sold carbon offsets through ICICO in the national voluntary market since 2008 (LTI and SX) and 2011 (SMJ).

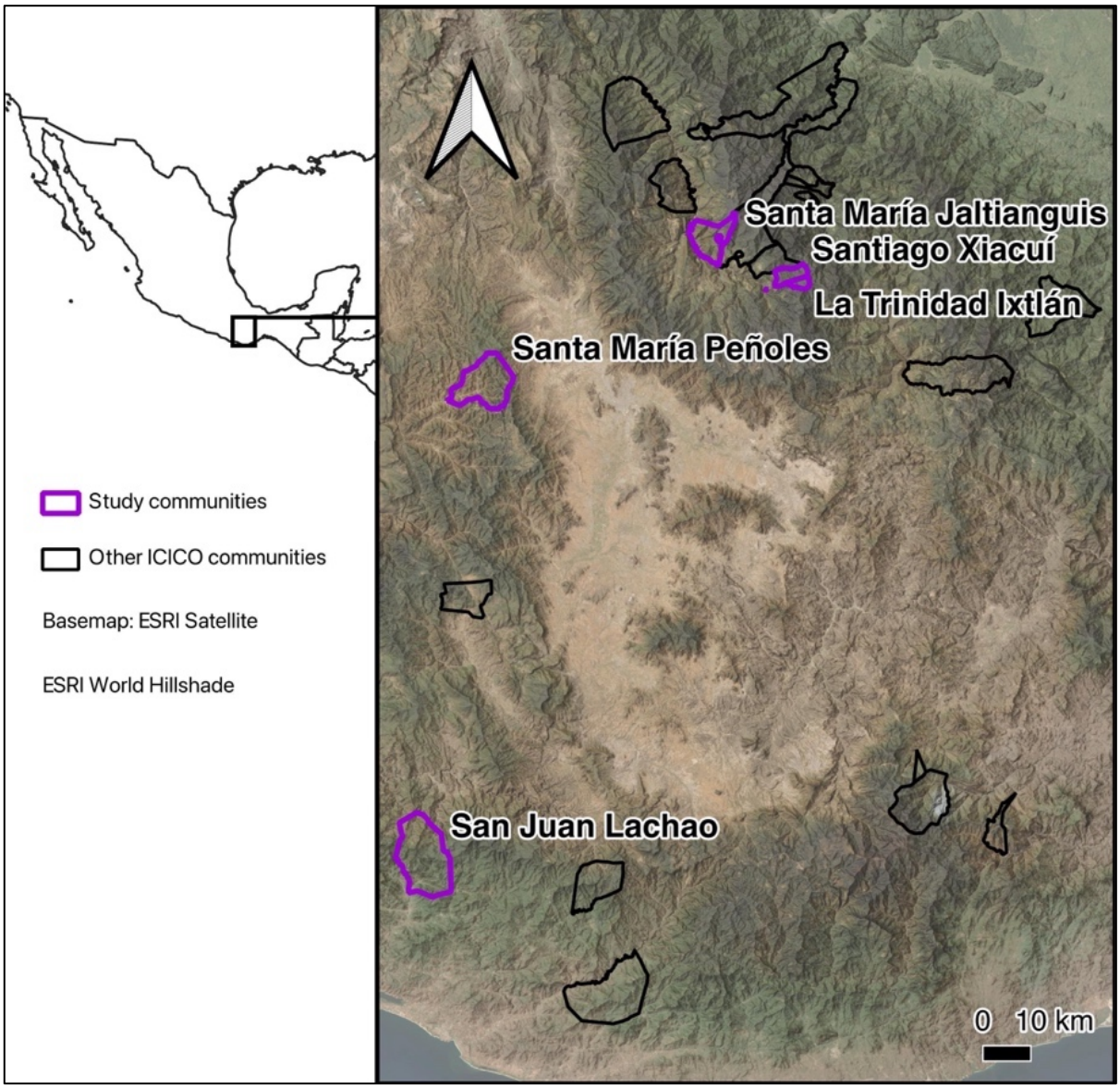


*Figure 20. Map showing the location of all members of the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO), highlighting the five study communities. Source: own elaboration based on data from the National Agrarian Registry (RAN, 2021).*

### *4.2.3. Research design*

In the summer of 2023, semi-structured interviews, field visits and participant observation were conducted with individuals or small groups with diverse levels of involvement with forest governance, as well as four focus group and participatory mapping workshops, exploring the role of FBCOs and other forest projects and programs in community's social and ecological

resilience in La Trinidad Ixtlán and San Juan Lachao. Consent forms and interview guides from this research component can be found in Appendix II, and the full list and characteristics of the interviewees is in Appendix III. From the findings that emerged from this and other research by the ROSES team, we designed a semi-structured interview guide with more precise questions around the social and ecological components of resilience, the perceived threats to these components, the decision-making processes for implementing FBCOs, and the perceived role of FBCOs in compromising or strengthening the features that interviewees themselves perceive as important for resilience. We did not use the term resilience during interviews or workshops to avoid imposing a specific framework, but instead asked broadly about people's visions for the future and what would help their communities and forests achieve their desired visions. We targeted current and former community leaders and those involved with diverse aspects of forest management. The interview guide was piloted in San Juan Lachao and then implemented in three other ICICO communities (Santa María Jaltianguis, Santiago Xiacuí, and Santa María Peñoles) during the summer of 2024. A total of 58 interviews were conducted during this second stage (Table 4)[15].

*Table 4. Data collection methods and number of participants in each study community.*

| | 2023 | | 2024 | Overall interviewee distribution | |
|---|---|---|---|---|---|
| **Community** | **Participatory workshops** | **Semi-structured interviews** | **Semi-structured interviews** | **By sex** | **By age** |
| San Juan Lachao | 2 | 37 | 5† | M: 27<br>F: 15 | <50: 12<br>50+: 29 |
| La Trinidad Ixtlán | 2 | 44 | - | M: 23<br>F: 21 | <50: 14<br>50+: 30 |
| Santiago Xiacui | - | | 14 | M: 8<br>F: 6 | <50: 13<br>50+: 1 |
| Santa María Peñoles | - | | 15 | M: 12<br>F: 3 | <50: 8<br>50+: 7 |
| Santa María Jaltianguis | - | | 24 | M: 23<br>F: 1 | <50: 21<br>50+: 3 |
| **Total** | **4** | **81** | **58** | **M: 93<br>F: 46** | **<50: 68<br>50+: 70** |

† Pilot interviews

Throughout the research process we also interviewed ICICO's technical services staff, including as recently as January 2026, in order to understand their role and the strategies they implement when working with communities to develop IMF projects. All interviews and workshops were conducted in Spanish, which all participants speak and understand. Interviews were audio recorded when consent was given, and notes were taken. Audio files and notes were

[15] The interview guide can be found in Appendix IV, and Section 2.3.3.2 has more details about the interviews.

transcribed and analysed through thematic coding using NVivo 14[16]. All 2023 data were coded and analysed by the lead author, while 2024 data were coded by two master's students and analysed by the lead author. Thematic analysis was carried out with a grounded theory approach by inductively deriving categories, themes, and patterns directly from data through an iterative process (Bryant & Charmaz, 2010). Themes were continuously developed and refined at successive levels of detail by developing high-level codes as markers for the main themes and then lumping, splitting, or more precisely defining a series of nested codes in an iterative process until they formed a coherent conceptual set (Boyatzis, 1998; Snilstveit et al., 2012). It is at this stage that the answers provided by participants were associated to different categories of shocks and stresses, strategies, and visions for resilience. Finally, we used the resilience spectrum typology (HLPE, 2025) to contrast our findings with the three proposed types of resilience (bouncing back, transformative, and equitably transformative resilience).

## 4.3. Results

### *4.3.1. Perceived shocks and stresses*

Research participants across all communities perceive climate change not as an abstract concept but as a daily reality that impacts every aspect of their lives and livelihoods. The main manifestation of this phenomenon is drought or water scarcity, which emerged as a central concern in all communities (Table 5) but was particularly prevalent in SMP. Nearly all interviewees from this community, located in the slopes around the Central Valleys region of Oaxaca (Figure 20), described a marked decline in rainfall and the drying of springs and streams which greatly impacts their ability to grow food: "*Nothing is being produced anymore, it doesn't rain, nothing grows, it dries up and that's it*" (SMP). Relatedly, people from all communities, but particularly SX, have observed an increase in the frequency and severity of forest fires. These are "*a main threat in our community, they burn the forests, the flora, the fauna dies and then our soil erodes, in the end it is not the same, the roots are gone*" (SX). Rising temperatures were also a source of concern, with one farmer from SJL stating that "*we are suffering because it is very hot, we can no longer work eight hours, we work in the morning and in the afternoon, at noon we can't.*" Some individuals who have been employed in communities' timber harvesting enterprises, mainly in SMJ and SMP, also point to the growing

[16] Section 2.3.3.4 contains more details about the coding and thematic analysis.

threat of forest pests and diseases, which they see as directly linked to the changing climate. Interviewees in both communities explained that drought-stressed trees are more vulnerable to beetle attacks, and that infestations have become more frequent and severe in recent years. An interviewee from SMP shared, "*The forest is mostly damaged by a bug we call descortezador [bark beetle]... that's why we're doing forest sanitation*." Others in SMJ described a true panoply of environmental threats: "*We're affected by drought and heat, and now pests too, first the bark beetle, then defoliators, and now root-eating ones*."

*Table 5. Main threats perceived by interviewees and the types of resilience strategies that communities employ to address each threat. Mainstream perceptions are represented in black text while dissenting opinions are shown in red.*

| | | | **Community strategies for resilience** | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | **Ecological** | | **Social** | | | |
| | | | **Forest conservation** | **Forest management** | **Community governance** | **Communality** | **Local employment** | **Education** |
| **Threats or challenges** | **Ecological** | **Drought** | Conserving tree cover increases water capture | Reforestation helps ensure future tree cover; harvesting trees reduces water security | Implementing rules for water extraction and sanctions for lack of compliance | | | Generating awareness about caring for water |
| | | **Forest fires** | | Firebreaks and removing litter prevent forest fires | Making announcements and organizing assemblies during the dry season; imposing sanctions | Putting out fires collectively through unpaid community service or *tequios* | | Teaching best practices for agricultural fires and trash burning |
| | | **Pests and diseases** | | Monitoring to detect outbreaks; controlled burning and treatment for managing outbreaks | | | | |
| | | **Rising temperatures** | Conserving tree cover provides shade | Reforestation helps ensure future tree cover; harvesting trees reduces shade | | | | |
| | | **Biodiversity loss** | Designating conservation areas protects native plants and animals | Practices such as leaving dead trees standing and building barriers provide habitat for wildlife; clearcuts lead to regeneration; monitoring protects against poachers | Prohibiting or restricting hunting | | | |
| | **Social** | **Migration** | | Employment opportunities in logging, milling or administrative tasks | Establishing and managing community forest enterprises to provide local employment | Maintaining a sense of place and belonging | Community enterprises generate employment; young people increasingly uninterested in forestry and agricultural work; community wages are low and insecure | People who leave to continue their studies often do not return |
| | | **Poverty** | | Employment opportunities in logging, milling or administrative tasks | Establishing funds to support the elderly and other vulnerable groups; supporting young people to continue their studies outside the community so they can return and contribute | | Local wages trickle down and circulate within the community | Young professionals who return to the community bring new projects and ideas |
| | | **Lack of awareness** | | Forest management units organize talks with schoolchildren | Serving in the *comisariado* and other *cargos* teaches people about caring for and managing natural resources | | Working in community enterprises generates awareness of the importance of natural resources | Campaigns and information sessions around water conservation and waste management |
| | | **Lack of basic infrastructure** | | Community forestry provides funds that get invested in roads, schools, clinics, drainage and other public works | Assemblies decide to invest funds from community enterprises such as forestry in infrastructure needs | Working collectively to pave roads and other public works through *tequios* | | |

We also inquired about social threats of challenges that affect communities' ability to sustain themselves into the future. The most common answer was migration, which is an issue that is prevalent across rural Mexico. A mass exodus in search of economic opportunities began since the North America Free Trade Agreement came into force in 1992 and greatly impacted small agricultural producers' ability to make a living. This is linked to the challenge of poverty, as one interviewee from SMP put it: "*There is revenue, but it's not enough to meet people's needs. So, we need and depend heavily on the forests.*" However, some interviewees have noticed that young people are increasingly migrating despite the fact that jobs are available within the community, because they are interested in pursuing other careers and opportunities: "*many don't come back anymore, maybe they come to visit, but it's not so much because there are no jobs, but because maybe the career they want to study isn't available here in the mountains*" (SX). Overall, there is also a sense that some community members lack awareness or are outright selfish in their action towards the community's resources: "*We think we can't do anything or that external factors are influencing things, but no, sometimes it's our own habits: not taking care of the water, not turning off lights that aren't being used...These are actions that, as a community, we still need to have a little more environmental awareness because we were used to having everything in abundance*" (SMJ).

### *4.3.2. Community strategies for social and ecological resilience*

When asked what allows or would allow their communities and their forests to sustain themselves into the future, factors related to community governance were the most frequently referenced (41% of the 58 semi-structured interviews conducted in SX, SMP, SMJ and SJL in 2024). Interviewees described the importance of strengthening local institutions like the *comisariado* and enforcing community agreements through sanctions. Governance was not only seen as a tool for enforcing internal rules[17], but also as a mechanism for ensuring inclusivity, transparency, and accountability: "*In the assemblies, everyone is informed about the projects, and that builds trust*" (SX). The assembly system was perceived by many as essential for translating environmental, economic, and social challenges into concrete management decisions: "*Sometimes we don't agree, but it's in the assembly where we talk and decide*" (SJL). For example, in SMJ, the assembly decided that some areas covered by their

[17] As explained in Section 1.2.2.

forest management plan and IFM project would not be harvested due to their proximity to sacred water bodies or the presence of a few individuals or a very rare pine species.

Equally cited (41%), the concept of *comunalidad* or 'communality' referred to a broader ethic of care, reciprocity, and mutual responsibility. Participants saw strengthening communal ties as a means to maintain social cohesion and the willingness of residents to collaborate on forest conservation activities and respond collectively to natural disasters and other emergencies. As stated by one of the interviewees: "*If a wildfire starts, our people are there, running to put it out, to calm it down. If any of our neighbouring communities has a fire, we go as well, because it can also affect us. And that is precisely what a forest culture is*" (LTI). Beyond these practical matters, communality is an existential issue for many interviewees: "*What matters is not losing the sense of communality. What I want is for young people to become involved in the internal life of the community so that we can conserve our way of life, this tranquillity*" (LTI).

Local employment (mentioned in 38% of interviews) was seen as a key strategy to address the persistent challenges of youth outmigration and poverty. Secure employment opportunities, especially those connected to forest management and conservation, were identified as a means to retain young people in the community and ensure intergenerational continuity of land stewardship: "*I would love for at least a majority of people to be employed in the enterprises here in our community. There should be more enterprises where local people are employed because that would improve the quality of life of everyone*" (LTI). The ability to generate income locally was also linked to reducing dependency on external actors, enabling greater community self-determination. The case of Lachao is a drastic example of this issue, given what occurred when forest management and hence the IFM project were suspended by the assembly: *"The capacities that were strengthened during those times have emigrated, they are gone. We had carbon technicians, biodiversity technicians, in forestry, in ecosystem services. Practically all of them, as project implementation fell, as programs ended, well they left seeking other sources of income"* (SJL).

Many participants (32.7%) advocated for increased investment in education and mentorship to ensure that youth would become the next generation of stewards. This emphasis on education underscores a deep awareness of intergenerational resilience, in which today's strategies must also prepare the next generation to adapt, lead, and sustain community life: "*I believe the future of our community lies in education. The more education there is, the more our people are trained, there will be more openness, more development, we will be able to profit more from*

*what we have*" (LTI). Many interviewees see the limited educational opportunities available in their towns as a significant driver of outmigration. To address this challenge, the forest management team in SMJ has developed targeted programs to engage both youth and the broader community. One such effort involves bringing local school groups into the forest, where students participate in tree planting, visit conservation zones, and learn directly about sustainable forest practices. These hands-on activities aim to cultivate a deeper connection to the land and inspire future participation in forest stewardship.

The forest itself was perceived not only as a source of employment, but also water security, climate regulation, and biodiversity preservation: "*The forest is our water factory. Without it, there is no life for the community*" (SX). Here, there were contrasting views with regards to what the forest needs to be resilient, with some emphasizing the need to conserve the forest and avoid cutting down trees, and others pointing to forest management as the necessary path. Particularly in SJL, interviewees expressed concern that forest management could be detrimental: "*When the forest is cut, the water goes away*." Across most communities, however, many interviewees described a shift from a more passive approach to forest management – where natural regeneration was expected to occur without intervention – toward more active stewardship, including reforestation, selective harvesting, and the designation of conservation areas. In SMJ, an interviewee reflected that "*before, the forest had to do the work on its own. Now there is reforestation, there is more maintenance*." This transition was often framed as a response to increasing environmental pressures, such as drought, pest outbreaks, and shifting seasonal patterns. Another interviewee from SMJ proposed that "*we should manage the forest with sanitation in mind […] That way, the forest stays strong, and we still benefit from it*."

#### *4.3.3. The impact of FBCOs on communities' strategies and their ability to work towards their visions for resilience*

Interviewees overwhelmingly perceived that the IFM projects they have undertaken by working with ICICO have enabled them to address many of the ecological and social threats they identified, and have strengthened their internal strategies for resilience (Table 6).

*Table 6. The perceived roles that improved forest management (IFM) projects have had in addressing each of the threats and strategies for social and ecological resilience identified by interviewees. Mainstream perceptions are represented in black text while dissenting opinions are shown in red.*

| | | | Project outcomes | | | |
|---|---|---|---|---|---|---|
| | | | IFM planning | | IFM implementation | |
| | | | Information | Capabilities | Activities | Funds |
| Threats or challenges | Ecological | **Drought** | People learn about conserving water and protecting riverbanks and wetlands | Training on improving water retention in soils through barriers | Installing fencing around wetland areas to protect vegetation from cattle; harvesting trees reduces water security | Purchasing and installing infrastructure for water capture and storage, purchasing fencing for wetland areas |
| | | **Forest fires** | People learn about the impact of forest fires on climate change and the importance of prevention and control | Training on preventing and combating forest fires | Increased capacity to monitor, prevent and control wildfires | Firefighting equipment |
| | | **Pests and diseases** | | Training on preventing and combating pests and diseases | Increased capacity to monitor, prevent and control pests and diseases | Purchasing and applying treatments, controlled burning, buffers |
| | | **Rising temperatures** | | | Increased capacity for reforestation, which will reduce heat perception; harvesting trees increases heat perception | Establishing nurseries or purchasing plants for reforestation |
| | | **Biodiversity loss** | People learn about local wildlife and how to conserve it | Training on biodiversity monitoring, including camera traps and acoustic microphones | Harvesting trees opens space for sprouts that feed wildlife; animals may be scared off by tree harvesting, forest composition changes | Biodiversity monitoring equipment |
| | Social | **Migration** | | Building capacities opens future employment opportunities in the community, including for women | More workers are needed to fulfil IFM tasks, including women | Funds used to pay workers and project coordinator; more people employed in forest management; more secure wages; involvement of women workers |
| | | **Poverty** | | Building capacities opens future employment opportunities in the community, including for women | More workers are needed to fulfil IFM tasks, including women; prohibition to extract fuelwood during verification periods is resented by those who lack alternatives | Wages trickle down and circulate inside the community; setting aside funds to support the most vulnerable, including the elderly |
| | | **Lack of awareness / selfishness** | People learn about climate change and the importance of forests; industries can continue to pollute | | People learn from exposure to forestry works during *tequios*, information sessions for schoolchildren | Organizing information sessions for schoolchildren in the forest, including transport and meals |
| | | **Lack of basic infrastructure** | | | Activities can include road improvement and maintenance | Paving roads, repairing and equipping clinics and schools, building community centers and offices; communities become dependent on IFM to cover these basic needs |
| Resilience strategies | Ecological | **Forest conservation** | People learn about climate change and the importance of forests | | Preventing pests, diseases and fires protects conservation areas | Secure income from IFM reduces pressure on forests; funds are not paid to individuals that conserve trees within agricultural plots |
| | | **Forest management** | People learn about the role of forest management in forest health and resilience | Learning to implement IFM practices increases capacity for forestry works | Increased capacity for reforestation, monitoring, pest control, fire control; harvesting trees goes counter to conservation, children will miss out on seeing old forests | Around 50% of funds in all communities invested in forest management works; more secure wages facilitate long-term planning for forestry works |
| | Social | **Governance** | Process occurs through local governance institutions, reinforcing the role of the *comisariado*, *consejo consultivo*, and the assembly; a 30-year commitment can raise doubts about loss of community autonomy | Members of the comisariado and project coordinators learn skills needed to manage IFP project, which are transferable to other community enterprises | The comisariado, the community project coordinator and the forest management unit work together to organize and implement IFM activities; discontent over new rules and restrictions lead to anger and at least two cases of sabotage | Building or improving the offices of the comisariado, buying trucks to facilitate their tasks; previously unpaid positions and tasks can now be financed through IFM funds; resentment that some tasks still realized through unpaid *tequios* |
| | | **Communality** | Meetings, workshops and presentations bring different interest groups together to find consensus; unequal participation in decision-making | | IFM tasks require people to come together and work through *tequios;* participation in tasks does not generate direct benefits | Paying for culturally important parties that bring people together; tensions around unequal benefit distribution |
| | | **Local employment** | | ICICO trains local workers to carry out all aspects of IFM projects, including women | More workers are needed to fulfil IFM tasks, including women | Funds used to pay workers and project coordinator; more people employed, more secure wages, involvement of women workers |
| | | **Education** | | | Information sessions for schoolchildren | Repairing and equipping schools, organizing information sessions, hiring teachers |

Through the participatory planning process, many felt that they acquired knowledge and capacities that they previously lacked, and which prepared them to undertake tasks that are increasingly important due to climate change, such as monitoring for pests and diseases as well as wildfire prevention and control. As one female worker from SJL explained: "*All that capacity we acquired it from ICICO's technical advisors. They shared their knowledge. You learn a lot, I even learnt about controlling forest fires. They teach all of that and there it doesn't matter if you are a man or a woman, you can help*" (SJL). However, in San Juan Lachao, the pilot community for the Mexico Forest Protocol, there were concerns that not everyone was involved with the decision-making process, including native Chatino speakers who expressed frustration that the information provided during that time was not translated. These resentments partly contributed to the decision by the assembly to suspend forest management in 2017.

Once the project was in place, the vast majority of interviewees (84% of semi-structured interviews) said that it brought benefits for their communities and their forests, while only a few individuals perceived disadvantages linked to the project. The IFM project increased communities' capacity to carry out the tasks they were already undertaking as part of their forest management plans, which is precisely the goal of this type of FBCO project. This is made possible because the income from IFM allows them to invest in equipment and materials, and, crucially, to hire more workers, therefore strengthening local employment as well as forest management as key strategies for resilience. These factors contribute to a perceived reduction of ecological threats including drought and rising temperatures ("…*doing pruning, barriers, thinning and we prepare the little trees, all lined up, well taken care of, and in two or five years they will have grown to give us air, to give us life, to give us water and so we don't suffer the heat…*" - SMP), and social challenges such as migration and poverty ("*things were great for a while when we were working the forest, there was a lot of employment, a lot, […] practically everyone had a job right here and was content. There was no need to leave*" - SJL).

Despite the bias in our sample towards individuals involved with forest management and decision-making around IFM, we did capture some contrasting views with regards to the impact of IFM activities. These opinions are in line with others expressed during the more open-ended interviews conducted in 2023, which included a broader range of community members. Some people shared concerns that the principle of forest management itself runs counter to their desire to conserve the forest for themselves and future generations: "*Now with the forest management practically all the big trees or parent trees have been cut down, and*

*who wouldn't have liked their children to get to see a forest like that, with big leafy trees that provide plenty of shade…*" (SMJ). Others were concerned that harvesting trees would lead to water scarcity and cause wildlife to move away. And in the case of SMP and SJL, the communities with the least amount of experience with forest management, discontent over new rules and restrictions on the use of the land led to anger and sabotage: "*When the project started, some were angry that they couldn't cut trees. They got angry and they went and set fire to the forest*" (SMP). These fundamental disagreements over forest uses and values contributed to the suspension of the forest management plan in SJL.

Through the targeted investment of IFM funds, communities have directly tried to address these concerns. All communities have used IFM funds to improve infrastructure in ways that will benefit all inhabitants regardless of land rights status, such as repairing and equipping clinics and schools, paving roads, improving drainage or street lighting, and building community centres. Some have also decided to set aside a portion of the funds to support vulnerable community members, mainly older residents. They have also invested in education activities within the community, bringing schoolchildren to the forest to learn about the practices they implement and how they care for their land. And they have sought to learn more about the impact of their management practices on wildlife by implementing biodiversity monitoring, using IMF funds to pay for equipment such as camera traps and acoustic monitors. Furthermore, at the time the interviews were conducted, SMP, SX and LTI were all exploring the possibility of investing IFM funds in infrastructure for water capture and storage, to face their biggest ecological challenge: drought and water scarcity. And SMJ had already taken this notion further than any other community: "*Of course there are benefits, because with that money we were able to buy the geomembrane, now we have two of them here and up there we have a water storage facility as well, all thanks to the [carbon] project*" (SMJ). The reservoir they have built is a model for others who are looking to increase their resilience (Figure 21). If anything, the possibilities that the IFM funds opened for communities led some to become concerned about becoming too dependent on this support to cover their basic needs: "*It's good that money comes in, but we need to be careful not to depend only on that*" (SJL).



*Figure 21. Water catchment area built by the community of Santa María Jaltianguis using funds from their improved forest management carbon project. Credit: Luke Dauner.*

There are some outstanding challenges with regards to the impact of IFM projects on community governance and communality, particularly in SJL and SMP. Governance structures based on mandatory community service can present a challenge when elected leaders are not motivated or able to carry out program requirements: *"Because they are not elected because of their profile, if you get there and they give you an enterprise to manage, you will not be able to make it work because you lack the know-how"* (SJL). Managing large amounts of money has introduced new challenges for comisariados and assemblies: "*It was harder to agree when we had money than when we didn't*" (SMJ). Furthermore, IFM projects impose significant labour requirements which are sometimes fulfilled through traditional community service or *tequios*, but this can create tension ("*We need to survive at home, to also cover the basics... People need to be paid, if they're going to work, to be paid*" - SMP), particularly when benefit distribution is not perceived to be proportional to the amount of labour provided: "*We have supported the road building, the productive projects, we have supported a lot. But sometimes it is not very equal because the bigger localities get more, and the small ones sometimes get nothing*" (SJL).

After the suspension of forest management put the continuity and permanence of the IFM project into doubt in SJL, ICICO restarted a process of participatory planning. Some of the

ICICO staff involved in the process explained that the project was very close to their hearts since SJL had been the pilot community in Mexico, and they were feeling the pressure to demonstrate the permanence of the project. Furthermore, the community risked being penalized if they failed to verify their IFM project within the required timeframe. During a follow-up visit in August 2025, we learnt that the community had submitted a new forest management plan to the Ministry of the Environment, which now needed to be approved by the assembly. The new *comisariado* that began their role in September 2024 was motivated to reactivate forest management to bring back the significant economic benefits the community had perceived in the past. The strategy that ICICO co-developed with the new *comisariado* involved planning a series of smaller meetings across the territory prior to the assembly to provide spaces for people to express their concerns and give detailed explanations and reassurances about the forest management plan and FBCO project. They were planning to provide Chatino translation for the more technical terminology, which had been a key concern, facilitated by the fact that three members of the *comisariado* spoke the language. They were also planning to invite all community members to the meetings, not only the official rights holders. Ultimately, however, the decision lies with the assembly, which has so far proven to be a strong institution where different views can be shared.

#### *4.3.4. The role of ICICO in aligning community visions with FBCO goals*

Despite their previous experiences selling timber and other forest products, many interviewees admitted to being ill-prepared strange notion of selling carbon offsets. When asked to recall what they thought when they first heard about carbon offsets, people of all ages admitted to being sceptical, but this was most prominent amongst older age groups. One consistent point of confusion was over the concept of "selling air." A farmer from SMP explained that when he first heard about FBCOs, he thought "*Well, how do they sell it, by the kilo? Maybe a big bag and people would run and fill it and tie it...*" There were also concerns around the nature of the transactions themselves, with many worrying that they were relinquishing ownership of the land by accepting payments over time. A municipal government official from SX said that many of his neighbours feared that eventually they would be told: "*you are no longer the owners of the forest, it is now the buyers who were paying year after year and now the forest is ours*".

In almost every interview, participants expressed that ICICO's participatory process for project development helped alleviate many of their concerns about undertaking an IFM project.

Through their long experience supporting communities with many different forest projects and programs, ICICO has developed an approach that they believe is conducive to making them broadly acceptable and therefore successful for communities. This methodology was explained in detail during an interview with ICICO's director of technical services (Table 7):

1. Interested communities reach out to ICICO with the desire to implement an IFM project. The technical services team will then seek out information about the community that will help them determine their potential to successfully adopt and implement IFM. This includes looking for news articles about any safety issues in the community, as well as inquiring about their previous experience with forest management. Communities that lack experience with the administrative and managerial tasks of forest enterprises and other community-level projects may struggle to implement the requirements of IFM projects.
2. ICICO schedules a meeting with the *comisariado* of the interested community to explain what an IFM project is, the potential benefits but also the costs and commitments that the community acquires. At this initial meeting, ICICO expects at least six people to show up: this would be the three members of the *comisariado*, plus the three members of the oversight council, and/or their deputies[18]. If fewer people show up, this is seen as a potential sign that the community lacks the organizational capacity or "strong internal social fabric" that ICICO sees as preconditions for this type of project. ICICO also uses this initial meeting to determine two more preconditions: whether the community has any outstanding agrarian conflicts with its neighbours, and whether the *comisariado* has been fully and legally accredited. Both would need to be resolved before any further planning can take place.
3. If the *comisariado* is convinced and wants to move forward, there are two possible paths. Some communities have an institutional arrangement known as *consejos consultivos*, a sort of council of elders, which acts as an intermediary step between the *comisariado* and the general assembly. ICICO considers the presence of a *consejo consultivo* as a good indicator of strong internal governance. If the community has one

[18] Section 1.2.2 provides a general overview of these governance bodies.

in place, then ICICO will present the project to the council, who will decide whether it is worth moving forward to a presentation at the assembly.

4. In communities that do not have a council of elders, or if the council meets and approves the project to move forward, the next stage is a presentation in front of the general assembly. These meetings of all official rights holders must happen at least twice a year, as required by law, although they usually happen more often and can be convened whenever important decisions need to be made. This stage is crucial, as the assembly is the ultimate authority when it comes to the common use areas. Initial scepticism, particularly regarding fears of "selling air" or losing forest ownership, are addressed during assemblies, as one interviewee explained: "*We didn't all understand it at first, but once the Integrator explained it in assemblies, we saw the benefit*" (SMJ). For ICICO, the assembly is also an opportunity to observe social dynamics; if there are noticeable conflicts between interest groups, or if it seems that the project would lead to more conflicts, then they will not move forward. The CAR Mexico Forest Protocol provides a list of topics that project developers are required to address in the assembly as part of their social safeguards, which include: explanations of concepts such as climate change and forest carbon projects, the anticipated costs (site preparation, project verification, etc.) and the anticipated benefits (to the local environment, as well as economic), including information on carbon pricing and benefit distribution.
5. If the assembly approves the project, then ICICO and the *comisariado* organize a series of workshops where they explain in detail all things related to carbon offsets and IFM projects in particular, including how the market works, all the processes involved in establishing baselines and verifying the project, and the requirements for the community in terms of labour and technical abilities. During follow-up meetings, ICICO works with participants to decide how the funds from the project will be invested. These workshops must be attended by the *comisariado*, who must also invite other attendees, mainly the workers who will be employed or tasked with carrying out the forest measurements and other activities. These will usually be people who are already involved with forestry work. Based on the discussions held during the assembly, ICICO may recommend that the comisariado invites certain vocal individuals or interest groups such as coffee producers or cattle ranchers. The *comisariado* may also wish to invite representatives from the municipal authorities, the civic arm of community governance, and the various committees that represent the

interests of schools, churches and other constituencies. In the words of an interviewee from SMJ: "*There were many workshops where all the community organizations were invited to attend, that includes the municipal government, the comisariado, each of the three schools, the health centre, and also people who had previously held leadership positions. And the decisions were made in those workshops.*"

6. After tasks have been assigned and distribution mechanisms have been agreed, ICICO receives an assembly act, which is an official document that states that the community has approved the project.
7. Finally, ICICO works with the *comisariado* to find ways to inform those that are unable to fully participate in the assembly process, mainly young people and those without land rights, who tend to be women, about the IFM project. This is part of the social safeguards requirements of the CAR Mexico Forest Protocol towards free, prior and informed consent (Climate Action Reserve, 2022). According to ICICO's technical director, it is important not to impose a specific communication strategy, but rather to support communities to utilize the means they already have. For example, in SMJ, they displayed a series of materials generated during an IFM planning workshops in a public area (Figure 22).

*Table 7. Description of the actors involved in each stage of the development of an improved forest management project by the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO).*

| | | Action situations | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Actors** | **Feasibility assessment** | **First scoping meeting** | **Second scoping meeting** | **Full project presentation** | **Participatory workshops** | **Project approval** | **Information sharing** |
| | **ICICO technical services** | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **Community** | **Assembly** | | | | ■ | | ■ | ■ |
| | **Comisariado** | | ■ | ■ | ■ | ■ | ■ | ■ |
| | **Council of elders** | | | ■ | ■ | ■ | | |
| | **Interest groups** | | | | ■ | ■ | | |
| | **Rights holders** | | | | ■ | ■ | | ■ |
| | **Non-rights holders** | | | | ■ | | | ■ |

Of the revenue that is generated from the sale of offsets, 80% goes directly to the communities and 20% goes to ICICO as the project developer. The president of the *comisariado* in SMP explained the process: "*The first time, we sold 9,000 tons of carbon offsets, and now the community has obtained almost twelve million pesos. Of those twelve million pesos, 20% goes to ICICO, with whom we work, so the community retains 80%. When that money arrived, the*

*community was thrilled*." Each year, the community must again decide how project funds will be spent, which must be demonstrated through an official assembly act.




*Figure 22. Image from a workshop held by ICICO in Santa María Jaltianguis, where community committees gathered to discuss how to distribute the funds. Credit: Brooke Rose, Melissa Arcila.*

### 4.4. Discussion

In light of the fast-growing number of forest-based carbon offsets projects, particularly improved forest management (IFM), and the accompanying claims that they can produce positive outcomes beyond carbon sequestration, it is increasingly important to understand the factors that must be in place for them to address locally relevant threats in ways that are consistent with community visions for social and ecological resilience. Here, we explore the components of resilience as defined by participant communities in Oaxaca, Mexico, the role of IFM projects in hindering or strengthening their strategies for resilience, and how participatory planning and implementation processes put in place by trusted catalysing agents can help ensure that FBCO projects lead to positive outcomes. We do so in partnership with the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO), a grassroots

organization that has played a key role in the integration of Mexican forest owners into the international voluntary carbon market.

In our case studies, we observe many of the requirements that Haller et al., (2018) identify as leading to the formation of strong institutions for resilient natural resource management. First, the presence of local actors that are empowered to engage in the institution-building process based on their own perspectives, which is a feature of the strong tenure security and relative autonomy that most communities in Mexico have enjoyed since the agrarian reform. Second, the presence of laws, regulations, and policies that recognize and accommodate local action, which in this case refers to CAR's Mexico Forest Protocol and its numerous provisions for communal landowners, including the requirement that projects undertaken by communal forest owners must demonstrate social as well as environmental safeguards. Fourth, the presence of "interest groups" where heterogeneous actors can discuss what kinds of institutions are important before negotiating overall regulations, a direct reference to the project planning workshops where different constituencies come together to agree on benefit distribution mechanisms and assign specific tasks. Finally, nongovernmental organizations (NGOs) that create the conditions for open debates and catalyse communication strategies for social learning, which describes the role of ICICO during project planning and implementation (although ICICO is best described as an inter-community organization, not an NGO).

Under the Climate Action Reserve (CAR) Mexico Forest Protocol (version 3.0), a project developer "may be the Forest Owner or an independent third-party contracted by the Forest Owner to assist the Forest Owner and implement the Forest Project" (Climate Action Reserve, 2022, p. 13). However, ICICO is in a unique position, since they describe themselves as part of, not independent from, the communities that collectively make-up this Indigenous-led organization. Their perspective is therefore extremely valuable as a case study for potential resilience outcomes of FBCO projects, since their technical services staff must understand and balance the needs and particularities of each community with the requirements of the market. They do so by staying involved in the debates and consultation processes with CAR, on the one hand, and working within communities' governance systems on the other. These types of alliances have been shown to be crucial for large-scale forest stewardship (Garcia et al., 2024), and can be considered part of the "nested" enterprises through which CFEs in Mexico organize themselves (D. B. Bray, 2020) in the language of the design principles for enduring institutions for sustainable resource management (Ostrom, 2005). ICICO's technical services director

strongly believes that project developers should be required to demonstrate having undertaken a truly participatory planning and implementation process; currently, CAR relies on the assembly act as the only means for project developers to demonstrate that they fulfilled their obligations of free, prior and informed consent.

From the perspective of most interviewees, ICICO's project planning and implementation process has enabled them to directly address many of the shocks and stresses they perceive and has strengthened their strategies for adaptation and transformation in light of perceived vulnerabilities. The information and training they received enabled them to fill some gaps in their knowledge about how to manage their forests in ways that directly address the many challenges linked to climate change, including drought, forest fires, pests and diseases, and biodiversity loss. The activities they undertook as part of project implementation increased their capacity for forest management, while providing local employment, including for women. And while the main use of funds was directed to wages and equipment for forest management, all communities also invested heavily in infrastructure projects that directly increase their resilience, including water capture and storage facilities, school buildings and equipment, and direct assistance to the most vulnerable. All of this was done through their traditional governance bodies, reinforcing the role of the assembly as the ultimate decision-making authority, and the *comisariado* and other positions as representatives and managers of the forest commons. These observations are in line with findings on the positive social and ecological outcomes that can occur when communities have high degrees of control over decision-making in natural resource management (Dawson et al., 2024; Garcia et al., 2024; Smith et al., 2019; Upton, 2020), and corroborate the well-documented ability of community forest enterprises in Mexico to generate social benefits beyond monetary income (Cubbage et al., 2015; Frey et al., 2019; Hernández-Aguilar et al., 2017; Orozco-Quintero & Berkes, 2010) while conserving forest cover in the long term (Pazos-Almada & Bray, 2018; Van Vleet et al., 2016).

While support for IFM projects was high among interviewees, it was not unanimous. Communities with a long history of forest management (SX, LTI and SMJ) described a relatively smooth transition into IFM, having already developed strong institutions for forest stewardship based on service positions or *cargos* and collective labour or *tequios*, through which individuals learn about and acquire skills for forest management that serve them well once they are assigned leadership roles in the *comisariado*. It should be noted that these three communities also have smaller populations and less forest hectares to manage, which probably

contributes to their ability to organize, as discussed elsewhere (Cisneros, 2019; Poteete & Ostrom, 2004). The larger communities of SMP and SJL are both relative newcomers to forest management and had already experienced program suspensions due to internal conflicts. Here, IFM projects exacerbated resentments over unequal participation in decision-making and the unequal distribution of benefits, based on previous experiences. Instances of project sabotage were mentioned in both cases. However, the motivation of accessing the relatively high and secure funding from IFM, money that they otherwise could not envision reaching their communities to address their social and ecological challenges, aided by ICICO's strategies for conflict resolution, led both communities to stay involved with the project and try to find consensus to move forward.

The participatory processes implemented by ICICO require considerable effort and strategy, which is consistent with the observed requirements for resilience that is actively produced rather than passively expressed (DeVerteuil & Golubchikov, 2016). In analysing the outcomes identified by interviewees through the lens of the resilience spectrum (HLPE, 2025), we easily identify many components of 'bouncing back resilience' in the implementation of forest management strategies aimed at preventing pests and wildfires or recovering tree biomass through reforestation. Furthermore, we also see the conditions associated with 'transformative resilience'. Firstly, ICICO's approach to the CAR Mexico Forest Protocol attempts to enable individual and collective capacities, agency and values throughout the process. They seek to include people with different views and perspectives and gather them in spaces where they have the power to shape upcoming activities and resource allocation decisions. They implement training through which skills are acquired and sharpened, and they incorporate and are responsive to local governance processes. Secondly, through a careful balancing act, ICICO seek to change structures of power by nudging communities towards a greater incorporation of women in physical forestry tasks as well as decision-making, implementing conflict resolution processes through (pre-existing) alternative communication channels, and introducing new roles such as the carbon project manager that give authority to young people who may otherwise not have the status to make their voices heard. And thirdly, by FBCO funds have allowed study communities to harness socio-ecological interdependencies by generating local employment, increasing knowledge about biodiversity through monitoring, significantly expanding their collective capacity for water capture and storage in the case of SMJ, and investing in basic infrastructure needs that could allow them to "bounce forward".

In this study, we also identify some of the proposed components of 'equitably transformative resilience' (HLPE, 2025). We find that ICICO certainly attempts to centre resilience efforts in the knowledge, experiences and resistance of those made vulnerable and marginalized by advocating for changes in the CAR Mexico Forest Protocol that acknowledge the realities of Mexican forest communities, and has implemented some measures aimed at reaching more marginalized members within communities themselves such as requesting Chatino translators in SJL. They have also put participation, accountability, non-discrimination, transparency, human dignity, empowerment and rule of law at the centre of all efforts to implement FBCO projects, for instance by working to fulfil all the legal requirements for timber harvesting authorizations through the federal government as well as the requirements of the CAR protocol while training community members to carry out these processes by themselves. However, whether the FBCO project implementation process has successfully nurtured socio-ecological equity and justice, and whether it has addressed inequalities in structures through redistribution and redress, are conditions that we are not able to evaluate at this point as they require a broader vision and potentially a set of valid comparisons for the study communities that have not engaged with FBCOs.

Our close association with ICICO enabled a deep understanding of communities' interactions with FBCOs, but it also entails some important limitations. The ROSES team (Researching Oaxaca's Socio-Ecological Systems) is built on a nearly 20-year partnership with ICICO. Through our commitment to community-engaged and responsive scholarship, the ROSES team aims to support ICICO and its communities in all aspects of their forest stewardship. While we maintain some degree of academic independence from ICICO, it is likely that peoples' opinions of and relationship with ICICO influenced their answers or comments during our interviews and workshops. Furthermore, since we worked exclusively within ICICO communities, we acknowledge that our findings may not be applicable to the way other project developers work with communities and should not be interpreted as proof that FBCO projects contribute to social and ecological resilience. Instead, it should be taken as supporting approaches that are inclusive, participatory and embedded in communities and their institutions, as this can lead to project implementation outcomes that are consistent with local visions for resilience.

### 4.5. Conclusion

Working in partnership with an Indigenous-led organization in Oaxaca (ICICO, the Integrator of Indigenous and Campesino Communities of Oaxaca), we identify how five of its member communities perceive and describe the components of social and ecological resilience and their associated threats, the role of ICICO in introducing and making decisions around forest-based carbon offset (FBCO) project planning, implementation and funding allocation, and how FBCO activities and funding allocation address perceived shocks and stresses in ways that we believe are conducive to transformative resilience. Interviewees identified a series of ecological threats, which they link strongly to climate change, including drought, forest fires, forest pests and diseases and biodiversity loss. They also perceive that outmigration, poverty, people's lack of awareness and their deficient infrastructure threaten their capacity for resilience. They reflected on how their forests, through either conservation or management approaches, are essential for their future resilience, and factors such as their traditional governance structures, a sense of communality, local employment and education can all contribute to resilient futures.

Most interviewees also felt that the planning and implementation processes facilitated by ICICO directly addressed many of the threats they perceived and strengthened their capacity for resilience. During project planning, information and training provided by ICICO was considered important for learning skills such as wildfire and pest prevention and combat, biodiversity monitoring, and the importance of forests as carbon sinks. They felt that ICICO's approach was compatible with and strengthened their traditional decision-making structures. The activities that communities were able to implement with FBCO funds directly increased their capacity for reforestation, wildfire and pest detection and control, water capture and storage, and biodiversity monitoring, generating local employment and capacities in the process. Finally, these communities received significant income from FBCO projects, which they collectively decided to invest in basic infrastructure needs such as schools and clinics, equipment and materials for forest management, water capture and storage infrastructure, and educational activities within the communities.

While support for FBCO projects and ICICO was very high, it was not universal. Many interviewees questioned the whole idea of cutting trees as part of forest management plans and FBCO projects, believing conservation is the better path for intergenerational resilience. There were also concerns around unequal participation in decision-making and benefit distribution,

particularly in the pilot community of San Juan Lachao where ICICO's process was beginning to be developed. Two communities saw instances of discontent and sabotage, although the potential for significant income generation later led to a restart of internal conflict resolution processes, mediated by ICICO. Finally, there were concerns around the suitability of their traditional institutions for forest governance in the face of the new requirements that they were facing.

Based on the findings from this exploratory study embedded in a broader multidisciplinary research partnership, we argue that forest-based carbon offsets can play an important role in strengthening local strategies for social and ecological resilience for vulnerable communities that are already living with the impacts of climate change. We join others in calling for metrics of success to go beyond changes in carbon stocks and encompass additional environmental and social dimensions or co-benefits (García & Moros, 2025), which have been found to have monetary valuations of the same order of magnitude or larger than estimated mitigation costs (Karlsson et al., 2020). In the case of communal forest owners, previous experience with collective forest management, strong governance institutions and project developers that can mediate and work within them can all contribute to project planning and implementation outcomes that successfully address locally relevant threats and strengthen community visions for resilience.

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# 5. BOTTOM-UP JELLING: CONTRASTING CASES OF (MIS)ALIGNMENT OF TRADITIONAL INSTITUTIONS AND VALUES IN MEXICAN COMMUNITY FOREST ENTERPRISES

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**Abstract**

In the Mexican context, the prevalence of community land ownership means that formal and traditional forest conservation and management approaches come into constant contact, creating plenty of opportunities for alignment or misalignment. Through a participatory case study methodology, this work explores how two contrasting communities in the state of Oaxaca adapt and modify their traditional forest governance structures and values around the forest commons in an effort to jell them with the formal rules and regulations that govern their forest enterprises. Methods included semi-structured interviews, focus groups, participatory mapping workshops, and participant observation in the Indigenous communities of La Trinidad Ixtlán and San Juan Lachao. In the course of these communities' interactions with various forest programmes, the increased responsibilities of leaders who traditionally serve as part of a system of unpaid community service has led to the designation of new service positions and the inclusion of financial compensation for the more time-intensive roles. The incompatibility of forest management plans with other uses of the forest commons led to the establishment of internal rules that curtail these uses, in one case, and to the suspension and re-design of the management plan in the other. Finally, the values for the forest that are made evident by formal institutions have also clashed with many people's views around conserving old standing trees and the beauty and importance of non-forest landscapes. Both communities have implemented communication and education campaigns to highlight values such as carbon sequestration or timber production, and have made targeted investments of funds in ways that reinforce the view of the forest as a source of income. This chapter increases our understanding of how communities modify their organizational and value structures in ways that blur the lines

between traditional governance and enterprise management, and highlights some potential outcomes of bottom-up jelling, quasi-jelling, and unjelling processes.

### 5.1. Introduction

Mexico is a unique context in which to study interactions between governance institutions at multiple scales, particularly when it comes to forest conservation and management policy. More than half of the country's forests are owned and managed under community governance structures, which include *ejidos* and *comunidades* or Indigenous communal lands (Barsimantov & Kendall, 2012; Madrid et al., 2009b)[19]. Government bodies at the federal, state and municipality levels, as well as non-government organizations, must therefore routinely interact with these complex communal governance institutions when implementing forest policies or programmes (Antinori & Rausser, 2007; Klooster & Masera, 2000), creating plenty of opportunities for alignment or misalignment.

Throughout the 20th century, as part of Mexico's agrarian reform, subsequent laws codified a specific governance arrangement that was inspired by ancient communal land tenure systems such as the Aztec *calpulli* as well as institutions for forest and pasture commons imported from Spain (D. Bray, 2013). The 1992 Agrarian Law gives communities significant autonomy to create their own internal rules (*reglamento interno*, in the case of *ejidos*, and *estatutos comunales*, in the case of *comunidades*) with respect to the governance of land and resource rights, which must comply with the legal framework. A general assembly made up of all registered members is the ultimate authority within *ejidos* and *comunidades*, where all aspects of internal rules and land use within common use areas are decided by consensus or majority vote; this includes electing the *comisariado*, a six-member commission (including deputies) that represents the community in official processes, and an oversight council (*consejo de vigilancia*) that has a supervisory role (Antinori & Rausser, 2007; Barnes, 2009; D. Bray, 2013; D. B. Bray et al., 2006). The people serving in these roles are typically unsalaried and unspecialized towards forestry or any other management skill (Antinori & Rausser, 2007; D. B. Bray et al., 2006). In addition to these officially mandated rules and roles, many Indigenous

[19] See Section 3.3 for more details about forests in community lands.

communities operate through a system of mandatory, unpaid community service, through which assemblies assign different civic and religious responsibilities called *cargos* to registered community members (Antinori & Rausser, 2007; D. B. Bray et al., 2006)[20]. While these arrangements were the result of a "top-down supply of governance institutions" (Bray, 2020, p. 4), Mexico's approach to land reform gave significant autonomy for communities to adapt and adopt their internal rules in accordance to their *usos y costumbres* (usages and customs), such that, one hundred years later, these governance structures are perceived by many community members as part of their traditions (Merino, 2005). These 'traditional' organisations are now being re-engineered by the forestry sector to act as collective commercial production operations (Antinori & Rausser, 2007).

The high degree of autonomy that communities in Mexico enjoy today when it comes to forest management is the result of a long process of alignment through political organization and resistance. Article 27 of the Mexican Constitution gave the Nation "original ownership" of all lands and bodies of water, which allowed the federal government to establish a system of forest concessions in the 1940s through which private companies backed by the federal government extracted timber from communal lands (Assies, 2008; D. B. Bray et al., 2006; Merino-Pérez, 2004). After three decades of intense exploitation of their natural resources, communities across six states in central and southern Mexico organized a resistance movement to oppose and eventually repeal the timber concessions (Pérez Avendaño, 2017). While some communities were already harvesting and commercializing their timber in previous decades, the passage of the Forestry Law in 1986 allowed communities to hire their own certified forestry technicians for the first time (Merino Pérez, 2018). The 1992 Agrarian Law soon followed, increasing the bundle of rights of communities by giving rightsholders the ability to transfer ownership of their individual plots while designating forested lands as common use areas to be governed collectively by the assemblies (Valsecchi, 2014). By the late 1990's, Mexico's community-based forestry sector was one of the world's largest (D. B. Bray & Wexler, 1996), and by the early 2000's one report considered it to be "at a scale and level of maturity unmatched anywhere in the world" (D. B. Bray et al., 2003). In addition to the commercialization of timber, some communities in Mexico generate income from nontimber forest products such as pine resin, conducting ecotourism, or bottling and selling spring water

[20] Section 1.2.2 contains more details about community governance.

through community forest enterprises (CFEs) (Cubbage et al., 2015; Hernández-Aguilar et al., 2017).

This study adopts Macqueen's (2008) definition of CFEs as entities recognized within a given community that generate profits from forests or trees and redistribute those profits within that community (Macqueen, 2008). While demand continues to grow for timber and wood products in central Mexico (Solís-Mendoza et al., 2024), local production has not been enough to meet demand (Torres-Rojo, 2021). In a recent survey of 25 communities in the Southern Mixtec region of Oaxaca, only three had a CFE (Hernández-Aguilar et al., 2017). This has been attributed to lack of access to finance, substandard physical infrastructure, and an absence of business plans (Solís-Mendoza et al., 2024). If CFEs fail to meet market demand, the concern is that this will be filled through other means that lack the social purpose and benefit-distribution advantages of CFEs, such as purely for-profit entities, para-statal concessions, or illegal logging within communities' territories or in protected areas (Barrow et al., 2016; Kanashiro Uehara et al., 2023; Medina et al., 2009; Tsanga et al., 2014). In fact, one recent study suggests that up to half of the supply for the timber market in Mexico comes from illegal logging (Torres-Rojo, 2021). With the goal of increasing the capacity and economic sustainability of CFEs, Mexico's National Forest Commission (CONAFOR) promotes a number of support programmes, including providing funding for improvements of roads and other infrastructure for management, harvest, transport, and processing, acquisition of harvest equipment, and training of employees (Antinori & Rausser, 2007; Frey et al., 2019). Communities in Mexico also have access to other sources of funding, which they tend to mix-and-match as needed with more targeted funding to support all their forest-related activities (Alatorre et al., 2021; Izquierdo-Tort, 2020; Zaga-Mendez et al., 2026). These sources include one of the world's largest and longest-lasting payments for ecosystem services (PES) programmes (Izquierdo-Tort et al., 2025), and a burgeoning voluntary market for forest-based carbon offsets (FBCOs).

This work examines the processes and outcomes of institutional jelling[21], that is, the piecing together of compatible traditional and formal institutions to generate rules that can be acceptable by community and state actors, in two communities in Oaxaca, Mexico. It specifically seeks to explore the ways in which institutions for forest governance are perceived

[21] The institutional jelling framework is described in detail in Section 2.1.2.

to be misaligned (unjelled) and the strategies for alignment or quasi-alignment that each community has employed with regards to 1) communities' institutions for collective action; 2) the de facto use of the forest commons; and 3) the values held by community members with regards to the forest. In doing so, it complements the insights from previous studies by exploring diverse views from a wide array of community members and examining two communities that differ greatly in terms of their experience with forest conservation and management programmes, their land uses and economic pressures more generally, their size and make up in terms of language and ethnicity, as well as the diverse uses and values of the land. .

This chapter proceeds as follows. Section 5.2 presents a revision of the literature. Section 5.3 provides an explanation for the methods of analysis. In Sections 5.4 and 5.5, the empirical results are presented. Section 5.7 concludes by discussing how the findings speak to the institutional jelling framework.

## 5.2. Background: National policy and local governance adaptations

A rich body of literature has documented the ways in which the Mexican model of community forestry and agrarian policy co-evolved during the 20th century, detailing the gradual decentralization process through which the state conferred significant autonomy over forest resources while maintaining significant control through the regulation of extraction (D. B. Bray et al., 2003, 2006; D. B. Bray & Klepeis, 2005; Klooster, 2003a; Merino-Pérez, 2004)[22]. With regards to PES and FBCO policies, a few studies have documented the ways in which they have been adapted in response to the agrarian context in Mexico (Denham, 2017; Ezzine-de-Blas et al., 2016; Osborne & Shapiro-Garza, 2018b; Shapiro-Garza, 2013; Shapiro-Garza, 2020a), and the key role of community organizations in mediating this process. For example, Denham (2017) documented how a community collective in Oaxaca lobbied for the inclusion of firebreaks as a compensated conservation activity in PES, to address traditional slash-and-burn practices (Denham, 2017). Another Oaxacan organization, the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO), was the first in Mexico to secure Climate Action Reserve (CAR) certification in 2014 and sold the first offsets using this protocol

[22] This process is summarized in Section 1.3.1.

(Osborne & Shapiro-Garza, 2018a) through a pilot project in the community of San Juan Lachao (Barrera De La Torre, 2021). ICICO was instrumental in expanding CAR's Mexico forest protocol to encompass the particularities of participatory, community-centric, FBCO production (Osborne & Shapiro-Garza, 2018a).

From the point of view of communities themselves, early work by Bray and Antinori, among others, has documented the "organizational innovations" that CFEs in Mexico have implemented and which demonstrate the "melding of the agrarian governance platform with entrepreneurial forms" (D. B. Bray et al., 2006). More recently, Hodgdon and colleagues (2013) documented the main forms of CFE governance, which differ in terms of delegation of forestry tasks by the assembly, from assigning them directly to the *comisariado*, to appointing a forest council or manager, or dividing up the authorized harvest volume among working groups (Hodgdon et al., 2013). They also identified common challenges and tensions across Mexican CFEs, including: the fact that the assembly has to make key decisions on forest management issues despite most community members lacking a full understanding of enterprise needs; the difficulty in supervising fellow community members in a business management setting; the fact that managerial positions are rotated every one to three years, which can result in "a kind of permanent incompetence"; that leaders or managers with poor accounting skills can generate confusion or suspicion; and the fact that community members may have varying objectives for their CFEs (Hodgdon et al., 2013).

Two relevant case studies by Engbring and Hajjar (2021 and 2022) reveal more details about the organizational structures and associated trade-offs in four communities with CFEs in the Sierra Norte region of Oaxaca, including La Trinidad Ixtlán. Through semi-structured interviews conducted in 2017 and 2018, they show that these communities have implemented paid work within their CFEs to varying degrees, ranging from providing minimal compensation to *cargo*-based CFE committees or coordinators, to hiring full-time, paid, permanent leadership with professional qualifications and assessing them based on the productivity of the enterprise sectors they managed (Engbring & Hajjar, 2021). They further find that this approach to CFE leadership has trade-offs with regards to the more traditional choice of electing rotational leadership under the *cargo* system: the latter was seen to enhance trust and transparency, and ensure that leaders understood and were responsive to community needs and traditions; on the other hand, *cargo*-based leaders may be less able to maximize revenues and navigate enterprise challenges, and leadership changes every few years were perceived to hinder strategic, long-

term enterprise planning (Engbring & Hajjar, 2022). However, these studies focus only on Sierra Norte communities, which have some of the longest lasting and best-known CFEs, and they rely heavily on interviews with community leaders and individuals working closely with CFEs.

With regards to communities' governance adaptations in the context of PES in Mexico, our systematic review of 140 publications revealed 25 studies that discuss governance outcomes (Alatorre et al., 2024; Izquierdo-Tort et al., 2025). These range from the rate of participation in assemblies, community workdays (*tequios*) and forest management activities (J. M. Alix-Garcia et al., 2018; Almeida-Leñero et al., 2017; Arriagada et al., 2018; Avila-Foucat et al., 2021) to changes in internal rules or decision-making processes (Bee, 2019; Denham, 2017; Gómez Bonilla, 2017b; Nieratkaa et al., 2015; Osborne & Shapiro-Garza, 2018a; Perevochtchikova & Rojo Negrete, 2015; Uscanga Morales & Perevochtchikova, 2020). These studies mostly focus on PES outcomes without embedding their findings within the broader historical context of forest management in study communities, including whether the observed changes may be linked to communities' interactions with other types of activities.

### 5.3. Materials and methods

The present work is part of a long-term research collaboration with the Integrator of Indigenous and Campesino Communities of Oaxaca (ICICO), a community-based organization and technical services provider that seeks to develop local capacities within its member communities for sustainable natural resource management (*ICICO AC*, 2026). ICICO is governed by a board comprised of representatives of its 16 member communities, and its technical services arm develops and implements a wide range of projects including FBCOs, PES and timber authorizations through participatory approaches (Osborne & Shapiro-Garza, 2018a). This study builds on the findings from a previous exploratory study conducted with four ICICO communities, among others, including La Trinidad Ixtlán and San Juan Lachao (Alatorre et al., 2021). This section starts by describing the study communities, before outlining the research design and methods employed. In what follows, translated quotes and information obtained from the interviews and workshops is identified by each community's initials (LTI for La Trinidad Ixtlán and SJL for San Juan Lachao) and an informant (I) or workshop number (W).

### *5.3.1. Site descriptions*

The state of Oaxaca, in the south of Mexico, is regarded as a success story for community-based natural resource management worldwide (Martin et al., 2011). Its forests cover 64 percent of the state's 9.5 million hectares (INECC et al., 2018). Unlike the rest of the country, where communal lands exist mostly in the form of *ejidos*, land in Oaxaca is predominantly held by Indigenous *comunidades* (Figure 23), with about 30 percent of the state's population belonging to one of 16 different ethnic groups (Oviedo, 2002). The state also has a history of resistance to government overreach. In 1956, at the height of the concessions era, a public-private partnership with a Canadian paper company based in the neighbouring state of Veracruz gave rise to FAPATUX (*Fábrica de Papel de Tuxtepec*), which received the exclusive right to harvest roundwood from designated areas during 25 years in exchange for a stumpage fee paid to the communities who owned the forests (Merino-Pérez, 2004). FAPATUX operated mostly in the Sierra Norte region of Oaxaca (also called *Sierra de Juárez*), in 250 thousand hectares of pine forests across nine ethnically Zapotec communities, including La Trinidad Ixtlán (Merino-Pérez, 2004). It was also awarded important concessions in ethnically Chatino municipalities in the Sierra Sur and Costa regions during the 1970s, including San Juan Lachao (Emanuel & Greenberg, 2000). In 1980, when the 25-year concession was coming to an end, communities from the Sierra Norte formed an organization and called a labour strike against FAPATUX (Pérez Avendaño, 2017). In 1982, then president José López Portillo issued a decree that renewed the forest concessions indefinitely (Merino-Pérez, 2004); in response, the community organization took the government to court and won a legal protection that eventually led to the repeal of the presidential decree (Pérez Avendaño, 2017).

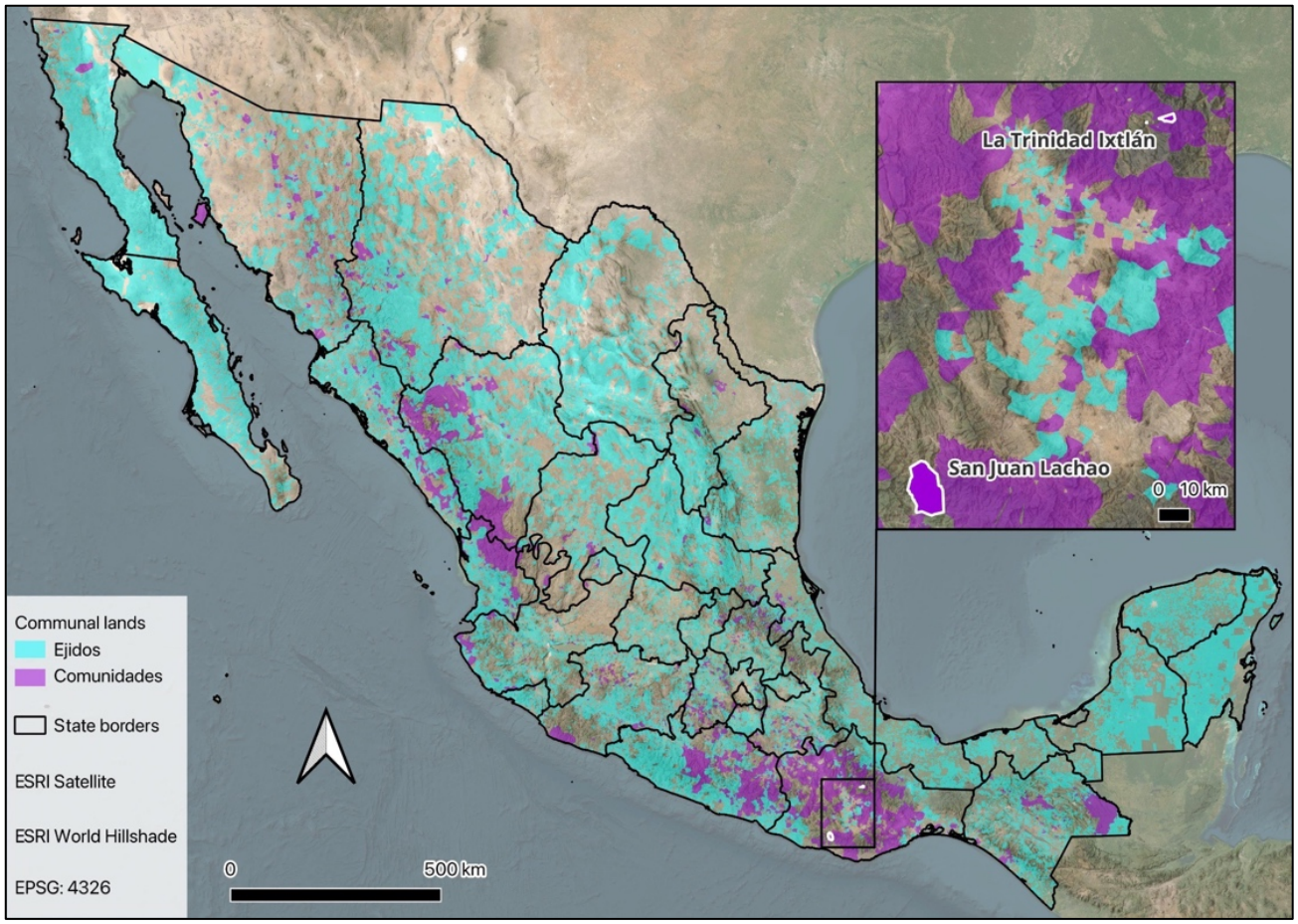


*Figure 23. Distribution of communal lands across Mexico. Oaxaca is home to the majority of Indigenous comunidades, including the two study sites: La Trinidad Ixtlán, in the Sierra Norte region, and San Juan Lachao, in the Costa region.*

#### 5.3.1.1. La Trinidad Ixtlán

Despite its relatively small size of just under 800 ha, the mountain community of La Trinidad Ixtlán has long been a regional leader when it comes to forest management. It is an Indigenous community located within the municipality of Santiago Xiacuí: its 754 inhabitants are mostly Zapotec descendants, although very few still speak the language. It was one of the first to join ODRENASIJ and to stage a work stoppage in protest against FAPATUX (Pérez Avendaño, 2017). Starting in 1984, the communities with the "greatest forestry potential" (Merino-Pérez, 2004, p. 189), including La Trinidad, sought to undertake their own forest management (Merino-Pérez, 2004). It was during this year that the first forestry unit in La Trinidad was founded, the direct predecessor of the community enterprises that today extract and process the community's timber products. When the 1986 Forestry Law came into force, the forestry concession system was officially ended and the right of communities to directly use their forests under comprehensive forestry management plans was recognized for the first time

(Merino-Pérez, 2004). As a result, in 1989, La Trinidad Ixtlán joined together with four neighbouring communities to secure their own technical forestry services, forming the Union of Zapotec-Chinantec Forest Producing Communities of the Sierra Juarez (UZACHI) with significant technical assistance and support from a regional NGO, ERA (Estudios Rurales y Asesoría Campesina).

While the community has now separated from UZACHI, the more than three decades of membership saw forest management grow almost exponentially, from an initial timber authorization of 2,500 $m^3$ in 1993 to a fourth authorization of 8,000 $m^3$ in 2023 (LTI-I42). At the same time, capacities within the community also increased significantly, as they learnt through UZACHI everything from cutting and loading wood to accounting and administration (LTI-I11, LTI-I14, LTI-I39). Community members' previous experience working for FAPATUX and a community sawmill called IXCASIT that was located in a neighbouring community and supplied the paper company in the 70s and 80s (Pérez Avendaño, 2017) meant that they were able to rapidly move towards vertical integration, purchasing the first sawmill machinery around 1995 (LTI-I32, LTI-I34). The community currently runs four CFEs: commercial logging, a sawmill, ecotourism cabins and guided tours, and charcoal production (Figure 24). It has also participated in a matching funds PES programme and has sold forest-based carbon offsets in the national (since 2008) and international (since 2019) voluntary markets (Haya et al., 2025).

Like many communities in Mexico, land in La Trinidad Ixtlán is held under a mixture of private and communal ownership under three distinct land-use types: urban, agricultural, and forest. Nearly 300 of the 754 inhabitants of La Trinidad are official rightsholders or *comuneros*. Families own their homes and agricultural parcels near the village regardless of people's statutes as rightsholders, and these private plots get passed down and subdivided across generations. However, they are still subject to community rules, and people are prohibited from selling them to outsiders. Their communal land is split into two polygons, with a small patch of land in a humid ravine that they call *tierra caliente*, and the larger pine-oak forested area they refer to simply as *el monte* (Figure 25).




*Figure 24. Like other Sierra Norte communities, La Trinidad Ixtlán has diversified its community forest enterprises and vertically integrated in the timber market. They collectively manage: a commercial logging enterprise, including growing their own saplings in greenhouses (top left); a sawmill (top right); an ecotourism venture with a zipline, cabins, and guided tours (bottom left); and charcoal ovens where they process leftover oak wood (bottom right). Credit: Andrea Alatorre, Elizabeth Shapiro-Garza.*

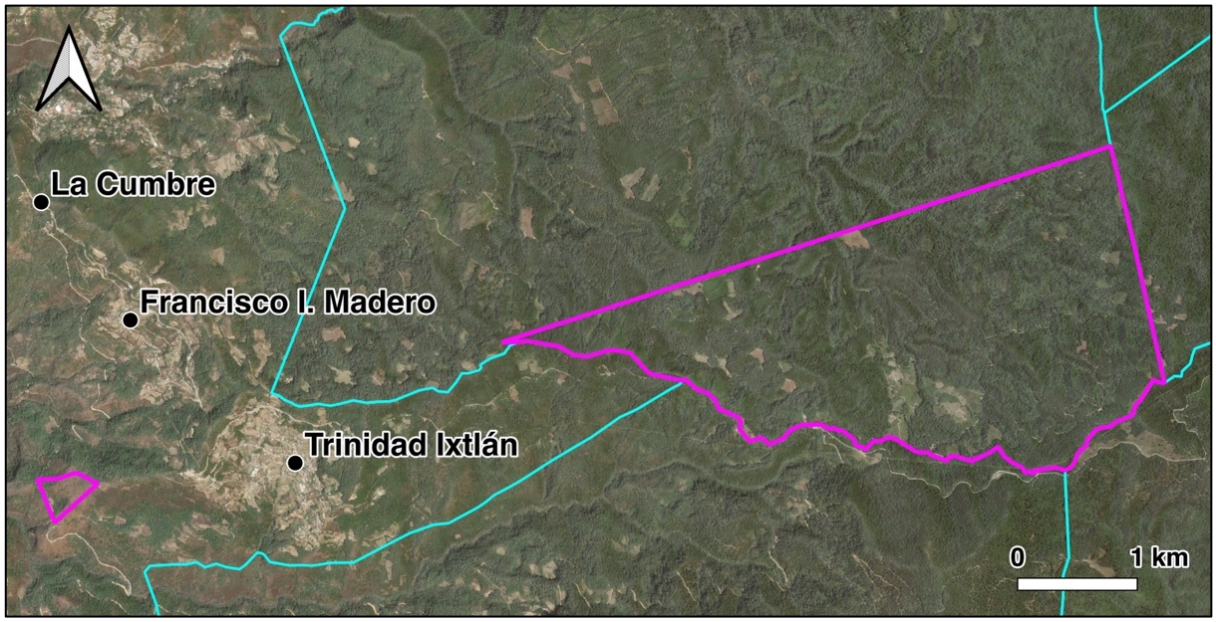


*Figure 25. Location of the communal territory (pink polygon) and town of La Trinidad Ixtlán, and its neighbours' boundaries (blue polygons). The area in and around the town, between the two communal polygons, is held under private ownership by community members, while still*

*subject to rules around ownership including the prohibition to sell land to those external from the community.*

#### 5.3.1.2. San Juan Lachao

In contrast to the smaller territory of La Trinidad, nestled in the Sierra Norte mountains, San Juan Lachao has a sprawling territory of more than 13 thousand hectares, encompassing an altitudinal range from 500 to 2,300 MASL. It is located in the Costa region, bordering the Sierra Sur, in an optimal site for coffee production. Some of the first coffee *fincas* in Oaxaca were established within Lachao's territory towards the end of the 19th century, and this crop was the main economic activity for decades (Morales Becerra & Mondragón, 2021; Traffano, 2019). Here, Indigenous Chatinos who still speak the language, a subgroup of Zapotec languages that are part of the Otomanguean family of dialects in south-central Mexico (McIntosh, 2015), share their ancestral lands with more recent mestizo settlers. Its approximately 4,500 inhabitants are spread out across the vast territory, with most people living in the main town of San Juan Lachao Pueblo Nuevo in the lowlands and the rest in smaller localities, some with only a handful of families (Figure 26). There is a stark spatial divide in terms of ethnicity, with most Chatino inhabitants living in the highland towns of Santa María Rancho Nuevo, El Ocote, La Ciénega and San Juan Lachao Pueblo Viejo, while the mestizo families now occupy the more fertile grounds in the lowlands, after having displaced the Chatinos and taken ownership of these parts of the territory (Traffano, 2019; SJL-I5, SJL-I10, SJL-I13, SJL-I35, SJL-W2).

In San Juan Lachao, as in other communities in the region, power dynamics between native Chatinos and the mestizo arrivals from the Central Valleys affected all aspects of community governance, including forest management. By law, *comisariados* should be made up of registered community members, but given that very few Chatinos were bilingual and even fewer were literate, mestizos dominated all positions of authority; this allowed them to enter into agreements with logging companies without the consent or knowledge of their Chatino neighbours (Emanuel & Greenberg, 2000). When the 1986 Forestry Law came into effect, it officially ended the system of concessions and acknowledged for the first time communities' rights to use and manage their own forests under sustainable management plans (Merino-Pérez, 2004). However, the law did not have a significant impact in the region, given that very few communities had access to technical services (Emanuel & Greenberg, 2000). In the 1990s, *comisariados* in Lachao sought to hire a forestry technician on a low budget and ended up with a deficient service provider who ignored best practices for soil conservation and wildfire

prevention. According to Emanuel and Greenberg (2000), this contributed to the devastation that occurred in 1998, when a wildfire ripped through the territory of Lachao, finding ample fuel from the outcome of hurricane Paulina the previous year.

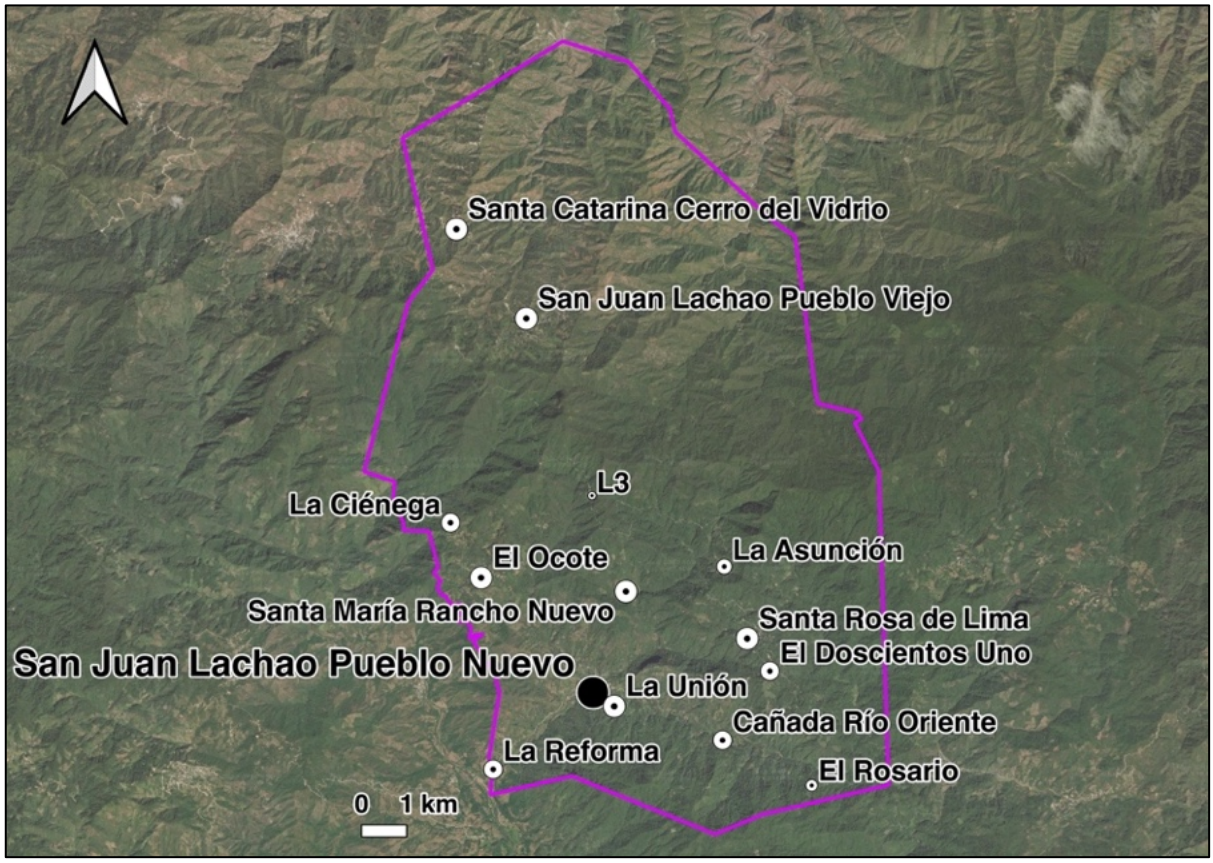


*Figure 26. The community and municipality of San Juan Lachao is spread across more than 13,000 hectares, encompassing an ecosystem gradient ranging from tropical wet forest to cloud forest. Most of its people live in the main town of San Juan Lachao Pueblo Nuevo, in the lowlands, while the rest are in small localities.*

In their own words, forest management was conducted in an unarticulated and unplanned way until the arrival of ICICO in 2008. A chance encounter with the technical director at the time led to a decade of rapid change in Lachao, beginning with its participation in a hydrological PES programme (SJL-I6, I7, I19, I20, I21, I24, W1, W2). The income from the PES scheme, together with the participatory planning processes implemented by ICICO, allowed the community to embark on a series of studies and eventually establish its first CFEs. In fact, in 2014 Lachao became the first pilot community when ICICO was developing the Mexican FBCO protocol with the Climate Action Reserve (Haya et al., 2025; Osborne & Shapiro-Garza, 2018a). By 2017, the community was simultaneously undertaking: commercial logging, an

FBCO project, PES, a water bottling plant, ecotourism (cabins and ziplines), a biodiversity conservation project, a wildlife management unit, and biodiversity monitoring (Figure 27).




*Figure 27. At the peak of its participation in forest activities, San Juan Lachao was collectively managing eight distinct programmes and projects, as proudly displayed in their training centre in 2018 (left); these included an ecotourism venture (top right) and a water bottling plant (bottom right), which were still operational in 2023. Credit: Andrea Alatorre, Rodrigo Gutiérrez.*

### *5.3.2. Research design and methods*

This study employed qualitative methods including semi-structured interviews, focus groups and participant observation within a participatory research framework (Álvarez Larrain et al., 2022; Black & Chambers, 2019) to describe and explore the challenges that community governance bodies have faced at different points in time and in different parts of their territories with regards to their forest enterprises, and what strategies they develop to jell their traditional institutions with formal rules and regulations. Research is participatory when data is collected and used for purposes that are defined by the community to serve community desires and interests, and this is done in an inclusive, equitable and non-discriminatory manner, by or in conjunction with community members, and remains under the community's ownership and control (Biangalen-Magata et al., 2015; FPP, 2017)[23]. In this case, in its role as a representative of its member communities, ICICO acted as a liaison and consultant during the research design. Conversations were held with ICICO's technical services team to jointly determine where the

[23] Section 2.3.3.1 explains participatory methods and community-engaged research in detail.

research would take place, based the author's previous work in the region (Alatorre et al., 2021) and ICICO staff's knowledge of community dynamics. La Trinidad Ixtlán was selected as an example of a community with long-term forest enterprises where the jelling process has been happening since the 1990s, while San Juan Lachao was selected as a case where the jelling process is ongoing and the outcomes of misalignments are evident.

Initial planning meetings took place in March 2023 with the *comisariados* of La Trinidad Ixtlán and San Juan Lachao, where the proposed research was presented. During these meetings, the intersections between research objectives and communities' concerns were discussed, and appropriate deliverables and data sharing mechanisms were established. Based on *comisariados'* interest in tools for intergenerational knowledge sharing, the author agreed to film field visits and interviews (with consent) and produce a short video documentary about the history of each community and their forests, to complement a written report and public presentations. A written expression of support was provided by the *comisariados* of both communities. A dynamic consent process was implemented throughout (Black & Chambers, 2019), which involves asking participants to consider their agreement to participate at each stage (before interviews and before each stage of the workshops).

Fieldwork was conducted during July and August 2023. All data collection was done in Spanish, a language that all participants spoke and understood. Semi-structured interviews were conducted with individuals and small groups with varying involvement in forest governance and knowledge about the community's history of forest management, including current and former leaders and foresters but also women, youth, elders and non-native Spanish speakers (Table 8)[24]. Seeking to include all groups within a community, some of whom may not have equal access to decision-making as a result of internal community dynamics, is considered an essential component of participatory research (FPP, 2017). Interviewing is a widely implemented tool for obtaining qualitative data (Denzin & Lincoln, 1994). In particular, semi-structured interviews place the interviewee (or interviewees) as a participant in a guided conversation organized around a series of predetermined open-ended questions, with the possibility that more questions will emerge during the dialog (DiCicco-Bloom & Crabtree, 2006). Interviewee selection was based on finding the people, known as key informants, who

[24] More details about semi-structured interviews can be found in Section 2.3.3.2.

were able to provide the desired information (Tremblay, 1957) based on their accessibility, knowledge and social position (DiCicco-Bloom & Crabtree, 2006).

*Table 8. Description of the semi-structured interviews conducted in each community.*

| | Interviewee characteristics | | | | |
|---|---|---|---|---|---|
| **Community** | **Sex** | **Age** | **Main occupations** | **Involvement in governance*** | **Total number of interviewees** |
| La Trinidad Ixtlán | Male: 23<br>Female: 21 | < 50: 14<br>> 50: 30 | Trades or small businesses: 16<br>Agriculture: 9<br>Forestry: 5<br>Homemaking: 5 | Communal leadership: 16<br>Municipal government: 16<br>Committees: 15 | 44 |
| San Juan Lachao | Male: 22<br>Female: 15 | < 50: 10<br>> 50: 27 | Coffee: 11<br>Trades or small businesses: 8<br>Other agriculture: 5<br>Cattle: 4 | Communal leadership: 10<br>Municipal government: 22<br>Committees: 11 | 37 |

* Not mutually exclusive

The interview guide was designed after the initial planning meetings and was approved by the ethics committee at the Université du Québec en Outaouais[25]. It contained three main sections, comprised of a series of questions about: the interviewee's origins and their history of participation in community governance; the history of the community and its forest enterprises, including which programmes and activities they are aware of, how decisions are made, and who participates in different decision-making processes; and the future that the interviewee desires for the community and what obstacles they may face. Interviews were usually conducted in people's homes or workplaces, and they lasted around one hour. In La Trinidad Ixtlán, most interviews were conducted in the town (n=41), with additional interviews in the ecotourism centre and sawmill; in San Juan Lachao, although the majority of interviewees lived in the main town of Pueblo Nuevo (n=18), care was taken to interview people from across the territory to capture a wide range of experiences, including Santa Rosa (n=5), Rancho Nuevo (n=4), Río Oriente (n=3), El Ocote (n=3) and Lachao Viejo (n=2). Interviews were audio recorded when consent was given, and interviewees interested in participating in the video documentary were also filmed. At the end of each interview, participants were invited to attend one of the two planned participatory workshops.

[25] The full interview guide is in Appendix II.

Participatory visual methods involve individuals or groups taking part in the production of creative outputs that are used to convey their knowledge, experience, opinions, and ideas (Black & Chambers, 2019). Two different techniques were employed[26]: timeline focus groups (Adriansen, 2012; Tolentino et al., 2015) and participatory mapping (Álvarez Larrain et al., 2022; Appel et al., 2012; Chambers, 2006). In preparation for these group activities, important events related to forest governance were extracted from interview notes at the end of each day. These included the moments when different CFEs were established or when programmes or projects started, the community governance bodies that were involved in each process, and any accompanying changes to internal institutions. A list of the governance bodies and traditional institutions considered in the analysis, as well as the different forest enterprises and programmes that communities participate in, is presented in Table 9. These data were then arranged into a preliminary timeline.

*Table 9. Governance bodies and their traditional institutions, as well as forest enterprises and programs and their formal institutions.*

| **Community governance body** | **Traditional institutions** | **Forest enterprises and programmes** | **Formal institutions** |
|---|---|---|---|
| Assembly | Key decisions related to all aspects of community life are made by consensus or majority vote | Commercial logging | A certified forestry technician must develop a sustainable forest management plan |
| | All villagers may attend but only rightsholders have a voice and a vote | | The Ministry of the Environment must approve the plan and any renewals or modifications |
| Comisariado | 3-person committee (plus deputies) represents the community in official processes | Sawmill | The Ministry of Finance collects taxes<br>The National Forestry Commission provides training and verification<br>The Ministry of Finance collects taxes |
| | Can bring proposals to the assembly but does not make decisions over communal matters | Ecotourism | The Ministry of Tourism must certify facilities and provides training and verification |
| | Oversees all aspects of natural resource management and reports to the assembly | | |
| Oversight council | 3-person committee (plus deputies) oversees all expenditures and activities undertaken by the comisariado | Water bottling plant | The National Water Commission regulates water extraction<br>The Ministry of Health regulates sanitation |
| | Monitors the communal territory to detect conflicts or invasions | | |
| *Cargos* (service positions) | Rightsholders are assigned to service positions by the assembly that they must mandatorily fulfil or pay someone else to take their place | Payments for ecosystem services (PES) | The National Forestry Commission sets rules of eligibility and required activities |
| | Usually unsalaried | Forest-based carbon offsets (FBCO) | The Climate Action Reserve sets protocols for project development and implementation including improved forest management activities |
| | Cargos follow a hierarchical structure with young people starting at the bottom and earning their way to the top, which are positions in the comisariado and municipal governments | | |

[26] These participatory visual methods are described in more detail in Section 2.3.3.3.

| | |
|---|---|
| *Tequios* (community work) | *Tequios* are convened whenever labour-intensive public service tasks are required, e.g. paving and maintaining roads |

During two workshops, one at the middle and one at the end of the stay, invited participants discussed and modified the timelines presented, with the goal of reflecting about the changes that have taken place in the community, and the internal governance processes that led to or resulted from each important transition (Figure 28). Based on the methodology developed by Álvarez Larrain et al. (2022), a printed aerial image of each community from the year 1995 was presented, and participants were invited to use markers to spatially depict the events from the timeline. The objective was not geographic accuracy, but rather to elicit further discussions during the map-making process (Emmel, 2008). Finally, a recent satellite image from 2023 showing the same area was unveiled, which prompted reflections about the extent of changes within this most recent history. Refreshments were provided during each workshop and best practices were implemented to help make participants feel at ease (Appel et al., 2012; Black & Chambers, 2019). Workshops were audio recorded, and pictures and notes were taken throughout the process.

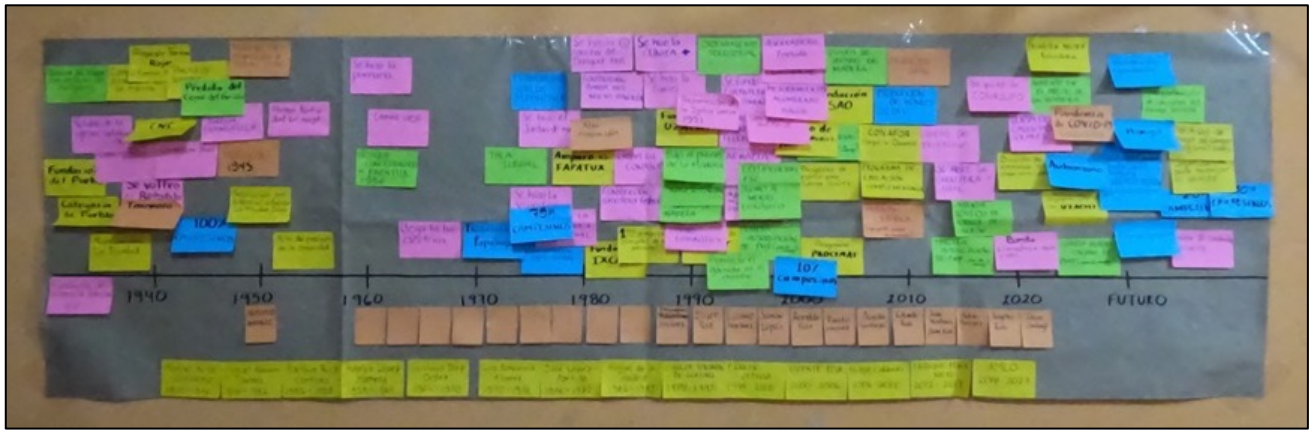




*Figure 28. Timelines constructed from individual interview data and focus group workshops in La Trinidad Ixtlán (top) and San Juan Lachao (bottom). Credit: Andrea Alatorre, Jimena Deschamps-Lomelí.*

All audio files were converted to text using a semi-automatic transcription method (Braußе et al., 2022) through which the author corrected the outputs generated by Open AI's Whisper Large model (Spiller et al., 2023). This method has been found to reduce manual transcription time by a factor of three to six, depending on noise levels (Braußе et al., 2022). The Whisper model was chosen because it runs on the researcher's computer, therefore data privacy issues arising within many other solutions do not apply (Tolle et al., 2023). Thematic analysis was carried out under a grounded theory approach, which emphasizes the generation of theories that are directly derived from the data itself (Charmaz, 2006). This is done by inductively deriving categories, themes, and patterns (Bryant & Charmaz, 2010) through an iterative process of development and refining at successive levels of detail (Snilstveit et al., 2012). This involved a process of noting recurring themes, which began while cleaning and transcribing interview notes at the end of each day during fieldwork. Later, all interview and workshop transcripts and notes were uploaded to the qualitative analysis software NVivo 14 and coded through thematic analysis (Boyatzis, 1998; Graneheim & Lundman, 2004). High-level codes were developed as markers for the main themes, followed by a process of lumping, splitting, or more precisely defining the different codes in an iterative process until they formed a coherent conceptual set (Boyatzis, 1998; Snilstveit et al., 2012). Robustness and replicability in thematic analyses are determined by whether the codes are applied consistently (Boyatzis, 1998). In this case, given that the coding was done by a single researcher, consistency can be considered to be high, although it may fall short on replicability.

In line with the commitment to share results in a timely and appropriate matter, and following best practices for participatory research (Álvarez Larrain et al., 2022; Black & Chambers, 2019;

Chambers, 2006), the printed aerial and satellite images remained with the community and the contents of the timelines and maps were digitized and shared. The author also delivered written reports, presented findings on numerous occasions, was interviewed in a local radio station, and organized a public viewing of the short video documentaries in November 2024.

### 5.4. Misalignments between traditional and formal institutions and values

Over the past four decades, the people of La Trinidad Ixtlán and San Juan Lachao have worked to diversify their forest-based livelihoods by collectively implementing, at different points in time: ecotourism ventures, wildlife management units, water bottling plants, timber authorizations, a sawmill, charcoal production and mushroom cultivation. They have also participated in PES and FBCOs, as well as multiple forestry training and funding programmes. These CFEs have generated income at the household and community level, while imposing new financial and labour considerations that have significantly transformed their governance strategies for collective action around the forest commons. This section describes the main misalignments faced by La Trinidad Ixtlán and San Juan Lachao as part of these emerging interactions, as identified through thematic analysis. Section 5.5 then describes the strategies that the two communities have put in place to generate new, jelled or quasi-jelled institutions and values for forest governance, as well as the perceived outcomes of these strategies. Here, an unjelled traditional institution is defined as a rule set in place by a community through the exercise of their legal rights for self-governance that is perceived to be incompatible with the formal rules and regulations of the forest enterprises and programmes that the community interacts with. Accordingly, a quasi-jelled arrangement is one where formal and traditional rules are partly perceived to be compatible but where some trade-offs remain in place, while a jelled arrangement is where either preexisting rules are perceived to be fully or mostly compatible with the requirements and expectations of programmes and policies or rules are added or modified to fulfil these requirements.

#### *5.4.1. Institutions for collective action*

The very fact that these communities are governed through a system of unpaid, mandatory community service is at odds with how conventional enterprises are usually run, which can lead to inefficiencies and tension (Antinori & Bray, 2005; Engbring & Hajjar, 2022). As one former forester from Lachao explained, the *comisariados* "*are not elected because of their profile, if you get there and they give you an enterprise to manage, you will not be able to make it work because you lack the know-how*" (SJL-I7). The more CFEs a community pursues, the

more pressure is put on the *comisariado*, who must come in and assume all aspects of their management, according to a former leader in Lachao: "*all projects are good, but you need to know how to administer them so that they move forward, you need to follow up. Now the projects are suspended, and I assure you that 90% is due to poor administration, because we don't all work hard enough*" (SJL-I22). Even in La Trinidad, where forestry is well established, elected individuals' capacities and motivations end up having a big impact: "*sometimes one person works really hard, sometimes another doesn't, and we will advance with regards to the forest depending on if we get the one or the other*" (LTI-W2). In the worst-case scenario, an incompetent or corrupt *comisariado* can jeopardise important sources of income and employment. In Lachao, the appointment of a *comisariado* president who mismanaged FBCO and PES funds was a big contributor to the assembly's decision to suspend the forest management plan: "*The people lost trust, how can we now recover, make them believe again? It is costing us dearly, having appointed that person*" (SJL-I6). Of course, mismanagement can also occur in for-profit, private enterprises, particularly when there is a lack of effective, credible and legitimate controls on management (Antinori & Bray, 2005).

Beyond the *comisariado*, key leadership positions in all CFEs in both communities are also assigned by the assembly and last for one or two years. This means that there is a big learning curve when a new team is assigned to a supervisory role. Both the supervisors of the sawmill and of the ecotourism committee in La Trinidad felt that they were gaining expertise and becoming comfortable in their roles just as their appointments were due to end (LTI-I21, I44, I45). Reflecting on his own lack of experience when he was appointed, a retired farmer from La Trinidad said "*someone came and told me, […] 'how is it possible that you are just a farmer and you are here?' Well, those are our customs, they named me as a delegate, and here I am every month attending meetings*" (LTI-I12). Furthermore, whenever someone is assigned to a position, they must either leave their normal job or find (and often pay) someone else to take their place, which means that employees earning wages through CFEs often have to ask for time off to fulfil their community commitments, as explained by a former member of the *comisariado* in Lachao: "*being in the comisariado is a very difficult situation because it limits you greatly. You neglect your family, neglect your home, if you have a job you neglect it as well to carry out your duties*" (SJL-I24).

Reflecting on the reasons behind the failure of the forest management plan in Lachao, a young man who was working as a forestry technician before the suspension said: "*the only way that*

*this can work is to establish enterprises that are independent of the comisariado […] with a manager and technicians who are held accountable and are paid in line with their performance […] not as an unpaid position, you will hire an expert who will deliver results and get paid*" (SJL-I7). A former leader agreed, saying that "*the comisariado became saturated with too many projects*" (SJL-I6). This proposal would resemble the structure of CFEs in the Sierra Norte community association known as Pueblos Mancomunados, which employs a full-time manager position (Engbring & Hajjar, 2021). A similar idea was being considered in La Trinidad at the time the fieldwork took place. A forestry engineer who was serving in the *comisariado* reflected on the fact that, even though they technically have logging and sawmill enterprises, there are significant inefficiencies linked to the fact that they are run and operated by the community, including the fact that people do not need to ask for time off to attend events such as graduations or weddings (LTI-I46). However, he and the current sawmill supervisors all acknowledged that they already struggle to recruit enough workers (LTI-I44, I45), and implementing more restrictions may further complicate things.

One final observation related to institutional misalignments is the fact that community members that are assigned leadership positions in the *comisariado* and oversight council must then become the enforcers of the rules of the programmes and projects the community is participating in. This can create resentment amongst their fellow community members. In Lachao, for example, one farmer questioned the decision to regulate the extraction of water from the river for irrigation, as part of the PES programme goals of greening the riverbanks: "*I don't agree with why the oversight council is fighting those that take water from the river. For whom do they fight? That water is just going downstream for the people in Nopala to grab it, when we used to use it for farming*" (SJL-I10). According to their internal rules, people in Lachao need to request a permit to extract water for irrigation or cut down a tree for personal use, and they need to pay a fee which contributes to finance the operations of the *comisariado*. Some interviewees directly linked the onset of these rules to the forest programmes, since their community statutes were updated during the planning process for the FBCO project (SJL-I10, I11, I28, I34). A few people strongly disagree with these rules, and one older Chatino man linked it to the issue of unpaid community service, saying that while you are fulfilling an unpaid appointment it can be impossible to pay these fees since you are not earning any income (SJL-I33). This resentment also contributed to the discontent around forest management: "*the people said, 'you forbid me from cutting down a tree, we also forbid you as comisariado from selling timber. No more*.'" (SJL-I11)

### *5.4.2. De facto private use of the forest commons*

In La Trinidad Ixtlán, farmers relied on cattle for ploughing the land. Along with neighbouring communities they kept their cattle in the adjoining forest, relying on unwritten rules that governed the use of the commons, as one farmer and former *comisariado* member explained: "*We used to ask each other, if you find my cattle, let me know, and they would tell you where they found it. It was a communication that we had*" (LTI-I29). When they and other neighbouring communities began implementing reforestations as part of their first forest management plans around 1990, they realized they could no longer keep the cattle in the forest as they eat and trample on the saplings. As a retired state government employee from La Trinidad put it: "*The hardest change was when we decided, when the assembly agreed that we would gather the cattle*" (LTI-I33). Today, very few people in La Trinidad have cattle for ploughing, as they either have to keep them on their own, relatively small private plots, or rent someone else's plot.

In Lachao, the misalignments between community members' uses of the commons and the assumptions and requirements of the projects they implemented were so severe that they eventually led to the suspension of the forest management plan. Understanding the reasons for this decision taken by the assembly in 2017 was a big focus of my research, and the motives are many and highly complex. But a key component was the tension between de facto and de jure tenure of the forest commons (SJL-I6, I8, I19, I20, I24). According to the 1992 Agrarian Law, forested lands are common use areas, and decisions about these territories must be made by the assembly (Barnes, 2009; Valsecchi, 2014). However, families often hold de-fact ownership of plots of land within the forest commons. In the case of Lachao, many families have grown coffee in the forest commons for generations. In the words of a former community leader: "*We start with the premise that pine trees in essence are common property, regardless of where you have a plot that you use. With this understanding, all the areas where pines are produced, from approximately 800 meters upwards, are susceptible to being harvested by the community. However, on a big part of that land, at least until 1200 or 1300 meters, there are plots with coffee orchards. So, coffee and pine trees overlap*." (SJL-I20) Because the de facto private plots were not officially acknowledged, when the forest management plan was designed and approved it encompassed most of the altitudinal range of pine trees.

### *5.4.3. Value misalignments*

At issue was also a deeper misalignment in terms of the values that people hold for the land and the forest. In the case of La Trinidad, the disappearance of cattle from the community is directly linked to the loss of the campesino lifestyle, which is a common sentiment especially amongst older interviewees. This has worked out well economically for the community, since they have received significant income from their CFEs, as one older woman notes: "*Now it's true that there is work in the forest, sowing wood, chopping firewood, who knows that else. But that benefits us all, because that generates more economy here in the village*" (LTI-I2). Meanwhile, the value of agricultural products has plummeted. However, some older community members feel nostalgic about their lost landscape and lifestyle, referring to the old agricultural landscape as "*beautiful*" (LTI-W2; Figure 29), revealing significant value misalignments.



*Figure 29. In La Trinidad Ixtlán there is a commonly perceived misalignment between the traditional agricultural lifestyle and the more recent forest-based economy: "It was a very good time as well, it looked so beautiful, full of corn, full of cattle, full of all that. And now… well, the forest is also beautiful, right?" (LTI-W2). Similar statements were made during field visits (left) and participatory mapping workshops (right). Credit: Andrea Alatorre, Jimena Deschamps-Lomelí.*

Many in Lachao, particularly Chatinos and their descendants, expressed discomfort and even horror at the thought of cutting down or extracting resources from trees as part of a forest management plan. A young biologist with Chatino ancestry who was involved in biodiversity monitoring projects during the period when forest management was in place recalled that "*an engineer once presented a project to extract resin from the pine trees, but people here said, how are you going to hurt a tree like that? They consider it a kind of mistreatment, torture for the trees.*" (SJL-I21) Other interviewees with Chatino roots reiterated the importance of taking care of the forest, including an older Chatino man who said "*if we take advantage of being in*

*a leadership role and we go and extract everything, what will we tell our children, our grandchildren? There will be no more water, there will be nothing left*" (SJL-I12). Some people directly linked this aversion to cutting trees to the trauma of having had their forests devastated after around a decade of exploitation by FAPATUX in the 1970s. A man who presided over the *comisariado* when the forest management plan was being developed said that he encountered opposition from the beginning: "*Some people were very negative, they said to me, 'how can we authorize something like that? If when FAPATUX was working here, they destroyed the whole forest. Now you are planning to do the same'*" (SJL-I19). When it comes to the community's vast forests, a big part of the debate in Lachao is whether they are worth more standing or as marketable products.

### 5.5. Communities' strategies for alignment

In both communities, the encounter between traditional and formal institutions and values for forest management has led communities to develop a series of adaptations and strategies for alignment, which have resulted in a series of jelled or quasi-jelled institutions and values. These are summarized in Table 10 and described in detail below. Over time, as these new or adapted rules get incorporated into communities' statutes (internal rules), they are considered formal institutions by Mexico's legal framework. However, in this work I rely on the perspectives of interviewees and workshop participants regarding what rules and values predate the implementation of CFEs and other programmes and projects (which are considered traditional), and which ones were developed in response to this implementation (which I consider as jelled or quasi-jelled institutional arrangements).

*Table 10. Tracing the community characteristics and traditional institutions and values that communities rely on for natural resource management, the formal institutions and values they come into contact with in the course of their participation in forest programmes, projects and policies, and the jelled institutions and values that can result from these encounters. Observations apply to both communities except when specified.*

| Community characteristics | Traditional institutions or values | Formal institutions or values | Jelled institutions or values |
|---|---|---|---|
| **Governance bodies** | | | |
| Assembly | Key decisions related to all aspects of community life are made by the assembly | Forest management and conservation programme participation, annual progress reports and expenditures must be | Key responsibilities related to programmes and projects are delegated to CFE authorities, themselves |

| | | | |
|---|---|---|---|
| | All villagers may attend but only rightsholders have a voice and a vote | approved by the assembly | elected by the assembly (LTI)<br>Non-rightsholders are invited to neighbourhood meetings for project planning and assemblies (SJL) |
| *Comisariado* | The *comisariado* must oversee all aspects of natural resource management and reports to the assembly<br>*Comisariado* members are not required to have particular skills and know-how for forestry or associated administrative procedures | The comisariado must sign off on all administrative procedures related to forest enterprises and programmes<br>Women are required to participate in leadership positions to get access to PES and other CONAFOR funds | The assembly designates new service positions (*cargos*) in the logging and sawmill enterprises that report directly to the comisariado<br>Monetary compensation for full-time positions including the president of the comisariado and CFE authorities is provided in recognition of increased workload (LTI)<br>Young people are supported by the community to continue their studies in preparation for key *comisariado* or CFE positions when they return (LTI)<br>Women are elected to leadership positions in the *comisariado* (SJL) |
| *Cargos* (service positions) | Mandatory service positions assigned to specific tasks that are unpaid and hierarchical<br>Related to all aspects of community everyday life with no specific skills required<br>Only rightsholders, who tend to be men, are assigned *cargos* | Communities are required to fulfill significant administrative requirements for programme monitoring and fiscal compliance<br>Additional forest programmes and projects have their own reporting and labour requirements | New service positions are created within CFEs to fulfil requirements<br>Full-time positions as CFE authorities are provided monetary compensation (LTI)<br>Women are increasingly elected to low-level *cargos* to prepare them for leadership positions (LTI) |
| *Tequios* (community work) | *Tequios* are convened whenever labour-intensive public service tasks are required, e.g. paving and maintaining roads | Programmes and projects often require labour-intensive activities such as reforestations | Using *tequios* to fulfil forest management tasks |
| **Uses of the forest commons** | While technically communal, de-facto private property is common, with uses including grazing, agriculture and even | Biophysical characteristics are the main considerations for designing forest management plans | Prohibiting cattle grazing in the forest commons (LTI)<br>Redesigning the forest management plan to |

| | | | |
|---|---|---|---|
| | building houses or outposts | within common-use areas<br>Forest-based carbon offsets projects consider the entire communal territory to be the 'project area' | avoid 'possessions' by coffee growers (SJL) |
| **Values for the forest commons** | Non-forest agricultural lands are valued for their ability to provide food security and for their beauty<br>Standing forests are valued for their beauty and longevity which future generations can enjoy | Forests are valued for their timber, carbon sequestration, and hydrological regulation potential | Value of forests as community income sources reinforced through education and targeted investments of funds into basic infrastructure and parties |

### *5.5.1. Modifications to community governance bodies*

Throughout the decades that they have been involved with forest management, the people of La Trinidad Ixtlán have developed a series of strategies within the framework of their collective institutions to adapt to the requirements imposed by government agencies and organizations. As their CFEs began to grow and specialize, the community decided to appoint new service positions or cargos, including a coordinator of the logging unit, a chief of finances, a forestry chief and a bookkeeper (LTI-I14). Furthermore, they recently began offering financial compensation to those that get assigned to these positions, in recognition of the full-time nature of their commitments that prevent them from being employed elsewhere (LTI-I14). The president of the comisariado also began to receive compensation, which does not amount to a salary but is meant to allow them to support their families while they are not able to earn income.

Additionally, for many decades the people of La Trinidad have chosen to support young community members to continue their studies beyond high school, which is the highest level available within the community, by exempting them from service positions and participation in the assembly and in otherwise mandatory collective tasks while they are enrolled in higher education elsewhere (LTI-W1). The idea was for young people to become professionals and then return to the community to help in all aspects of community life. And while some believe that this has not worked out because "*many became teachers, they became professionals, all sorts, and they just left. They didn't even remember their community*" (LTI-W1), others see it as the mechanism that has enabled them to separate from UZACHI and undertake every aspect of forest management independently. The most recent forest management plan was developed

by someone who left to pursue his studies, obtaining bachelor, master and doctoral degrees in forestry. While he does not live in the community, many consider that he has given back in a big way by implementing his knowledge there, and use him as an example of the success of their strategy (LTI-I12, I14, I20, I34, I38).

Both communities have sought to increase women's participation in forest governance positions, which is a significant departure from the way most communities in Mexico traditionally operate (Engbring & Hajjar, 2021; Mitchell, 2006; Vázquez-García & Ortega-Ortega, 2017). In order to fulfil new requirements by the National Forestry Commission to include women in the *comisariado* and oversight council to improve their eligibility to receive PES funds, the assembly in Lachao began appointing women directly to these leadership roles (SJL-I24, I30). They also began inviting more women, regardless of land rights status, to attend the assemblies (SJL-I24). In the case of La Trinidad, women have begun to be appointed to other *cargos*, with the view that they will gain the necessary experience to fulfil leadership roles in the future (LTI-I12, I33). However, some interviewees expressed concern that this increased participation in community governance can represent a significant burden for women, given that they need to fulfil their cargos while still being responsible for household and caregiving tasks (LTI-I14, I17, I36; SJL-I30), as previously documented in other communities in Mexico engaging in forest management (Gómez Bonilla, 2017a) and more broadly (K. Brown & Fortnam, 2018).

At times, ICICO has played an active role in conflict resolution. In the case of Lachao, some ICICO staff explained that the carbon project was very close to their hearts since it had been the first pilot community in Mexico, and they were feeling the pressure to demonstrate the permanence of the project. Furthermore, the community risked being penalized if they failed to verify their FBCO project. The strategy that ICICO co-developed with the new *comisariado* involved planning a series of smaller meetings across the territory prior to the assembly to provide spaces for people to express their concerns and give detailed explanations and reassurances about the forest management plan and FBCO project. These were due to take place shortly after my last visit, in August 2025. Crucially, they were planning to provide Chatino translation for the more technical terminology during the meetings in the highland localities, which had been a key concern by many native Chatino speakers during the previous years, as stated during interviews and workshops (SJL-W1, I24, I33, I34) and as explored in depth by Barrera De La Torre in his thesis (Barrera De La Torre, 2021). This would be

facilitated by the fact that three members of the *comisariado* spoke the language. They were also planning to invite all community members to the meetings, not only the official rights holders, in line with new requirements by the Climate Action Reserve's Mexico Forest Protocol, Version 3.0, that information gets distributed beyond those who are able to attend assemblies (Climate Action Reserve, 2022) (SJL-I6, 2025). The *comisariado* was also considering a proposal by ICICO for the community to establish an official commercial logging enterprise, such as the one in La Trinidad Ixtlán and other ICICO communities.

The plan to carry out meetings throughout the territory seems like a simple and promising solution. However, it is not the first time that the authorities have attempted similar measures, as stated by a former member of the municipal government: "*We have done meetings by neighbourhoods, but I think that's not enough, the mechanism we are using is not enough because it doesn't reach everyone. We need to look for other ways of sharing information, of making sure it's coming across*" (SJL-I20). There is also another governance body that was called upon throughout the planning and implementation processes for the forest programmes and activities. Each locality within San Juan Lachao holds its own internal meetings and appoints a *jefe de barrio* or neighbourhood chief, who acts as a liaison between the locality and the *comisariado* and municipal governments in the main town of Pueblo Nuevo. These chiefs can be summoned for meetings with the idea that they will then transmit the information amongst their neighbours. Given the size of the community, this strategy can provide a more efficient means of communication beyond the assembly: "*We do it with the goal of having the assemblies be a bit more fluid, shorter, and to avoid the expense of trying to do many assemblies*" (SJL-W1). During the discussion in the first focus group workshop, many agreed that the neighbourhood chiefs often either failed to communicate the information they were given, or they deliberately presented a different version in order to rally their neighbours behind them in organized resistance.

Finally, while the case of Lachao is clearly an example of conflict exacerbated by participation in forest conservation and management programmes, it also demonstrates the strength of the assembly as a collective institution for decision-making. As the community moved from a highly unequal governance system to one that gave the power to the assembly – a process that occurred independently of the forest management transition and was mostly driven by anger at the unfair and at times violent status quo (SJL-I10) – they were looking to democratize decision-making. It seems like they succeeded. Many may disagree with the outcome, but the

fact is that the assembly worked as it was supposed to, by providing a forum for debate and for decisions to be questioned. When a small group of coffee producers that were impacted by the forest management plan explained their situation to the assembly, enough people were concerned that they voted to suspend it until these types of issues could be addressed (SJL-I6, I8, I19, I20, I24, I36, W1, W2). And after it was discovered that the *comisariado* was mismanaging funds, the assembly reacted rapidly and replaced the leadership after only 3 months (SJL-I22).

### *5.5.2. Modifying the use of the commons, or adapting the management plan?*

While the implementation of forest management plans revealed incompatibilities with previous uses of the forest commons in both La Trinidad and Lachao, the ways in which each community chose to address this issue were markedly different. In La Trinidad, the realization that allowing people to graze their cattle freely in the forest would jeopardize tree regeneration led the assembly to decide to ban free grazing and require cattle owners to gather their animals. This decision was made around 1990, while the community was developing their first management plan, which would be authorized in 1993. More than 30 years later, the outcomes of this decision are evident. On the one hand, forest management has grown steadily, with the latest authorization allowing more than three times the harvesting volume of the initial one (LTI-I42). On the other hand, cattle have all but disappeared from the community (LTI-I1, I11, I29, I33, I36, I41, W1, W2). This has direct implications for agricultural activities, as very few cattle were available for ploughing, and tractors do not work well due to the steepness of the terrain. One workshop participant summarized this perceived trade-off: "*if we had continued that way we would have income as well, because now cattle is worth a lot, and there used to be a lot of cattle. But we exchanged them for trees, and now… Now we're milking the trees*" (LTI-W2).

In San Juan Lachao, when they realized that forestry works were going to take place in their plots, coffee growers brought their concerns to the assembly and organised a small minority to vote to suspend the forest management plan (SJL-I6, I8, I19, I20, I24, I36, W1, W2). This happened in 2017. Furthermore, several workshop participants stated that some Chatino inhabitants of the highlands set fire to a part of the forest that had been included in the carbon offsets project in protest at being prevented from clearing the land to grow corn (SJL-W1). Many of those who had been in the *comisariado* when the forest projects were being developed shared the perception that some forest users were being ignorant and intransigent: "*Everything*

*is communal, but you get people who say, 'I put a wire fence there, so this is mine, if you're going to do work there you need to share the profits'. But it is the forest. So, sure, they own the wire, but they do not own the land*" (SJL-I19). However, an interesting reflection shared during one of the mapping workshops sheds light on the importance of examining the wider historical context: "*What would have happened if coffee production had never arrived to Lachao? What would our forests be like today? We would have slashed and burned everywhere. This forest you see today would be gone. Why? Because, like it or not, growing shade coffee allowed us to conserve part of the forest.*" (SJL-W2; Figure 30) Indeed, several interviewees and workshop participants stated that many of the people who had stopped growing coffee since the 1990s due to pests and diseases had transitioned to cattle ranching, replacing partly forested areas with grasslands (SJL-I1, I4, I20, I22, I29, I32, W1, W2). During the years that followed the suspension of the forest management plan, the community of Lachao worked with a forestry engineer to redesign it to account for longtime coffee plots, and they submitted it to the Ministry of the Environment for approval. By August 2025, the plan had been approved by the Ministry, and it was just missing the approval by the assembly. The new *comisariado* that began their role in September 2024 was motivated to reactivate forest management and was working closely with ICICO to develop communication strategies to increase the likelihood that the new plan would be approved, as described below.



*Figure 30. The Chatino community of San Juan Lachao has a long and complex history with coffee production, and it has been grown by large and smallholders in the vast forested landscape since around 1915. This is credited both with maintaining the forest in good condition, which enabled forest management to happen, and with leading to the disruption of forestry activities due to the spatial overlap between commercial pine species and shade coffee production in de-facto private plots within the forest commons. Credit: Andrea Alatorre, Jimena Deschamps-Lomelí.*

### *5.5.3. Coalescing around certain values for the forest*

In La Trinidad, one key factor that is perceived to have facilitated their interactions with forest programmes and activities is that the community as a whole is informed and relatively capable of taking over a variety of forest management tasks as community service or as CFE employees. Because of their small size, and the overarching importance of forest management as a source of income for the community, young adults are easily exposed to forest activities as they begin participating in assemblies and community service. For example, when ICICO began discussions with the community about implementing an FBCO project, this relatively complex and abstract proposition was more easily digested due to people's previous experiences: "*Perhaps initially we didn't understand the mechanism, but our people have long been involved and participating in service positions, so you learn things, and when the issue came to the assembly it was already acceptable*" (LTI-I34). In addition to community service, education practices have also been employed to build consensus around the values of the forest. Socialization starts early, as all schoolchildren are exposed to forest management through guided visits organized by the *comisariado* and talks by the local forestry technician (LTI-I22, I34). According to a local teacher and headmistress: "*the kids really like it, they have taken us to the greenhouse to explain how trees are grown and about the local species, they take us to see the reforestations and give talks about wildfires, that all helps a lot and builds awareness*" (LTI-I22).

Here, four decades of coalescence around forest management as the main economic activity has meant that most community informants perceive forestry and all related forest projects as the source of benefits such as infrastructure and support for culturally important parties. Thirty interviewees mentioned positive community-level outcomes of the income generated from forest management activities, mainly investment in public works and services (n=19) such as: building and maintaining roads and sidewalks (n=16); buying school infrastructure (n=15); buying supplies and equipment for the local clinic (n=5); and maintaining and improving churches and temples (n=4). This exchange with an older couple exemplifies a typical response when asking about changes in community life:

> LTI-I9: *Now the comisariado provides a lot of support, they give money for the parties, for the schools, the comisariado supports everything. That wasn't the case before. When I had to serve in the party committee, there wasn't any money, once I even had to sell a cow to have enough, remember?*
> LTI-I8: *Now, thank God, a lot of support comes from the comisariado.*

LTI-I9: *Yes, everyone, every committee, where do we get funds? With the comisariado. The comisariado is like their bank.*
Interviewer: *And where does that money come from, that the comisariado then distributes?*
LTI-I8: *Where does the money come from, she asks… Well, from the forest. From the forest. From the wood, that's where they get the funds so that everyone has enough and can keep going.*

The fact that there are so many tangible benefits from CFEs, PES and FBCOs in La Trinidad has clearly helped construct a shared vision for the role of forest management in building community prosperity. This strategy is particularly important in the context of Oaxaca, and most of Mexico, where the government mostly fails to provide basic infrastructure and services, particularly in more remote areas. As a bread maker who has served in many CFE positions explained: "*You can see for yourselves, about 90% of the community streets are paved with hydraulic pavement, we have draining, public lighting, maybe you'll get to see the auditorium, the sports courts… That is all the infrastructure we have generated from our forest enterprises. If we sat here waiting for the government to get to us, we would be highly marginalized, we would be some 20 years behind*" (LTI-I34).

In Lachao, community natural resource management is a very recent paradigm. As shown in the previous sections, the community was not institutionally set up to fulfil the requirements of all the programmes and activities they undertook in a very short period of time, as they had previously outsourced forest management to private companies and decision-making power was concentrated around a few individuals. When ICICO began developing projects in Lachao, they provided capacity building by training a group of young people in all aspects of project implementation and monitoring: "*We were blind. We knew nothing. Nothing at all. Then the engineer from ICICO gets here, and he starts training people, because even that is a part of the programme, training people*" (SJL-I7). These people then went on to form the forest brigade, as they called it, a group of mostly young people employed in diverse aspects of forest work. This strategy of generating local capacities and employment was hugely successful for a short period of time: "*Things were great for a while when we were working the forest. There was a lot of employment, a lot, there were many programmes and practically everyone had a job right here and was content. There was no need to leave*" (SJL-I36). Women also received training in forest management and biodiversity monitoring, and many became employed as part of the brigade and as technicians in the water bottling plant (SJL-I9, I21). This process of

capacity building seems to have been aimed at establishing or reinforcing a particular way of valuing the forest.

After the suspension of the commercial logging enterprise, most of the members of the brigade became unemployed. As well as losing income from timber sales, the *comisariado* also lost the income from the FBCO project, as it is directly linked to forest management and depends on the community demonstrating additional carbon capture due to the realization of forestry works that would not be possible without the increased funds from the project. By 2023, when the interviews took place, it was clear that "*the capacities that were strengthened during those times have now emigrated, they are gone. We had carbon technicians, biodiversity technicians, in forestry, in ecosystem services. Practically all of them, as project implementation fell, as programs ended, well they left seeking other sources of income*" (SJL-I24). The fallout from the suspension of the forest management plan happened slowly. By 2023, it had become clear to some that the financial support that the *comisariado* had been starting to provide was no longer possible without the income from logging and FBCOs, as stated by a member of the *comisariado* at the time during a workshop: "*they say they are planning their parties, they want to build a chapel, this and that, and they come and we tell them, we don't have any money. And they say, 'but for a while you were giving it out'. Yes, but that was when all those programs were in place*" (SJL-W2).

### 5.6. Diversity of visions

In each of the topics discussed above, it is possible to depict some generalized views from within each community. However, this does not mean that there is consensus, particularly when it comes to the type of outcomes that are most desirable. Having interviewed people of diverse ages and genders allows for an analysis of the differing perspectives that exist within the community. In general, all interviewees agree on the broad outlines of the history and the importance of forest management for the economy and the infrastructure they enjoy today. However, we do find differences regarding the importance each group assigns to the various topics discussed in the interviews[27] (Appendix VI).

[27] Appendix VI contains two tables showing the prevalence of certain topics across different types of respondents from both communities.

One of the most notable differences emerges when categorizing interviewees based on the highest community service position or *cargo* they have held. It is clear that those who have served in the municipal government place greater importance on social issues – such as health problems – while those who have served only on the communal land board prioritize climate change. Meanwhile, those who have served in both branches of local authority hold a much more balanced view of the topics discussed, addressing climate change and biodiversity alongside the changes observed in younger generations and conflicts both within and outside the community. In the case of La Trinidad, those who have served on committees (who are mainly women) are primarily concerned with generational shifts and health issues, though they also mention various other social and ecological topics.

There are also differences when looking at the age and gender of the participants. People under the age of 50 speak more about carbon offsets whereas older individuals speak much more about forest management (specifically the era of forestry concessions) and agricultural programmes. Likewise, we observe that it is primarily men who speak about forest management. In San Juan Lachao, older individuals speak more about agriculture, specifically tusta chili (a key historical crop) and coffee, while the interest of women in biodiversity monitoring is notable and responds to the fact that many were hired to that role under the forest brigade. In general, across both communities, all interviewees agree on the importance of social development programs, such as government support for schools, the elderly, and road maintenance. In the case of San Juan Lachao, given the vastness of the territory and the complex history of its population, significant differences in perception are to be expected among the various communities that make up its territory. Forest management is of particular interest in Rancho Nuevo, whereas coffee is mentioned more frequently by the inhabitants of Santa Rosa. Livestock farming was discussed most in El Ocote, relative to the other communities. Agriculture is a topic of equal concern to everyone.

It is clear that, depending on whom you ask about land use and the changes that have occurred, you may be left with a completely different impression. This highlights the fact that communities are not homogeneous; rather, there is a diversity of experiences and perspectives that can complement one another to provide a more comprehensive view of the challenges facing the community and the potential solutions.

## 5.7. Discussion

In the context of rural livelihood strategies, the diversification of income generating activities, including through the participation in incentive-based policies, is a common way to manage risk (Ávila-Foucat et al., 2021; Kimengsi et al., 2019; Sunderlin et al., 2005; Villavicencio Valdez et al., 2012). As they diversify their sources of income, communities must incorporate new requirements and processes that may be misaligned with their preexisting governance structures and values (de Koning, 2014; Fairhead et al., 2012; Hajjar et al., 2021; Taylor & Cheng, 2012), requiring a process of adaptation. Such interactions between formal and pre-existing informal or traditional institutions for natural resource management have been described in diverse contexts, including Asia (Hartanto et al., 2008; McDougall et al., 2013), Africa (H. C. P. Brown & Lassoie, 2010; Mogende & Kolawole, 2016; Walters et al., 2015), Latin America (Cisneros, 2019; Garcia et al., 2024; Taylor & Cheng, 2012) and elsewhere in Mexico (Ellis et al., 2015). These studies tend to focus on *who* is leading the adaptation process, characterizing it as a dichotomy between externally induced or voluntary strategic reframing, with marked differences in terms of outcomes. An institutional jelling perspective, on the other hand, places the emphasis on "building bridges" that can lead to "optimal resource management outcomes" (Kimengsi et al., 2025). This chapter documents this bridge-building or jelling process in two case studies in Oaxaca, Mexico, that differ markedly in terms of their historical contexts and the reported outcomes. Qualitative data from semi-structured interviews, workshops and participant observation in two contrasting communities and thematic analysis were used to explore the ways in which institutions for forest governance and values for forests are perceived to be misaligned (unjelled) and the strategies for alignment that each community has employed with regards to 1) communities' institutions for collective action; 2) the de facto use of the forest commons; and 3) the values held by community members with regards to the forest.

A series of jelled, quasi-jelled and unjelled institutions have emerged from the encounter between traditional and formal institutions for forest management, as summarized in Figure 31. With regards to community governance bodies, the increased responsibilities of leaders who traditionally serve as part of a system of mandatory and unpaid positions and the increased labour and administrative requirements have led to the designations of new service positions and the inclusion of financial compensation for the more time-intensive roles. Increased labour requirements have been addressed through the pre-existing institution of *tequios*, while rules

around the inclusion of women in leadership positions also have been readily incorporated into the traditional *cargos* hierarchy. De-facto private use of the forest commons has always existed but has had to be curtailed to account for forest management plans that only consider de-jure land tenure designations, or forest management plans have had to be suspended and re-designed. Finally, the values for the forest that are made evident by formal institutions have also clashed with many people's views around conserving old standing trees and about the beauty and importance of non-forest landscapes, mostly agriculture. Both communities have implemented communication and education campaigns to highlight these new, alternative values such as carbon sequestration or timber production, and have made targeted investments of the funds they have earned in ways that reinforce the view of the forest as a source of income.

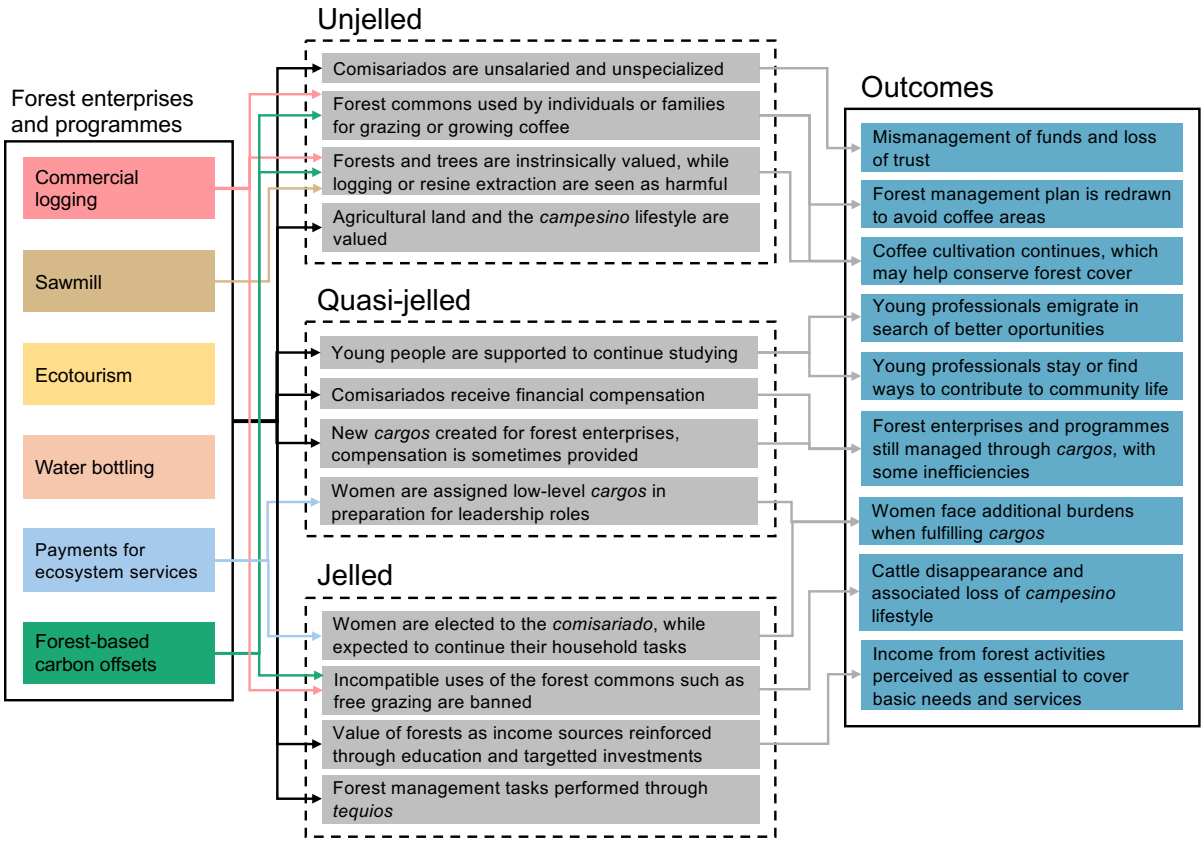


*Figure 31. Representation of unjelled, quasi-jelled and jelled institutions that result from the implementation of forest enterprises and programmes in general (black arrows) or in particular (coloured arrows) by the communities of La Trinidad Ixtlán and San Juan Lachao, and some of the outcomes of these processes.*

The communities of La Trinidad Ixtlán and San Juan Lachao share many of the conditions theorized to lead to a jelled institutional arrangement (Kimengsi et al., 2025), albeit to different

degrees. First, the presence of *social actors that have a full understanding of how informal and formal institutional provisions shape resource management in socio-ecological systems*. As described above, particularly for the case of La Trinidad, the system of mandatory community service or *cargos* has helped ensure that community members are exposed to all aspects of CFE and forest programme management from the time they begin participating as young adults. Like other communities in Oaxaca, these institutions for collective action have facilitated the adoption of instruments such as PES and FBCOs, and the investment of funds for the benefit of the community as a whole (J. M. Alix-Garcia et al., 2018; Kerr et al., 2014; Nieratkaa et al., 2015; Rodríguez-Robayo et al., 2016). Another contributing factor in La Trinidad was the transfer of knowledge about formal forest management processes from individuals that were formerly employed by FAPATUX who later came into leadership positions (Acosta Espino, 2023; Merino Pérez, 2018), as well as from having been part of UZACHI for three decades. In the case of San Juan Lachao, several historical and social factors have prevented some social actors from gaining a full understanding of the institutions around forest management. Despite efforts by ICICO to co-develop participatory processes for benefit allocation and build capacities within the community, ethnic Chatinos whose ancestors were displaced from the lowlands with the arrival of mestizo coffee growers and marginalized from decision-making processes due to their illiteracy still feel excluded from forest governance processes. Many have demanded that technical information be translated, and that other current and potential uses of the forest be considered in forest management plans. Other studies have shown that the exclusion of Indigenous People from resource management processes can create legitimacy concerns (Ebel, 2020) and, in the worst case scenarios, lead to dispossession and displacement (Smith et al., 2019).

Second, the presence of *social actors that recognise the value and salience of their socio-ecological system and agree on the need to manage it sustainably*. The level of agreement was particularly strong in the case of La Trinidad, with most interviewees listing positive outcomes of forest management and expressing great pride in their ability to sustainably manage it for the past four decades. The community's small population size and common ethnic identity probably facilitated internal negotiations and contributed to building common values and management goals, as has been found elsewhere (Cisneros, 2019; Poteete & Ostrom, 2004). But even in Lachao, while many disagreed on whether conservation or management was the best way to achieve it, there was overarching agreement on the importance of having healthy forests now and in the future.

Third, there should be *a certain willingness to make concessions by abandoning some provisions and accepting new ones, as long as this benefits all social actors and sustains the resource system*. Community forest enterprises in Mexico are embedded in governance structures that are generally based on collective decision-making processes by legal rights holders (D. Bray, 2013). While there is considerable variation in the way that CFEs are governed, with more or less control exerted by or independence from the governance structure of the community itself (D. B. Bray et al., 2006), both study communities have adapted the structure of *cargos* or community service positions from its civic and religious origins to include oversight of CFEs and implementation of forest programmes. Other studies across Oaxaca have suggested that adapting their decision-making structures allows communities to face changing market dynamics (Villavicencio Valdez et al., 2012) in ways that mitigate trade-offs between CFE's dual goals of generating revenue and fulfilling a social mission (Engbring & Hajjar, 2022). But the case of Lachao demonstrate the risk that communities can face when incorporating a growing number of responsibilities on a leadership system that is not designed to face such complex tasks. Both communities are struggling to find the right balance of communal and entrepreneurial features to more efficiently manage their resource system and create benefits for all social actors. Ultimately, conflict itself may have a positive potential to generate institutional changes that lead to more socially equitable forms of resource use (Bohle & Fünfgeld, 2007; Cronkleton et al., 2008).

Fourth, the presence of *formal and informal social actors that are intrinsically incentivized through resource use and extrinsically by incentive mechanisms that can be complementary*. It is clear that resource use is an important motivator for government agencies and communities to choose to interact with each other. From the perspective of the National Forest Commission (CONAFOR), supporting community forestry is crucial to supply the timber market, as evidenced by the endurance of their various forestry subsidies and programmes (Frey et al., 2019). And a study in twelve states across Mexico found that communities that manage to combine timber management with value-added products have been particularly successful at generating income and economic development (Cubbage et al., 2015), showing that many communities in Mexico have been successfully running CFEs. Furthermore, both case studies demonstrate how incentive mechanisms can complement pre-existing resource use. Within the literature on incentive-based conservation instruments, some attention has been placed on whether they effectively crowd out pre-existing motivations to conserve (Agrawal et al., 2015; Rode et al., 2015; Underhill, 2016; Van Hecken et al., 2019). However, here I show that

incentive mechanisms are just one of many economic motivations for forest protection and sustainable forest management that communities in Mexico can mix-and-match within a holistic vision of the forest commons, as previously suggested in other works I have co-authored (Alatorre et al., 2021; Zaga-Mendez et al., 2026) and as theorized more broadly for the case of Mexico's PES as a *compensation* rather than an incentive for stewardship (Shapiro-Garza, 2020b).

And finally, *external bodies that are willing to mediate but not influence the process through participatory processes*. The Integrator of Indigenous and Campesino Communities of Oaxaca has played a role in both communities as a mediator or facilitator that works with communities to develop forest projects including FBCOs, PES, and commercial logging. Such partnerships have been described as vital for CFEs in Mexico (Orozco-Quintero & Berkes, 2010). It is important to note, however, that ICICO staff do not believe that the term *external* or *intermediary* adequately describes their role, given that they are a grassroots organization that is governed by an assembly of member communities, and most technical services staff themselves come from ICICO communities. They are therefore part of communities' governance institutions, operating within and between them. This organization therefore fits the definition of *boundary spanners*, or actors that are willing to mediate through participatory methods (Haller et al., 2018) and engage in relationship building (Garcia et al., 2024; Neal et al., 2022). The role of ICICO was certainly more involved in Lachao than in La Trinidad, to the point where one could question whether they sought to influence the process given the importance of demonstrating the permanence of Mexico's first international FBCO project. However, their involvement has always been at the request of Lachao's authorities, and their process is dictated by local norms and values as much as possible.

A key question remains on whether the condition of having *young social actors that are willing to continue enforcing informal institutional provisions* is or can be fulfilled in these cases. While the *cargos* institution remains relatively strong in both communities, many interviewees and workshop participants observed a significant generational change, where young people are increasingly choosing to leave the community and pay for others to perform their community tasks rather than staying and participating actively in community life. While some young people in La Trinidad are interested and able to develop the skills and actively contribute to CFE management through manual and administrative labour, many have ambitions that lie outside of the community and have a strong preference for non-manual labour. These

observations by many interviewees are consistent with findings in other contexts of rural livelihood diversification, with Kimengsi et al. (2019) identifying that young people and those with more favourable socio-economic status prefer non-forest to forest activities in Cameroon (Kimengsi et al., 2019). And in the case of Lachao, many of those who were strongly motivated to contribute to CFE management when funding was available to employ them have now emigrated to Mexican cities or to the United States after the suspension of the forest management plan. This lack of interest in or ability to participate in forest-related work is a significant challenge for communities that seek to make forest enterprises a central aspect of their long-term vision for prosperity.

### 5.8. Conclusion

Establishing community forest enterprises and complementing them with income from incentive-based forest conservation and management programmes has enabled communities in Mexico to diversify their income sources and generate significant collective benefits such as local employment and infrastructure. In the process of implementing these activities and programmes, their traditional governance structures and arrangements can come into conflict with programme rules and expectations. This chapter documents two contrasting processes of institutional jelling at the community level and from the bottom-up, highlighting the role of the historical and social context in determining the potential outcomes.

In the course of their interaction with policies and programmes managed and implemented by different ministries or organizations, an overarching finding was the way that participation introduces additional responsibilities on communities' leadership bodies, who tend to be elected by assemblies due to their participation as community members and not necessarily due to their knowledge of forest management or their administration or accounting skills. Furthermore, like other elected positions or cargos, the leaders in the comisariado and oversight council must serve for three years, work full time, and were traditionally not paid for what is considered a service. Other institutions around the de-facto use of the forest commons for agriculture or cattle grazing were also deemed to be incompatible with forest management plans. Additionally, requirements around the participation of women in leadership position and the inclusion of non-rightsholders in information sessions were also misaligned with traditional institutions.

In La Trinidad Ixtlán, the jelling process was probably facilitated by the community's small size and common ethnic identity, as well as long-term capacity building linked to their strong traditional institutions of community service. The community was committed to succeed as forest managers after their long struggle for autonomy against the concessions system, and over time modified their practices around the access, use and management of their forest resources. This study documents their numerous adaptations including paying comisariados, creating new (paid) service positions within community forest enterprises, and prohibiting the grazing of cattle in the forest commons. According to many, this has yielded the "dream of their ancestors" (LTI-I36) of a highly educated and skilled community undertaking all aspects of forest management by and for themselves.

The case of San Juan Lachao is more complex. Here, these programmes exacerbated preexisting tensions, and a brief period of jelling was followed by conflict and resistance from those who wanted to unjell from these programmes and the visions they imposed. Centuries of resentment by the forest-dwelling Chatinos were exacerbated by a timber management plan that imposed restrictions on their de-facto use of the forest commons. While forest management brought opportunities for significant income and employment generation at the community level from PES, FBCOs and other sources, and initially enabled the establishment of a wide range of community forest enterprises, the fast pace of change did not allow for the development of governance processes that could support this new reality. They have spent the past decade debating the way forward, with a regional community-based organization, ICICO, playing a mediating role. Instead of banning coffee cultivation in forest management areas, like they did with cattle in La Trinidad, San Juan Lachao has been attempting to modify the timber management plan to avoid zones of de-facto private property, among other strategies that they were developing at the time the fieldwork took place.

These two case studies serve to highlight the importance of regarding informal institutional provisions in the same light as formal ones when it comes to the design and implementation of forest management and conservation programmes. Usually, only de jure definitions of ownership are considered, when the reality on the ground is often more nuanced. And while a number of values can coexist in a community's landscape, only a specific set of conditions are valued by programme goals. However, despite their similarities, these cases also demonstrate the difficulty in determining an "appropriate institutional combination" (Kimengsi et al., 2025), given the variation in terms of processes and outcomes that can exist even within the same

country and state. Communities historical contexts, such as their past experience with timber concessions and community forestry, as well as land use and economic pressures more generally, their size and make up in terms of language and ethnicity, the diverse uses and values of the land and the degree of influence of those whose land use is in conflict with forest management plans, will likely influence the jelling or unjelling process.

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# 6. GENERAL CONCLUSIONS

Since winning the right to manage their own forests back in the 1980s, communities across Mexico have established forest enterprises to harvest timber and other forest products, with profits being invested in essential community infrastructure and services. Many have sought to diversify not only their forest enterprises but also the funding to sustain them, turning to government programmes such as payments for ecosystem services (PES) and a burgeoning international market for forest-based carbon offsets (FBCOs). These schemes offer significant income for eligible communities but also place important requirements and restrictions on preexisting practices, which can create a need to restructure local rules and authority in the access, use and management of resources. This thesis increases our understanding of this entire process through three very different but complementary chapters, each with its own set of contributions and limitations.

## 6.1. Main contributions of the thesis

This thesis set out to answer the following research question: *How do the dynamic interactions between historical land-use patterns and participation in decentralized forest policies influence lands, visions and institutions in Mexican communities?* It incorporated the approach proposed by Lund and colleagues (Lund et al., 2018) regarding the importance of analysing this issue from multiple, complementary disciplinary and methodological perspectives, just as different pieces are required to assemble a larger puzzle. Here, each specific research objective (RO) constitutes one of these puzzle pieces:

> RO1: To describe and explore the patterns around land-use and livelihood strategies that Mexican communities have experienced during the past two decades and how they relate to participation in decentralized forest policies and programmes through national-level geospatial data.
>
> RO2: To study how community governance bodies and project developers match local visions for transformative resilience with targeted investments of funds from decentralized forest policies and programmes in five Indigenous communities in Oaxaca through qualitative data.
>
> RO3: To explore the governance challenges faced by La Trinidad Ixtlán and San Juan Lachao when implementing decentralized forest policies and programmes and how they

have modified their traditional institutions in response through qualitative data within an institutional jelling framework.

The way these objectives are set out is a direct mirror of my academic background, since I was initially trained in the natural sciences before transitioning towards social sciences due to an acknowledgement of the complexity of the social and ecological systems that I was studying, which defied a purely quantitative understanding. I turned to an explanatory sequential mixed methods design where quantitative data and their analysis are meant to provide a general understanding of the research problem, while the qualitative component is intended to refine and explain the results obtained by exploring participants' perspectives in more depth (Tashakkori & Teddlie, 2003). I do so by integrating a multiscale perspective, which allowed this thesis to flow nicely between a national, regional and local scale of analysis, while demonstrating the strengths and weaknesses of each individual approach in achieving a full understanding of the process and outcomes of forest decentralization policies in Mexico's communities. Below, I describe how I implemented an explanatory sequential mixed methods approach in an innovative way by first collecting and analysing national-level data on forests, communities, and the policies that involve them, and then integrating these findings with rich qualitative data from a regional-scale and then a local-scale case study approach.

### *6.1.1. The quantitative component: National-scale analysis to identify trends and interactions*

In order to address RO1, *to describe and explore the patterns around land-use and livelihood strategies that Mexican communities have experienced during the past two decades and how they relate to participation in decentralized forest policies and programmes through national-level geospatial data*, we provided an overview of forest and forest policy trajectories in communal lands at the national level (Section 3). We presented or updated key figures related to communities and their territories, such as the number and proportion of them that subdivided their common-use areas during a long land titling process (29% of *communities* and 43% of *ejidos*), when they did so (mostly in the early 2000s), and whether this has led to large-scale land acquisitions (no). We also confirmed that 52% of Mexico's forests are owned by communities, a number that seems to have remained fairly unchanged since the 1990s, and that forest cover increased dramatically between 2010 and 2020, by nearly 10%. This does not mean that forest loss is not happening. In fact, levels of forest cover loss started rising rapidly around 2017, then dipped for two years which coincide with the COVID-19 pandemic, and started

trending upwards again in 2023. Peak forest loss levels occurred in 2019, which coincides with the onset of two interventions championed by the 2018-2024 presidential administration: the agricultural subsidy *Sembrando Vida*, and the mega infrastructure *Tren Maya* project. Deforestation levels after this point were particularly high in the Yucatan Peninsula, where both of these policies were implemented, and fully reversed the deforestation risk estimates.

We then went on to describe communities' experiences with forestry, based on the most comprehensive dataset available of 1,900 communities. This sector experienced incredible growth after 2012 and remains strong due to the longevity of timber harvesting permits, despite the fact that not many new permits have been awarded since 2020. States in the north and northwest of Mexico have the largest proportions of community forest enterprises, despite not being as well-known and studied as the state of Oaxaca. Timber permits interact strongly with another key forest policy, payments for ecosystem services (PES), with 55% of communities with permits having participated in PES at some point. Furthermore, there seems to be a positive correlation between past PES participation and future timber harvesting, which reveals a purposeful political agenda to make communities' forests increasingly productive. With regards to protected areas, the overlap with PES reveals an apparent contradiction, as communities are simultaneously incentivised to participate in PES if they are unlucky enough to be saddled with a federal or state protected area, or to designate their own voluntary protected areas to gain access to PES and, later, forest-based carbon offsets (FBCOs), while also being incentivised to invest PES funds into "sustainable productive activities" such as timber harvesting.

This chapter increases our understanding of the spatial and temporal interactions between different conservation and management policies, broadening the findings from previous, regional-scale studies (Alatorre et al., 2021; Ezzine-de-Blas et al., 2016) to the national level. Its main methodological contribution consists of a clean and comprehensive database of community-level interactions with a wide array of policies and programmes, an anonymized version of which will later be made available, as will the coding used to obtain it from publicly available repositories. This database will enable the realization of further research on these important topics, as will be discussed in Section 6.4. Conceptually, this chapter also casts doubt on studies, particularly impact evaluations, that fail to adequately consider the context in which a given policy operates, by looking at them in isolation of other interventions or by focusing only on the hectares under contract rather than the broader community context.

### *6.1.2. The qualitative components: Regional-scale analysis to understand context and visions in five communities*

Having set the stage of what a long series of political agendas seem to want from communities' resources, Section 4 explores what communities themselves want from their forest, the threats that affect them, and their visions for resilience. It addresses RO2, *to study how community governance bodies and project developers match local visions for transformative resilience with targeted investments of funds from forest decentralization policies and programmes in five Indigenous communities in Oaxaca through qualitative data*, by working in partnership with an Indigenous-led organization in Oaxaca (ICICO, the Integrator of Indigenous and Campesino Communities of Oaxaca). We identify how five of its member communities perceive and describe the components of resilience and their associated threats, the role of ICICO in introducing and making decisions around forest-based carbon offset (FBCO) planning, implementation and funding allocation, and how FBCO activities and funding allocation address perceived threats and strategies for resilience. Interviewees identified a series of ecological threats, which they link strongly to climate change, including drought, forest fires, forest pests and diseases and biodiversity loss. They also perceive that outmigration, poverty, people's lack of awareness and their deficient infrastructure threaten their capacity for resilience. They reflected on how their forests, through either conservation or management approaches, are essential for their future resilience, and factors such as their traditional governance structures, a sense of communality, local employment and education can all contribute to resilient futures.

Most interviewees also felt that the planning and implementation processes facilitated by ICICO directly addressed many of the threats they perceived and strengthened their capacity for resilience. During project planning, information and training provided by ICICO was considered important for learning or perfecting skills such as wildfire and pest prevention and combat, biodiversity monitoring, and the importance of forests as carbon sinks. They felt that ICICO's approach was compatible with and strengthened their traditional decision-making structures. The activities that communities were able to implement with FBCO funds directly increased their capacity for reforestation, wildfire and pest detection and control, water capture and storage, and biodiversity monitoring, generating local employment and capacities in the process. Finally, these communities received significant income from FBCO projects, which they collectively decided to invest in basic infrastructure needs such as schools and clinics,

equipment and materials for forest management, water capture and storage infrastructure, and educational activities within the communities, among others.

While support for FBCO projects and ICICO was very high, it was not universal. Many interviewees questioned the whole idea of cutting trees as part of forest management plans and FBCO projects, believing conservation is the better path for intergenerational resilience. This non-market incentive for collective action deserves more attention within the resilience literature. There were also concerns around unequal participation in decision-making and benefit distribution, particularly in the pilot community of San Juan Lachao when ICICO's participatory methodology was beginning to be developed. Two communities saw instances of discontent and sabotage, although the potential for significant income generation later led to a restart of internal conflict resolution processes, mediated by ICICO. In the end, monetary incentives for collective action were more powerful than intergenerational value. Finally, there were concerns around the suitability of their traditional institutions for forest governance in the face of the new requirements that they were facing, which is the subject of the final chapter.

This chapter fills an important knowledge gap by exploring the role of intermediaries in FBCO contexts, and how an organization that is embedded with and respectful of local governance structures and practices can facilitate the alignment of project goals and community visions for resilience. It is therefore also a useful link between the previous and the following chapters: while Section 3 shows the prevalence of PES and other forest-based policies at the national level in Mexico, and Section 5 discusses how these policies interact with and lead to changes in local institutions and values around forests, Section 4 describes the actual encounter between forest policies and communities through five case studies in Oaxaca. Furthermore, this case study reflects about the nature of the 'resilience' outcomes and proposes that ICICO's approach to FBCOs through the CAR Mexico Forest Protocol contains the characteristics associated with 'transformative resilience' and some of the main aspects of 'equitably transformative resilience'. However, more research is needed to answer whether and under which conditions FBCOs can contribute to equitably transformative resilience.

#### *6.1.3. A local analysis of institutional challenges in two contrasting communities*

Finally, Section 5 addresses RO2, *exploring the governance challenges faced by La Trinidad Ixtlán and San Juan Lachao when implementing forest decentralization policies and programmes and how they modified their traditional institutions in response through qualitative data within an institutional jelling framework*. It is based on findings from multiple

visits and fieldwork carried out in five different occasions between 2023 and 2025, including a main field stay in the summer of 2023 where the bulk of the interviews, workshops and participant observation were conducted. A lot was learnt about these two communities, including their history of agrarian conflicts, their resistance against forestry concessions, and the profound ways in which their livelihoods have been transformed within the space of a generation, as discussed in Section 6.4 below. Section 5, however, focuses on the findings with regards to the governance challenges that these communities faced when implementing forest management and conservation programmes, and how they modified their traditional institutions in an effort to jell them with formal rules and regulations. The analysis and discussion are based on the newly proposed institutional jelling framework, which is focused on the deliberate process of building bridges between complementary traditional and formal institutions (Kimengsi et al., 2025).

In the course of their interaction with policies and programmes managed and implemented by different government agencies or organizations, an overarching finding was the way that participation introduces additional responsibilities on communities' leadership bodies, who tend to be elected by assemblies due to their participation as community members and not necessarily due to their knowledge of forest management or their administration or accounting skills. Furthermore, like other elected positions or *cargos*, the leaders in the *comisariado* and oversight council must serve for three years, work full time, and were traditionally not paid for what is considered a service. Other institutions around the de-facto use of the forest commons for agriculture or cattle grazing were also deemed to be incompatible with forest management plans. Additionally, requirements around the participation of women in leadership position and the inclusion of non-rightsholders in information sessions were also misaligned with traditional institutions. In the community of La Trinidad Ixtlán, which has been managing their forests since the 1980s, adaptations included paying *comisariados*, creating new (paid) service positions within community forest enterprises, and prohibiting the grazing of cattle in the forest commons. In San Juan Lachao, where community forestry is a recent paradigm that fully started around 2008 when ICICO began working with the leadership at that time to implement PES and develop a forest management plan, governance challenges led to the suspension of the timber harvesting permit. Instead of banning coffee cultivation in forest management areas, like they did with cattle in La Trinidad, in San Juan Lachao they have been attempting to modify the timber management plan to avoid zones of de-facto private property, among other strategies that they were developing at the time the fieldwork took place.

Empirically, this chapter provides original observations on the topics of community forest enterprises, de-facto property rights, and value misalignments, all of which will resonate with recent trends in the areas of justice and community governance (Dawson et al., 2024), plural valuation of nature (IPBES, 2022; Zafra-Calvo et al., 2020), and 'reversing the gaze' to learn about the many ways in which communities are stewarding the land (McDermott et al., 2026). More specifically, this chapter provides empirical validation for the institutional jelling framework, showcasing the characteristics of the study communities that are associated with producing jelled institutions, as well as those that have led to unjelling or quasi-jelling. Furthermore, by linking specific outcomes to the jelling and unjelling process, this chapter demonstrates that the misalignments between institutions at multiple levels can have profound and wide-ranging consequences, but so can alignment itself. In many ways, the reduction in agricultural productivity and the loss of the campesino lifestyle in La Trinidad can be directly linked to the decision to adapt the use of the forest to the needs of the forest management programme. Of course, whether these outcomes are positive or negative will depend on who you ask. This fact demonstrates the difficulty in determining an "appropriate institutional combination" (Kimengsi et al., 2025), in other words, whether jelling traditional and formal institutions is the preferable path that can lead to more "sustainable socio-ecological systems" (Ibid.). Therefore, it may be argued that the institutional jelling framework, not unlike other theoretical approaches to institutions, is unable to perfectly predict the conditions under which such positive outcomes can appear, as it fails to sufficiently recognise the fundamental issues of divergent values and power dynamics.

### 6.2. Theoretical implications

Each of the three main chapters included in this thesis contributes to an increased understanding of forest decentralization policies in community social-ecological systems (SES). With regards to the community context, my findings show that a crucial aspect of the definition of the commons, and that which distinguishes it from a public good, can be agreed to by different groups of actors. The Mexican state in its multiple iterations, the international buyers of carbon offsets, the technical services of a community organization, community leaders, foresters, bakers, teachers and more all agree that a commons "requires management and protection in order to sustain it" (Hess, 2008, p.37). From the perspective of Mexican forest policy, this management and protection should maximize the flow of goods and services, as shown by the continued investment in PES programmes and subsidies for community forestry, although

recent administrations have renewed a focus on agricultural production and away from conservation. For the voluntary carbon market, improved forest management (IFM) projects can help ensure that more carbon is captured and sequestered in the commons than would otherwise have occurred, and that this will be resilient in the face of the growing environmental threats posed by climate change. For ICICO, gaining access to funding programmes linked to forest management is a sound strategy for maintaining autonomy and self-determination over the commons, less they be concessioned off to private parties who will lack the knowledge and the motivation to harvest resources in a respectful and sustainable way. For supporters within communities, these funds facilitate their continued and improved stewardship over the commons, going beyond the fulfilment of basic needs and services that the state cannot address and assuring their survival in the face of climate change. For some of the detractors, this management and protection should be focused on preserving the forest for future generations, acknowledging the value of old trees regardless of how much carbon they can capture.

The justification behind forest decentralization policies or community-based forest management approaches is that situating decision making closer to where forest management and use actually occurs and in the hands of representative local authorities is expected to result in more ecologically and socially sustainable outcomes (Agrawal & Ribot, 1999; Lund et al., 2018). This has been the trend in Mexican environmental policy over the past four decades, with forest concessions giving way to incentives for community forestry, federal protected areas allowing for some extractive use while promoting the establishment of voluntary protected areas, and PES programmes claiming to support both conservation and active management through small 'compensations' for good stewardship. As Lund and colleagues emphasize, this subject has been studied by a variety of academic disciplines with a strong a tendency of compartmentalization, whereby the findings from one strand do not necessarily inform or draw on those of other strands (Lund et al., 2018). In this thesis, while each chapter is relatively compartmentalized, together they build a more comprehensive and nuanced understanding of the effects of forest decentralization policies on communities' lands, institutions, and visions for the future. It thus demonstrates that an explanatory sequential mixed methods approach can bring different disciplinary perspectives into contact with one another, exploiting the strengths of each while compensating partially for the weaknesses. By doing so across three different spatial scales (national, regional and local), this thesis provides a possible footprint for addressing the much-debated problem of generalizability and explanatory power in socio-ecological research, as will be discussed in Section 6.4.

By bringing together the notions of equitably transformative resilience (HLPE, 2025) and institutional jelling (Kimengsi et al., 2025) within an SES framework, this thesis also proposes that the careful and deliberate blending of 'traditional' (forest governance structures that are put in place by communities themselves, as perceived by research participants) and formal institutions (the rules and requirements of forest enterprises and programmes) can support transformative resilience, in some cases, but may still present significant trade-offs with regards to equitability. For instance, incorporating a community's common-use forest area into a forest management plan for commercial timber harvesting can be incompatible with previous uses of the forest, such as cattle grazing. This can lead communities to impose rules banning cattle from the forest, which over time can lead to the disappearance of cattle from the community since there are no places to keep them. A lack of cattle can negatively impact agricultural production if they are used for tilling the land (and are hard to replace by tractors, in the case of La Trinidad's hilly terrain). Is this outcome positive or negative? It can certainly be considered positive by more conservation-minded people, who would rejoice in seeing formerly agricultural lands being overgrown by forests, which are eventually incorporated into forest management plans. However, many in the community may perceive it as negative, since it compromises their food security and makes them dependent on external sources of nutrition. Therefore, a key element of equitably transformative resilience, that of "centring resilience efforts in the knowledge, experiences and resistance of those made vulnerable and marginalized" (HLPE, 2025), is not fulfilled in this specific case.

Additionally, this thesis touches on the rich debate around critical institutionalism, which has long criticized much of Ostrom's work. As outlined by Hall and colleagues (2014), the three main critiques can be grouped under the headings of the 'homogenous community', the avoidance of politics, and socially inadequate analyses (Hall et al., 2014). In the case of Mexican *comunidades*, while it can be argued that the 'myth of community' can lead to the exacerbation of inequalities and exclusion, as discussed in Section 1.2.2 and as demonstrated in the case studies, and that local practices are not entirely internally generated, as explained in the same section and in much greater detail in (D. Bray, 2013), this thesis defends the continued use of the 'community' as a unit of study. As the use of the institutional jelling framework in Section 5 demonstrates, it is possible to distinguish between those institutions that are formally linked to external interventions, and those that are held by and recognised by the community, and that each community has made their own despite their common origin in a legal framework. These are not the pastoralist communities that Cleaver and Franks (2008), cited in Hull et al.,

(2014), struggled to locate and define. These are Indigenous communities with centuries-long attachment to a more-or-less well delimited piece of land, that they constantly want to find better ways to manage and protect. Even some of the descendants of Mestizo settlers in San Juan Lachao see themselves as Indigenous, because they are "among the Chatinos" (SJL-I11)[28]. Of course, the picture might be different for the case of *ejidos*, which are not part of the case studies presented here, and where decision-making has been found to be more individualized (Córdoba et al., 2021; Izquierdo-Tort et al., 2022). This conception of Mexican 'communities' can be illustrated by revisiting Ostrom's design principles (Ostrom, 2005) while expanding on the contribution by Bray (2020, p. 225) where he systematically compares them to the Mexican experience with CFEs (Table 11).

*Table 11. Ostrom's design principles and their applicability or inapplicability for the Mexican context of community forest enterprises. First two columns taken from Bray, 2020. Third column contains applicable findings from this thesis.*

| Design principles (2005) | Bray's contribution (2020) | Contributions from this thesis (2026) |
|---|---|---|
| 1) Clearly defined common-pool resource boundaries and rights. | Common-pool resource boundaries established by agrarian and forest laws. CFE rightsholders have withdrawal (harvest), management and exclusion rights, but not alienation – a nearly full bundle of rights. | Communities' physical boundaries and their tenure rights are recognized and have not changed significantly in the past 50 years. The boundaries of resources themselves are constantly being reevaluated, with protected areas often encompassing parts of communities' territories and imposing restrictions on their use, and emerging markets for ecosystem services creating 'new' common-pool resources that, if they happen to exist within communities' boundaries, can then be monetized by them. |

[28] I do regret not being able to include more of those rich conversations that go well beyond the scope of the papers that make up this thesis. Here is one exchange, translated by me, about this interesting subject:

I11: *And that is how Lachao was founded.*

A: *And they were Chatino People, right?*

I11: *Of course, originally there were only Chatinos, only Chatino People. Yes, most of us in San Juan Lachao are Chatinos. There are some that only speak Castilian [Spanish], but it is only about 30%. About 60 or 70% of us, we are Chatinos.*

J: *Do you speak Chatino, sir?*

I11: *No, but most people do. But I consider myself Chatino because I am among the Chatinos. That's right.*

A: *Your parents, your grandparents, did they speak it?*

I11: *No, because my father came from Miahuatlán, and my mother came from Juchatengo. My grandparents were muleteers. They were small traders who bought coffee and chili peppers.*

| | | |
|---|---|---|
| 2) Proportional equivalence between benefits and costs, including the ability of users to devise rules on how much, when, and how products are to be allocated or harvested and the rules related to distribution of benefits. | CFEs do not have autonomy to devise rules on "how much and how." These imposed rules do not crowd out incentives for collective action due to strong economic incentives. "When" is dictated by weather conditions. CFEs have full autonomy in rules related to distribution of benefits. | While harvesting rules for commercial logging or the sale of non-timber forest products are set by the state, communities exercise significant agency when it comes to the internal use of resources. They can determine the conditions under which trees can be harvested for individual use, the amount of firewood that a family can extract, or the permitted intensity of water use (for instance, the diameter of the hoses used to pump river water in Lachao). They can also choose to leave certain areas or species untouched despite being permitted to do so by the forest management plan based on cultural reasons or water needs. They can even choose to suspend or cancel forest management at any point.<br><br>With regards to the "when", weather does play a key role but also the availability of labour, with many young men recently emigrating to the United States under short-term work visas or finding work in nearby tourist destination during high season. Likewise, community events such as parties can generate significant absences.<br><br>Distribution of benefits can be influenced by programme rules. For instance, the requirement to hire a forestry technician in the national PES schemes means that a certain percentage must go to them, and the same goes for project developers for FBCOs. Equally, programmes and projects involve significant investments in terms of time and labour, which means that a certain percentage of income must be spent on wages (as there is a limit to what can be achieved through *tequios*), equipment, and road maintenance. |
| 3) Collective choice arrangements where most individuals affected by resource rules can participate in making and modifying said rules. | CFEs have little or no capacity to make or modify rules about harvests and protection of forests under management programmes. Rules are almost entirely imposed by law and regulations. CFEs can make and modify rules about management of non-commercial forests, within limits. | But they can choose to suspend and redesign forest management plans to make them more suited to local conditions including de-facto private use in the forest commons. Also, while it is not possible for communities to legally harvest more than their authorized volumes, it is possible to harvest less, and many communities over time have elected to do so due to fears of overharvesting or due to labour or market constraints. |
| 4) Monitors of biophysical conditions and user behaviour are at least partially accountable to the users and/or are users themselves. | CFE monitoring of biophysical conditions is carried out by professional foresters responding to official regulations, reflected in authorized volume of harvest. Monitoring of issues such as forest pest outbreaks is done by community. User behaviour is monitored by community, though federal monitoring can apply. | Certified professional foresters can themselves be community members, as is the case in all the Sierra Norte communities studied here. Monitoring roles can also be created through the *cargos* structure, with community members working as accountants for CFEs in an unpaid, rotating capacity. Monitoring forest conditions can be done by community members, often with training and capacity building from CONAFOR or intermediaries. |

| | | |
|---|---|---|
| 5) Users who violate rules-in-use are likely to receive graduated sanctions from users. | Anecdotal evidence for graduated sanctions exists, no systematic studies. | Adding to the anecdotal evidence, graduated sanctions exist in La Trinidad Ixtlán and San Juan Lachao, with consequences ranging from fines to jail time. |
| 6) Users have rapid access to low-cost, local arenas to resolve conflicts. | Community assembly and new organizational forms such as Council of Principals serve this function in CFEs. | The assembly is indeed a mechanism for conflict resolution; however, it is not always "low cost" nor is it "local" to all. In the case of Lachao, bringing together around 1,000 rightsholders is very costly, with expenses including chair rental and the provision of food and beverages. This prevents them from holding assemblies as often as some would like or as required by law. Additionally, many people don't live in the main locality where assemblies are held, but have to travel several hours on difficult roads to get there. Alternative mechanisms such as locality-specific meetings can partially make up for these shortcomings. |
| 7) The rights of users to devise their own institutions are not challenged by external government authorities and users have long-term tenure rights. | Communities required to organize. CFE rights to organize are recognized. Long-term tenure rights are guaranteed by constitution and Agrarian Law. | There are some limitations to communities' long-term tenure rights. Article 45 of the Agrarian Law [29] states that common use community lands can be subject to contracts between rightsholders and third parties for a maximum duration of 30 years, which can be renewed. This is why the Climate Action Reserve's Mexico Forest Protocol (Version 3.0) provides for 30-year contracts, which is contrary to other parts of the world where 100-year contracts are the norm. This may disadvantage Mexican projects with regards to others in the voluntary marketplace.<br><br>Tenure rights are also contingent on the community having no outstanding territorial conflicts with its neighbours. |
| 8) Appropriation, provision, monitoring, enforcement, conflict resolution and governance activities are organized in multiple layers. | CFEs are "nested" within clearly and legally defined multilevel governance both of the territory in general and forests in particular. CFEs may also be "nested" within regional, state, and national representative CFE organizations. | CFEs may also be "nested" in terms of the enterprises themselves or the funding mechanisms that interact with them. For instance, FBCO projects are nested within forest management plans for commercial logging, and other activities such as ecotourism or water bottling can also depend on logging, FBCOs and/or PES for funding and general forest maintenance. |

Beyond the particularities of the Mexican context, the findings presented in this thesis can inform broader debates around institutional change, transformative resilience, and the

[29] The original text of Article 45 states that: *Las tierras ejidales podrán ser objeto de cualquier contrato de asociación o aprovechamiento celebrado por el núcleo de población ejidal, o por los ejidatarios titulares, según se trate de tierras de uso común o parceladas, respectivamente. Los contratos que impliquen el uso de tierras ejidales por terceros tendrán una duración acorde al proyecto productivo correspondiente, no mayor a treinta años, prorrogables.*

governance of common-pool resources under changing economic and environmental conditions. It shows how decentralized forest policy implementation acts upon the recipient communities, both in terms of forest cover loss but also how they interact with communities' institutions and their values and visions for the future. It joins a growing call for complementing remotely sensed data about communities and their forests with place-based, community-engaged research (Kanashiro Uehara et al., 2023; McDermott et al., 2026; Wyborn & Evans, 2021) and demonstrates the potential of explanatory sequential mixed methods in integrating these apparently independent perspectives and approaches. This thesis also provides new and useful perspectives that add to ongoing debates around the design principles for long-lasting institutions for sustainable, or resilient, natural resource management (D. B. Bray, 2020; Haller et al., 2016; Kimengsi et al., 2025; Ostrom, 2005, 2009), reflecting on how different theoretical contributions such as institutional jelling (Kimengsi et al., 2025, 2026), boundary-spanning intermediaries (Coggan et al., 2013; Haller et al., 2018; Pham et al., 2010; Tanveer et al., 2024) and equitably transformative resilience (HLPE, 2025) can be brought together to create a better understanding of the enabling conditions and potential outcomes of interventions that are meant to increase resilience.

### 6.3. Limitations

As with any research endeavour, no matter how theoretically sound and well thought-out, there are many limitations associated with the work presented in this thesis that are important to highlight. Firstly, regarding the national-level component, its main limitation is a conceptual one: it is not possible to claim that we can now understand everything that communities are doing with their forests, since the data is limited to official and publicly available sources. All sorts of things are invisible from this scale of analysis, including communities' connection to the land, the formal, informal and traditional institutions that regulate forest use and access, the degree to which they rely on the forest for their livelihoods, and what role their forests and any policy that they adopt may play in hindering or strengthening their strategies for resilience. However, this limitation is partly addressed by the following two empirical chapters, which explore those subjects in greater depth. This is precisely the goal of using explanatory sequential mixed methods.

There are also methodological limitations linked to data availability and resolution for the national-level analysis. This is particularly the case for the timber harvesting data, which was put together from a variety of different sources, as there is no comprehensive and publicly

available data (unlike for PES). While I took great care to avoid this, it is possible that I am missing observations or double-counting data from multiple sources. Furthermore, whenever I had to do matching by name and not through spatial interaction algorithms, there will likely be several errors due to names being spelled differently in different datasets, or due to communities within the same small administrative area (municipality) having very similar names being grouped as one. This was notably the case with the PES applications data, as well as some of the timber authorizations datasets. Finally, there are limitations linked to the suitability of the Global Forest Change dataset for the specific forest types found in Mexico, particularly drier forests, and the inability to distinguish between forest loss that is due to timber harvesting, natural disasters, or land-use change. This is an important point which is not addressed in Section 3, but which is being considered in an impact evaluation that I am working on and which is currently being finalized, which makes use of the database assembled as part of this work, as mentioned in Section 6.4.

With regards to the two chapters based on qualitative data and analysis, one major limitation is the fact of mine and my collaborators' association with ICICO. The ROSES team (Researching Oaxaca's Socio-Ecological Systems) is led by Prof. Elizabeth Shapiro-Garza, who has been collaborating with ICICO for nearly 20 years. She brought together a group of like-minded researchers, committed to community-engaged and responsive scholarship, to support ICICO and its communities in all aspects of their forest stewardship. While we maintain some degree of academic independence from ICICO, this type of research differs greatly from more extractive approaches where communities and grassroots organizations are merely asked for consent and studied according to externally defined research objectives and hypotheses. During our interviews and workshops, it is likely that peoples' opinions of and relationship with ICICO influenced their answers or comments. This is particularly true for the 58 semi-structured interviews conducted in 2024 in San Juan Lachao, Santiago Xiacuí, Santa María Jaltianguis and Santa María Peñoles, where ICICO staff accompanied us and helped conduct some of the interviews themselves. During my work in La Trinidad Ixtlán and San Juan Lachao in 2023, the fact that I worked through ICICO may have influenced community leaders' initial ability to accept or refuse partnering with me (they may have felt compelled to agree since ICICO made the introductions).

The selection of interviewees and workshop participants was also limited by a series of constraints, including time and budget but also the need to follow culturally appropriate

approaches. During my fieldwork in 2023, I worked within communities' traditional governance structures, which meant that the *comisariados* at the time introduced me to many of the interviewees or recommended specific participants. In some cases, they specifically called for certain individuals to attend the workshops. I compensated for this by finding other people who were not in the list provided by the comisariado, interviewing them and inviting them to attend the workshops. But despite my best efforts to include people with diverse backgrounds and experiences, I must acknowledge that there were limitations in my ability to record the views of the most marginalized. Particularly in San Juan Lachao, where the territory is vast and the roads poorly maintained, it was extremely difficult to move around and reach the most remote localities, although I did make the trips on several occasions by hiring a local taxi driver. This limitation would have been partially addressed by spending more time in the communities, particularly in Lachao. However, this was not possible, partly due to budgetary constraints, but mainly due to personal reasons. As a mother of a small child, my time away from home was severely curtailed. I therefore favoured long-term engagement through many short visits, which actually began in 2018 during my masters' research. Overall, I spent time in La Trinidad and Lachao in in five different occasions between 2023 and 2025, with the longest visit taking place during a six-week period in the summer of 2023.

Beyond the selection of the individual participants, the selection of the study communities is also an important limitation that affects both qualitative chapters. Since we worked exclusively within ICICO communities, our findings may not be applicable to the way other organizations and project developers work with communities. From anecdotal evidence and the media, we know that there have been many cases of carbon project developers in Mexico using less than transparent tactics to establish contracts with communities and end up paying lower prices than what they had promised. With regards to the ROSES team, that is precisely what compels us to work with what we know to be a highly passionate and ethical group of people at ICICO, the fact that we want to support their approach to community forestry and beyond. But it does bias our vision of communities in Mexico towards a very specific group of communities that have joined ICICO's vision and mission. Therefore, our findings should not be interpreted as saying that FBCO projects necessarily contribute to resilience. Instead, they should be taken as supporting approaches that are inclusive, participatory and embedded in communities and their institutions.

### 6.4. Future research avenues

This thesis and the research that informed it can open many exciting possibilities for future work, and it can also yield valuable insights for policymakers. In fact, further research has already benefitted from the contributions of this thesis. In August 2024, I began working on a project led by my long-term collaborator Santiago Izquierdo-Tort, where I took the lead in an impact evaluation of Mexico's PES programmes. We are specifically looking at the issue of programme permanence by assessing whether reductions in funding lead to increased forest cover loss in communities that were previously participating in PES. The coding I had developed and the datasets I had already assembled were instrumental in facilitating this ambitious project, which will change our understanding of what happens when a once flagship environmental policy is left to slowly become irrelevant, as discussed in Section 3.5.2.

Beyond this one specific application, the database should allow for the development of many other research outputs. For instance, it will be useful when selecting case studies more 'objectively', as it will make it possible to sample according to the specific characteristics you want to test, such as having community forestry, or having established a voluntary protected area, or having reapplied to join PES seven times in the past seven years (this is the case for one community that I would be very interested in learning more about, for instance). Furthermore, it would be possible to identify which otherwise eligible communities have not participated in any of these national programmes, which would also be in interesting line of inquiry (why have they not participated? Are they actively avoiding this? Are they actively trying but failing?) as it would help to counter the prevailing narrative of 'successful' community forest enterprises that seems to dominate the literature, particularly for the case of Mexico.

Other themes that emerged from the rich qualitative data gathered as part of my PhD have yet to be explored in depth and could yield many interesting insights. In particular, there is much yet to say about the issue of livelihood transitions, which is in fact the part of the title of this thesis that is least explored here. In the reports and presentations I produced for the communities of La Trinidad Ixtlán and San Juan Lachao, this was consistently one of the themes that elicited the most interest and reflections from attendants, who found it compelling to visualize the drastic changes that have occurred in the last few generations with regards to the ways that people make a living through some illustrative graphs that I presented. I plan to explore these themes in greater depth and write a paper about it in the coming months, as I

believe there is much that we do not understand about the ways in which these forest programmes have much broader, unintended consequences that can affect all aspects of community life.

With regards to forest-based carbon offsets, I believe that ICICO and its member communities still have a lot to teach us about the ways in which these projects are impacting them. As described in Section 4, communities can stand to receive truly large amounts of money from participating in FBCOs, much more than they could aspire to obtain from forestry, PES, ecotourism, or any other source. This will undoubtedly have long-term implications with regards to benefit and cost distribution, livelihood transitions, migration, etc. As part of the ROSES team, we aim to continue working with ICICO communities to explore these issues. For instance, we are currently developing a survey instrument that we plan pilot during the summer of 2027 and that will focus on perceptions of fairness of cost and benefit distribution. A longer-term research idea is to follow a community from their initial approach with ICICO and throughout the development of its FBCO project, which would yield richer and more nuanced insights about ICICOs participatory processes. From an empirical point of view, the proposed application of the resilience spectrum concept (HLPE, 2025) could be employed in further works to determine whether and under which conditions FBCO projects can contribute to equitably transformative resilience, including through comparative case studies.

From a methodological standpoint, this thesis could inspire other transdisciplinary research that directly addresses the complicated and elusive issue of scale: how can we complement the broad, generalizable findings from a national scale of analysis with the in-depth and participatory but highly context-specific ones from place-based research? While doing so requires a mix of skills that not many individuals are likely to possess, collaborations across disciplines can be extremely rewarding, as I have learnt from my work with the ROSES team, and can lead to the questioning of deeply held assumptions. It may seem like this thesis is the result of not being able settle on one single approach or perspective, but in fact I purposefully attempted to use all the skills I have learnt throughout my winding career to address the scale problem, which has long interested me. I hope that more work can bridge this divide and contribute to a more comprehensive understanding of forest decentralization policies in community contexts.

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## APPENDIX I – List of datasets included in national-level analysis

List of datasets that were compiled, cleaned and mapped for the national-level analysis, indicating their sources and the dates in which they were accessed.

| Data | Type | Description | Time frame | Source / URL | Date accessed |
|---|---|---|---|---|---|
| PES - National 2018 | Shapefile | PES polygons including beneficiary information and amounts for PSA-H, PSA-B, FPB and Especiales | 2003-2018 | CONAFOR's Ecosystem Services office | Dec-18 |
| PES - Matching Funds | Shapefile | Mecanismos locales y fondos concurrentes polygons, beneficiaries and amounts | 2008-2018 | CONAFOR's Ecosystem Services office | Dec-18 |
| PES - National 2019, 2020, 2021,2022 | Shapefile | PES polygons for remaining years | 2019-2022 | CONAFOR: https://snif.cnf.gob.mx/programas-y-apoyos/# | Feb-22 |
| PES - Matching Funds 2019, 2020, 2021, 2022 | Shapefile | Polygons for remaining years | 2019-2022 | CONAFOR: https://snif.cnf.gob.mx/programas-y-apoyos/# | Feb-24 |
| PES - Fondo Patirmonial de Biodiversidad | Shapefile | PES FPB polygons from 2021 and 2022, not included in the other PES files | 2021-2022 | CONAFOR: http://idefor.cnf.gob.mx/ | Mar-24 |
| RAN Agrarian Nuclei | Shapefile | Polygons and names of agrarian nuclei, no dates | N/A | RAN: https://datos.gob.mx/busca/dataset/datos-geograficos-perimetrales-de-los-nucleos-agrarios-certificados-por-estado--formato-shape | Feb-22 |
| Wildlife Management Units (UMAs) | Shapefile | Polygons, names and dates | 1992-2007 | SEMARNAT: http://www.conabio.gob.mx/informacion/gis/ | Feb-18 |
| UMAs | Shapefile | Polygons but no dates | ? | SEMARNAT: https://gisviewer.semarnat.gob.mx/geointegrador2Beta/index.html | Oct-23 |
| Voluntary Protected Areas (ADVCs) | Shapefile | Polygons, property type, dates, names | 2003-2021 | CONANP: http://sig.conanp.gob.mx/website/interactivo/advc/ | Feb-22 |
| Land cover | Shapefile | Land cover as vectors, comprehensive list | 2018 | INEGI: http://www.conabio.gob.mx/informacion/gis/ | Feb-22 |

| | | | | | |
|---|---|---|---|---|---|
| Land cover | GeoTIFF | Land cover as raster file, simplified categories | 2010, 2020 | CONABIO: http://geoportal.conabio.gob.mx/metadatos/doc/html/nalcmsmx30gw.html | Oct-23 |
| Manufacture | CSV | List of manufacture activities with coordinates and names | 2010-2020 | INEGI: https://www.inegi.org.mx/app/descarga/default.html | Feb-22 |
| Tourism | CSV | List of accomodation service providers with coordinates and names | 2010-2020 | INEGI: https://www.inegi.org.mx/app/descarga/default.html | Feb-22 |
| Forest management authorizations | Shapefile | Polygons of nuclei with permits, not polygons of extraction. Names, dates (weird), contains about 2,800 | 1914-2028? | CCMSS: https://comunidadesybosques.ccmss.org.mx/autorizaciones_aprovechamiento.php | Mar-22 |
| Forest management authorizations | CSV | List of agrarian nuclei with permits, no coordinates, contains about 2,600 | 1995-2018 | CCMSS: https://comunidadesybosques.ccmss.org.mx/autorizaciones_aprovechamiento.php | Mar-22 |
| Forest management certifications (FSC) | CSV | List of certified communities including name and date, no coordinates | 2015-2020 | CCMSS: https://comunidadesybosques.ccmss.org.mx/certificacion_forestal.php | Mar-22 |
| Forest management certifications (NOM) | CSV | List of certified communities including name and date, no coordinates | 2017-2020 | CCMSS: https://comunidadesybosques.ccmss.org.mx/certificacion_forestal.php | Mar-22 |
| Forest products storage and transformation centers | CSV | Centros de almacenamiento y transformación de productos forestales, only about 170, includes names and coordinates | 2011-2019 | CCMSS: https://comunidadesybosques.ccmss.org.mx/autorizaciones_aprovechamiento.php | Mar-22 |
| Forest management autorizations | Shapefile | Polygons of nuclei with permits, only 2013 onwards (one for 2021) | 2012-2021 | CONAFOR: https://snif.cnf.gob.mx/programas-y-apoyos/# | Mar-22 |
| CONAFOR authorizations valid up to December 2023 | Shapefile | Polygons of agrarian nuclei with permits of many kinds including forest management (pmfm) | 2013-2023 | CONAFOR: https://idefor.cnf.gob.mx/layers/geonode%3Apmf_corte_dic_2023_wgs84_corregido | Feb-24 |

| | | | | | |
|---|---|---|---|---|---|
| CONAFOR authorizations valid up to June 2023 | Shapefile | Polygons of agrarian nuclei with permits of many kinds including forest management (pmfm) | 2013-2020 | CONAFOR: https://idefor.cnf.gob.mx/layers/geonode%3Apmfm_cierre_junio_2023_wgs84 | Feb-24 |
| CONAFOR authorizations | Shapefile | Polygons of agrarian nuclei with permits of many kinds including forest management (pmfm) | 2013-2021 | CONAFOR: https://idefor.cnf.gob.mx/layers/geonode%3A_4326_pmf | Feb-24 |
| CONAFOR certified nuclei | Shapefile | Polygons of nuclei certified by FSC or NOM as of June 2022 | ?-2022 | CONAFOR: https://idefor.cnf.gob.mx/layers/geonode%3Acertificaciones_corte_junio_2024 | Feb-24 |
| Forest management authorizations 1995-2018 | CSV | List of "current" permits, no geodata (aprovechamientos_vigentes_003_064.csv) | 1995-2018 | CONAFOR - Datos abiertos: https://datos.gob.mx/busca/dataset/autorizaciones-y-aprovechamientos-forestales/resource/53452377-e558-4c52-a030-c1333e71e601 | Oct-23 |
| Municipalities | Shapefile | Municipality polygons and names | 2018 | INEGI – idegeo: https://idegeo.centrogeo.org.mx/interactive/layers | Apr-22 |
| Population size 2010 | Shapefile | Locality population sizes according to the 2010 census | 2010 | INEGI: http://www.conabio.gob.mx/informacion/gis/ | May-22 |
| Population size 2020 | CSV | Locality population sizes according to the 2020 census | 2020 | INEGI: https://www.inegi.org.mx/programas/ccpv/2020/default.html#Microdatos | May-22 |
| SIAP: Agriculture | CSV | Municipality-level data on agricultural production, split into crops, including surface, volume and price | 2003-2020 | SIAP: http://infosiap.siap.gob.mx/gobmx/datosAbiertos.php | Jun-22 |
| SIAP: Animal products | CSV | Municipality-level data on animal products, split into types, including volume and value | 2006-2020 | SIAP: http://infosiap.siap.gob.mx/gobmx/datosAbiertos.php | Jun-22 |
| IRDef 2018 | tif | Raster file, indicator of economic pressure for deforestation constructed with data from 2014-2017 | 2018 | Amerigeoss: https://data.amerigeoss.org/es/dataset/economia-sectorial-ambiental-y-de-recursos-naturales/resource/6d7e93aa-a6bc-403d-900a-a53ff3fe13dd | Aug-25 |

**APPENDIX II – 2023 consent forms and guides**

These materials correspond to the fieldwork I carried out in the summer of 2023 in La Trinidad Ixtlán and San Juan Lachao. All interviews and workshops were conducted by me and my research assistant, Jimena Deschamps Lomelí. All materials were approved by the Université du Québec en Outaouais ethics review board in 2023.

**A. Consent form for interviews**

# Dinámicas de subsistencia y gestión territorial en comunidades forestales mexicanas

Por la presente solicitamos su participación en este proyecto de investigación, cuyo objetivo es comprender mejor **la historia de las decisiones sobre el uso del territorio de la comunidad y cómo éstas afectan a las decisiones futuras**. Este proyecto está financiado por la **Fundación de Investigación de Flandes (FWO)**. El objetivo principal es estudiar cómo cambia la importancia de las actividades relacionadas con los bosques para las economías comunitarias en función del uso histórico y de la participación en programas de conservación.

El día de hoy, [ ], le invitamos a participar en una entrevista que consiste **en responder a preguntas sobre la historia de esta comunidad y sobre cómo ha decidido gestionar su tierra y sus recursos naturales**. La entrevista durará aproximadamente una hora. Con su permiso, nos gustaría filmar y grabar esta entrevista. Estamos realizando un vídeo en colaboración con el Comisariado de Bienes Comunales para registrar la historia de esta comunidad a perpetuidad. Con su permiso, incluiremos su nombre en el vídeo. **Esto significaría que renuncia a su derecho al anonimato**. También podremos grabar sólo el sonido y utilizar extractos sin incluir su nombre.

Los datos recogidos en el marco de este proyecto de investigación serán tratados de conformidad con las leyes y reglamentos aplicables en la provincia de Quebec y los reglamentos y políticas de la Universidad de Quebec en Outaouais. Los resultados se difundirán en **un informe y una presentación a la comunidad, en artículos y presentaciones científicas y en la tesis doctoral de la investigadora.** Los datos recogidos se guardarán en una computadora y disco duro externo protegidos con contraseña, y la única persona que tendrá acceso a ellos será Andrea Alatorre Troncoso. El video final será compartido con la comunidad.

**El resto de los datos se destruirán en cinco años**, a menos que ustedes acepten que sus datos se conserven para análisis secundarios.

**Su participación en este proyecto de investigación es voluntaria**. Usted es totalmente libre de participar o no, y de retirarse en cualquier momento sin perjuicio alguno. Los riesgos asociados a su participación son **mínimos** y la investigadora se compromete a poner los medios necesarios para reducirlos o mitigarlos. Contribuir al avance del conocimiento sobre la **silvicultura comunitaria y la conservación** es un beneficio directo previsto. Del mismo modo, el vídeo obtenido se compartirá con usted y con el resto de la comunidad. No hay compensación monetaria.

Este proyecto de investigación ha sido aprobado por el comité de ética. Si tiene alguna pregunta sobre este proyecto de investigación, póngase en contacto con **Andrea Alatorre Troncoso (alaa22@uqo.ca)**. Si tiene alguna pregunta sobre los aspectos éticos de este proyecto, póngase en contacto con **André Durivage (andre.durivage@uqo.ca)**, presidente del Comité de Ética de la Investigación de la Universidad de Quebec en Outaouais.

**USO SECUNDARIO DE LOS DATOS**

Con su permiso, nos gustaría poder conservar los datos recogidos al final de este proyecto para otras actividades de investigación en los ámbitos de la **silvicultura comunitaria y conservación**, bajo la responsabilidad de **Andrea Alatorre Troncoso**. Para preservar sus datos personales y su identidad, los datos se anonimizarán, es decir, ya no será posible que nadie los relacione con su identidad. Nos comprometemos a respetar las mismas normas éticas que para este proyecto. No es necesario dar su consentimiento para participar en este proyecto de investigación. Si da su consentimiento, sus datos se conservarán durante un periodo de **diez años** tras la finalización de este proyecto y después se destruirán.

**CONSENTIMIENTO VERBAL**

1. **¿Está de acuerdo en participar en esta investigación?**
2. **¿Está de acuerdo con que lo/la grabemos?**
3. **¿Está de acuerdo con una grabación de vídeo o prefiere una grabación de audio?**
4. **¿Está de acuerdo con que se utilice su nombre en el vídeo que se producirá?**
5. **¿Está de acuerdo en que utilicemos sus datos para futuras investigaciones?**

## B. Consent form for focus group workshops

Por la presente solicitamos su participación en este proyecto de investigación, cuyo objetivo es comprender mejor **la historia de las decisiones sobre el uso del territorio de la comunidad y cómo éstas afectan a las decisiones futuras**. Este proyecto está financiado por la **Fundación de Investigación de Flandes (FWO)**. El objetivo principal es estudiar cómo cambia la importancia de las actividades relacionadas con los bosques para las economías comunitarias en función del uso histórico y de la participación en programas de conservación.

El día de hoy, [ ], los invitamos a participar en un taller que consiste en **revisar, editar y completar una línea de tiempo de fechas y acontecimientos clave que cuenten la historia de su comunidad, discutiendo con miembros de su comunidad y reflexionando sobre su historia compartida y cómo influye en el presente y el futuro**. Se tomarán fotografías y vídeos del mapa a lo largo del ejercicio, sin captar sus rostros. Se grabará el audio del proceso y también se tomarán notas físicas.

Dado que participarán en una discusión con otros miembros de la comunidad, no podemos garantizar su confidencialidad. No obstante, los datos se codificarán y se comunicarán de forma anónima de acuerdo con las leyes y reglamentos aplicables en la provincia de Quebec y los reglamentos y políticas de la Universidad de Quebec en Outaouais. **No se asociará ninguna información que pueda identificarlos a las grabaciones de audio transcritas y las notas tomadas durante el ejercicio no identificarán a las personas.** Se tendrá cuidado de no tomar fotos o vídeos en los que aparezcan los rostros de las personas. Por último, los resultados de la investigación se presentarán a nivel regional.

Los resultados se difundirán en **un informe y una presentación a la comunidad, así como en artículos y presentaciones científicas y en la tesis doctoral de la investigadora**. Del mismo modo, en colaboración con el Comisariado de Bienes Comunales, **se producirá un vídeo** utilizando imágenes del mapa las actividades de hoy para contar la historia de la gestión de la tierra de la comunidad. Los datos recogidos se guardarán en una computadora y disco duro externo protegidos con contraseña, y la única persona que tendrá acceso a ellos será Andrea Alatorre Troncoso. El video final será compartido con la comunidad. **El resto de los datos se destruirán en cinco años**, a menos que ustedes acepten que sus datos se conserven para análisis secundarios.

**Su participación en este proyecto de investigación es voluntaria**. Usted es totalmente libre de participar o no, y de retirarse en cualquier momento sin perjuicio alguno. Si desean retirarse del ejercicio, pueden solicitar que se borren sus adiciones a la línea del tiempo. Los riesgos asociados a su participación son **mínimos** y la investigadora se compromete a poner los medios necesarios para reducirlos o mitigarlos. Contribuir al avance del conocimiento sobre la **silvicultura comunitaria y la conservación** es un beneficio directo previsto. Del mismo modo, el vídeo obtenido se compartirá con usted y con el resto de la comunidad. No hay compensación monetaria.

Este proyecto de investigación ha sido aprobado por el comité de ética. Si tiene alguna pregunta sobre este proyecto de investigación, póngase en contacto con **Andrea Alatorre Troncoso (alaa22@uqo.ca)**. Si tiene alguna pregunta sobre los aspectos éticos de este proyecto, póngase en contacto con **André Durivage (andre.durivage@uqo.ca)**, presidente del Comité de Ética de la Investigación de la Universidad de Quebec en Outaouais.

**USO SECUNDARIO DE LOS DATOS**

Con su permiso, nos gustaría poder conservar los datos recogidos al final de este proyecto para otras actividades de investigación en los ámbitos de la **silvicultura comunitaria y conservación**, bajo la responsabilidad de **Andrea Alatorre Troncoso**. Para preservar sus datos personales y su identidad, los datos se anonimizarán, es decir, ya no será posible que nadie los relacione con su identidad. Nos comprometemos a respetar las mismas normas éticas que para este proyecto. No es necesario dar su consentimiento para participar en este proyecto de investigación. Si da su consentimiento, sus datos se conservarán durante un periodo de **diez años** tras la finalización de este proyecto y después se destruirán.

**CONSENTIMIENTO VERBAL**

1. **¿Están de acuerdo en participar en esta investigación?**
2. **¿Están de acuerdo en ser grabados?**
3. **¿Aceptan que se tomen fotos y vídeos durante el taller?**
4. **¿Aceptan que utilicemos sus datos para futuras investigaciones?**

### C. Semi-structured interview guide

Fecha: Número de archivo:

Lugar: Nombre de la entrevistadora:

Hora de inicio:

Hora de fin:

Buenos días/tardes,

Soy Andrea Alatorre Troncoso y soy estudiante de doctorado en el Departamento de Ciencias Naturales de la Universidad de Quebec en Outaouais. Como mencioné en nuestra comunicación inicial, el objetivo principal de este proyecto de investigación es estudiar cómo cambia la importancia de las actividades relacionadas con el bosque para la economía de las comunidades en función de los usos históricos y de la participación en programas de conservación y silvicultura. Dado que otros miembros de la comunidad le han identificado como una persona con un profundo conocimiento de la historia de esta comunidad, quería tomarme el tiempo de conocerle para hacerle algunas preguntas. Antes de la entrevista propiamente dicha, vamos a leer juntos el formulario de consentimiento para asegurarnos de que entiende lo que implica su participación en la investigación.

*[Presentación del formulario de consentimiento]*

PREGUNTAS GUÍA:

1. ¿Puede hablarnos un poco de usted, de dónde es y cuánto tiempo lleva viviendo aquí?

2. ¿Qué cargos ha ocupado en las estructuras de gobierno de la comunidad?

3. Estoy intentando comprender las diferentes opciones de que disponen las comunidades de esta región para gestionar su territorio. ¿Puede enumerar y describir brevemente los programas, proyectos o iniciativas de los que tenga conocimiento y en los que participe o haya participado la comunidad?

4. En su opinión, ¿qué grado de autonomía tienen o han tenido las comunidades en la transición de cada una de estas iniciativas o acontecimientos? ¿Se puede considerar que tomaron estas decisiones o fueron impuestas por el contexto?

5. Más concretamente, cuando hablamos de toma de decisiones comunitaria, ¿quién toma las decisiones en la comunidad? ¿Se deja de lado a algún grupo de personas? ¿Qué es una comunidad?

6. ¿Qué sabe de la historia de la comunidad y de sus recursos naturales? ¿Cuándo se fundó? ¿Cómo se ganaba la vida la gente en aquella época? ¿Cómo ha cambiado esto con el tiempo?

7. ¿Cómo cree que los acontecimientos o las decisiones del pasado influyen en las decisiones futuras sobre la gestión del uso de la tierra? ¿Puede dar ejemplos concretos?

8. Todos tenemos una idea diferente de cómo debería ser el futuro. Según su experiencia, ¿a qué futuro(s) aspira esta comunidad? ¿Qué factores influyen en su capacidad para alcanzar sus objetivos?

### D. Guide for participatory mapping workshops

Fecha: Número de archivo:

Lugar: Nombre de la facilitadora:

Hora de inicio:

Hora de fin:

**Observaciones generales:**

| | |
|---|---|
| Número de participantes | |
| Género de los participantes | |
| Ambiente general al inicio | |
| Personas que sobresalen | |
| Comentarios reflexivos | |

Buenos días/tardes,

Soy Andrea Alatorre Troncoso y soy estudiante de doctorado en el Departamento de Ciencias Naturales de la Universidad de Québec en Outaouais. Gracias a todos por estar aquí. Algunos de ustedes ya han participado activamente en mi proyecto de investigación y les estoy especialmente agradecida. Como muchos de ustedes saben, en los últimos días he estado documentando la historia de su comunidad, primero hablando con individuos y luego organizando debates en grupo. La línea de tiempo que presento aquí es una integración de todas estas discusiones por separado. El objetivo del taller de hoy es utilizar esta línea de tiempo colectiva como referencia para describir espacialmente dónde tuvieron lugar algunos de estos acontecimientos o actividades, y los cambios resultantes en su paisaje. Quiero dejar claro que el mapa resultante permanecerá en la comunidad, y que el ejercicio no se trata de juzgar sus habilidades de dibujo o de geografía sino de aprender juntos sobre la historia de la comunidad.

Antes de iniciar la discusión como tal, vamos a examinar juntos el formulario de consentimiento que explica con detalle lo que implica su participación en la investigación.

*[Presentación del formulario de consentimiento]*

*[Presentación de la imagen de satélite y de las canastas de materiales]*

Ésta es la base del mapa que van a construir juntos. Se trata de una imagen aérea de alta resolución de su comunidad, tal y como está delimitada por el registro agrario nacional (RAN). También verán una canasta con plumones y calcomanías que podrán utilizar como ustedes quieran. No duden en echar un ojo y compartir sus primeras impresiones.

¿Prefieren empezar por el pasado e ir hasta el presente? ¿O empezar por la fecha actual y trabajar hacia atrás?

*[Se procede a la votación]*

Como primer paso, sugiero marcar las características del paisaje que no han cambiado desde el inicio de la línea de tiempo, como ríos, carreteras, etc.

Ahora, tomemos el punto de referencia que hayamos elegido (pasado o presente) y utilicemos los materiales proporcionados para rellenar el mapa de modo que tenga el aspecto que tenía en esa época.

La idea ahora es empezar a modificar el mapa para que refleje los cambios que se han producido a lo largo de los años. Debemos elegir un intervalo de tiempo que tenga sentido: ¿los cambios serán cada dos años? ¿Cada cinco años? ¿Qué le parece?

*[Tomar una foto del mapa desde la cámara montada en un trípode, mirando hacia abajo, en cada intervalo de tiempo elegido]*

**Preguntas guía para el resto del proceso:**

- ¿Por qué eligieron este color/figura/material para representar esta actividad/uso de la tierra?
- ¿Por qué se produjo este cambio o acontecimiento? ¿Fue facilitado o provocado por decisiones o acontecimientos anteriores?
- ¿Por qué se produjo este cambio en el uso de la tierra o esta actividad en este lugar concreto? ¿Quién lo decidió?
- ¿Cómo cree que serían las cosas hoy si este cambio/acontecimiento no hubiera tenido lugar? ¿O si hubiera ocurrido en otro lugar?
- ¿Cree que otros miembros de la comunidad son conscientes de que se ha producido este cambio/evento? ¿Y las generaciones más jóvenes?

Ahora que hemos llegado a [el año actual o de referencia], les invito a que observen la segunda imagen aérea para ver hasta qué punto coincide con sus recuerdos del aspecto que debía tener el paisaje en aquella época. ¿Ven algo en la imagen que falte en su mapa o que no esté en el lugar correcto? ¿O falta algo en la imagen que ustedes hayan incluido en su mapa?

Por último, les invito a que añadan una o varias capas finales para representar cómo les gustaría que fuera el futuro. Este futuro puede ser mañana, dentro de 10 años o cuando ustedes quieran. ¿Qué cambios les gustaría ver en su comunidad? ¿Qué tendría que ocurrir ahora para que se produjeran estos cambios? ¿Qué probabilidad creen que tiene este futuro y por qué?

**E. Invitation to attend focus group timeline workshops (example)**

# Invitación a participar en un taller de línea del tiempo

Nos complace invitarle a participar en un proyecto de investigación titulado "**Dinámicas de medios de subsistencia y gestión territorial en comunidades forestales mexicanas**"*. Este

proyecto está dirigido por **Andrea Alatorre Troncoso**, estudiante de doctorado del Departamento de Ciencias Naturales de la **Universidad de Quebec en Outaouais** (UQO). El objetivo de este proyecto es comprender cómo influye la historia sobre la toma de decisiones en torno al territorio.

Esperamos contar con su presencia durante la siguiente actividad:

## Construcción de una línea de tiempo de la historia de la comunidad



- **¿Dónde?** Salón del cabildo del palacio municipal de San Juan Lachao.
- **¿Cuándo?** Domingo 6 de agosto, 10 am.
- **¿Qué implica?** Participar en un ejercicio de discusión grupal sobre los eventos clave que han dado forma a la comunidad y sus esperanzas para el futuro. Se proporcionarán bebidas y una pequeña botana.
- **¿Cuánto tiempo dura la actividad?** Entre 2 y 3 horas.

Durante estos ejercicios se tomarán notas, grabaciones de audio, fotos y/o vídeos con su permiso. **Le agradecemos de antemano su interés y su apoyo.**

* El proyecto cuenta con la aprobación del Comisariado de Bienes Comunales y la Alcaldía Municipal, así como del Comité de Ética de la UQO.

**F. Invitation to attend screening of video documentary (example)**

## **INVITACIÓN**: PROYECCIÓN DE UN VIDEO SOBRE LA HISTORIA DE LA TRINIDAD IXTLÁN

La Bióloga y Maestra en Ciencias **Andrea Alatorre Troncoso** conoció La Trinidad Ixtlán por primera vez en 2018, cuando realizó parte de sus estudios de maestría en la comunidad, en colaboración con la **Integradora de Comunidades Indígenas y Campesinas de Oaxaca**

(ICICO). Actualmente es candidata al grado de **Doctora en Economía Ecológica** por la **Universidad de Quebec**, en Canadá, en donde estudia los **cambios en los medios de vida y el uso de la tierra en las comunidades forestales de México**.

El año pasado, el Comisariado de Bienes Comunales invitó a la Maestra a realizar parte de sus **estudios de doctorado** en La Trinidad Ixtlán, bajo el acuerdo de que sus resultados serían compartidos con la comunidad. El día **viernes 8 de noviembre de 2024 a las 6pm, frente a la Agencia Municipal**, Andrea Alatorre Troncoso presentará un **corto documental sobre la historia de La Trinidad Ixtlán**, preparado a través de las entrevistas, talleres y recorridos de campo realizados durante su estancia. El evento será abierto al público.

La Maestra extiende una **cordial invitación a las y los habitantes de La Trinidad Ixtlán** a asistir a su presentación, en particular a aquellos que **participaron de diversas formas en su trabajo de investigación**. El video será entregado al Comisariado de Bienes Comunales, el cual manejará su difusión a través de las redes sociales más adelante.

Esperamos contar con su presencia.

Saludos cordiales,

Andrea Alatorre Troncoso

Candidata al doctorado en economía ecológica

Universidad de Quebec en Outaouais

## APPENDIX III – Characteristics of interview participants (2023)

Full list of interview participants from the semi-structured interviews conducted by me in La Trinidad Ixtlán and San Juan Lachao in 2023.

| Municipality | Community | Informant number | Sex | Age | Main livelihood | Secondary livelihood | Influence | Economic precarity | Highest cargo | Highest cargo (2) | Attends assemblies | Highest cargo type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| San Juan Lachao | Pueblo Nuevo | 1 | Male | 75 | Coffee | Government programs | Medium | Insecure | Presidente Municipal | Presidente CBC | No - Not anymore | Both |
| San Juan Lachao | Pueblo Nuevo | 2 | Female | 82 | Coffee | Unassigned | Medium | Secure | Unassigned | Unassigned | Unassigned | Unassigned |
| San Juan Lachao | Pueblo Nuevo | 3 | Female | 78 | Coffee | Small business | Low | Insecure | Not Applicable | Not Applicable | Unassigned | Not Applicable |
| San Juan Lachao | Pueblo Nuevo | 4 | Male | 70 | Coffee | Cattle | High | Wealthy | Presidente Municipal | Presidente CBC | No - Not anymore | Both |
| San Juan Lachao | Rancho Nuevo | 5 | Male | 77 | Coffee | Other agriculture | Medium | Secure | Suplente presidente municipal | Alcalde constitucional | No - Not anymore | Municipality |
| San Juan Lachao | Rancho Nuevo | 6 | Male | 59 | Trade/temp | Other agriculture | High | Secure | Presidente CBC | Unassigned | Yes | Unassigned |
| San Juan Lachao | Rancho Nuevo | 7 | Male | 34 | Trade/temp | Forest management unit | Medium | Secure | Unassigned | Unassigned | Yes | Comisariado |
| San Juan Lachao | Rancho Nuevo | 8 | Female | 50 | Unassigned | Trade/temp | Medium | Insecure | Unassigned | Unassigned | Unassigned | Unassigned |
| San Juan Lachao | Río Oriente | 9 | Female | 35 | Homemaking | Forest management unit | Low | Secure | Unassigned | Unassigned | Unassigned | Unassigned |
| San Juan Lachao | Río Oriente | 10 | Male | 65 | Coffee | Other agriculture | High | Secure | Presidente Municipal | Regidor | No - Not anymore | Municipality |
| San Juan Lachao | Pueblo Nuevo | 11 | Male | 67 | Cattle | Coffee | Medium | Wealthy | Presidente Municipal | Suplente CBC | No - Not anymore | Both |
| San Juan Lachao | Pueblo Nuevo | 12 | Male | 78 | Other agriculture | Trade/temp | High | Secure | Presidente Municipal | Suplente CBC | No - Not anymore | Both |
| San Juan Lachao | Pueblo Nuevo | 13 | Female | 91 | Coffee | Trade/temp | Low | Insecure | Unassigned | Unassigned | Not Applicable | Unassigned |
| San Juan Lachao | Pueblo Nuevo | 14 | Male | 76 | Government programs | Coffee | Medium | Wealthy | Presidente Municipal | Unassigned | No - Not anymore | Municipality |
| San Juan Lachao | Santa Cruz | 15 | Male | 70 | Coffee | Other agriculture | Low | Secure | Suplente regidor | Unassigned | Unassigned | Municipality |
| San Juan Lachao | El Ocote | 16 | Female | 49 | Cattle | Other agriculture | Low | Secure | Unassigned | Unassigned | Unassigned | Unassigned |
| San Juan Lachao | El Ocote | 17 | Female | 60 | Unassigned | Unassigned | Low | Secure | Unassigned | Unassigned | Unassigned | Unassigned |
| San Juan Lachao | El Ocote | 18 | Female | 65 | Unassigned | Unassigned | Low | Secure | Unassigned | Unassigned | Unassigned | Unassigned |
| San Juan Lachao | La Reforma | 19 | Male | 60 | Animal rearing | Other agriculture | High | Secure | Presidente CBC | Unassigned | No - Not anymore | Comisariado |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| San Juan Lachao | Pueblo Nuevo | 20 | Male | 35 | Trade/temp | Animal rearing | High | Secure | Presidente Municipal | Consejo consultivo | Yes | Both |
| San Juan Lachao | Pueblo Nuevo | 21 | Female | 31 | Migration and remittances | Forest management unit | Low | Secure | Unassigned | Unassigned | No - Never | Unassigned |
| San Juan Lachao | Pueblo Nuevo | 22 | Male | 60 | Cattle | Other agriculture | Medium | Secure | Presidente CBC | Alcalde constitucional | Yes | Both |
| San Juan Lachao | Pueblo Nuevo | 23 | Female | 70 | Small business | Unassigned | Low | Secure | Unassigned | Unassigned | Unassigned | Municipality |
| San Juan Lachao | Río Oriente | 24 | Male | 49 | Trade/temp | Unassigned | High | Secure | Presidente CBC | Regidor | Yes | Both |
| San Juan Lachao | Pueblo Nuevo | 25 | Male | 60 | Other agriculture | Trade/temp | Medium | Secure | Unassigned | Unassigned | Unassigned | Municipality |
| San Juan Lachao | Santa Rosa | 26 | Female | 88 | Coffee | Trade/temp | Low | Secure | Unassigned | Unassigned | Unassigned | Unassigned |
| San Juan Lachao | Santa Rosa | 28 | Male | 70 | Coffee | Government programs | Low | Secure | Agente municipal | Comité de escuelas | No - Not anymore | Municipality |
| San Juan Lachao | Santa Rosa | 29 | Male | 50 | Apiculture | Coffee | Low | Secure | Alcalde constitucional | Agente municipal | Yes | Municipality |
| San Juan Lachao | Pueblo Nuevo | 30 | Female | 49 | Trade/temp | Unassigned | Low | Secure | Síndico municipal | Comité de contraprestaciones | Yes | Municipality |
| San Juan Lachao | Pueblo Nuevo | 31 | Female | 85 | Small business | Government programs | Low | Unassigned | Unassigned | Unassigned | Unassigned | Unassigned |
| San Juan Lachao | Pueblo Nuevo | 32 | Female | 60 | Cattle | Coffee | Medium | Wealthy | Presidente Municipal | Clínica | Yes | Municipality |
| San Juan Lachao | Lachao Viejo | 33 | Male | 80 | Other agriculture | Unassigned | High | Secure | Agente municipal | Comité de escuelas | No - Not anymore | Municipality |
| San Juan Lachao | Lachao Viejo | 34 | Male | 72 | Other agriculture | Coffee | Low | Secure | Agente municipal | Suplente agente municipal | No - Not anymore | Municipality |
| San Juan Lachao | Santa Rosa | 35 | Male | 83 | Coffee | Other agriculture | Low | Secure | Agente municipal | Unassigned | No - Not anymore | Unassigned |
| San Juan Lachao | Santa Rosa | 36 | Male | 50 | Small business | Unassigned | Medium | Secure | Agente municipal | Síndico | Yes | Municipality |
| San Juan Lachao | Pueblo Nuevo | 37 | Female | 62 | Homemaking | Other agriculture | Medium | Secure | Unassigned | Unassigned | No - Not anymore | Unassigned |
| San Juan Lachao | Pueblo Nuevo | 38 | Male | 55 | Other agriculture | Trade/temp | High | Secure | Suplente agente municipal | Unassigned | Yes | Municipality |
| Santiago Xiacuí | La Trinidad Ixtlán | 1 | Male | 83 | Other agriculture | Unassigned | Medium | Secure | Agente municipal | Presidente CBC | No - Not anymore | Both |
| Santiago Xiacuí | La Trinidad Ixtlán | 2 | Female | 59 | Trade/temp | Other agriculture | Low | Insecure | Comité de escuelas | Clínica | Yes | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 3 | Female | 82 | None | Not Applicable | Low | Insecure | Unassigned | Unassigned | No - Never | Unassigned |
| Santiago Xiacuí | La Trinidad Ixtlán | 4 | Female | 72 | Homemaking | Trade/temp | Low | Secure | Comité de escuelas | Clínica | No - Never | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 5 | Female | 44 | Homemaking | Unassigned | Low | Insecure | Comité de escuelas | Iglesia | No - Never | Other - Comites |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Santiago Xiacuí | La Trinidad Ixtlán | 6 | Female | 45 | Homemaking | Unassigned | Low | Unassigned | Iglesia | Unassigned | No - Never | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 7 | Female | 53 | Trade/temp | Unassigned | Medium | Secure | Ecoturismo | Comité de escuelas | Yes | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 8 | Female | 72 | Homemaking | Small business | Low | Secure | Comité de escuelas | Not Applicable | No - Never | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 9 | Male | 73 | Other agriculture | Unassigned | Low | Secure | Agente municipal | Alcalde constitucional | No - Not anymore | Municipality |
| Santiago Xiacuí | La Trinidad Ixtlán | 10 | Female | 55 | Small business | Other agriculture | Medium | Secure | Comité de escuelas | Unassigned | Unassigned | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 11 | Male | 85 | Other agriculture | Cattle | Medium | Secure | Jefe de monte | Tesorero municipal | No - Not anymore | Both |
| Santiago Xiacuí | La Trinidad Ixtlán | 12 | Male | 76 | Trade/temp | Small business | High | Wealthy | Agente municipal | Presidente CBC | No - Not anymore | Both |
| Santiago Xiacuí | La Trinidad Ixtlán | 13 | Male | 91 | Other agriculture | Forest management unit | Medium | Secure | Agente municipal | Suplente CBC | No - Not anymore | Both |
| Santiago Xiacuí | La Trinidad Ixtlán | 14 | Female | 28 | Forest management unit | Homemaking | Medium | Secure | Not Applicable | Not Applicable | No - Never | Unassigned |
| Santiago Xiacuí | La Trinidad Ixtlán | 15 | Male | 70 | Other agriculture | Trade/temp | Medium | Wealthy | Secretario CBC | Secretario municipal | Unassigned | Both |
| Santiago Xiacuí | La Trinidad Ixtlán | 16 | Male | 80 | Forest management unit | Other agriculture | Medium | Secure | Agente municipal | Presidente vigilancia CBC | No - Not anymore | Both |
| Santiago Xiacuí | La Trinidad Ixtlán | 17 | Female | 50 | Other agriculture | Unassigned | Medium | Secure | Comité de escuelas | Consejo consultivo | No - Never | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 18 | Male | 69 | Trade/temp | Unassigned | Medium | Secure | Agente municipal | Alcalde constitucional | Yes | Municipality |
| Santiago Xiacuí | La Trinidad Ixtlán | 19 | Female | 50 | Forest management unit | Trade/temp | Medium | Secure | Clínica | Unassigned | No - Never | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 20 | Male | 75 | Government programs | Unassigned | Unassigned | Wealthy | Vigilancia CBC | Consejo consultivo | No - Not anymore | Comisariado |
| Santiago Xiacuí | La Trinidad Ixtlán | 22 | Female | 43 | Unassigned | Unassigned | Low | Wealthy | Comité de banda | Unassigned | No - Never | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 23 | Male | 76 | Small business | Unassigned | Low | Secure | Alcalde constitucional | Unassigned | No - Not anymore | Municipality |
| Santiago Xiacuí | La Trinidad Ixtlán | 24 | Female | 72 | Small business | Unassigned | Low | Secure | Comité de escuelas | Unassigned | No - Never | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 25 | Male | 35 | Small business | Trade/temp | Medium | Wealthy | Secretario municipal | Forest management unit | Yes | Both |
| Santiago Xiacuí | La Trinidad Ixtlán | 26 | Female | 72 | Trade/temp | Unassigned | Medium | Secure | Comité de escuelas | Unassigned | No - Never | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 27 | Female | 80 | Homemaking | Unassigned | Low | Wealthy | Comité de escuelas | Unassigned | No - Never | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 28 | Male | 35 | Trade/temp | Other agriculture | Low | Wealthy | Unassigned | Unassigned | Yes | Unassigned |
| Santiago Xiacuí | La Trinidad Ixtlán | 29 | Male | 71 | Other agriculture | Unassigned | Medium | Insecure | Agente municipal | Presidente CBC | No - Not anymore | Both |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Santiago Xiacuí | La Trinidad Ixtlán | 30 | Female | 83 | Migration and remittances | Unassigned | Low | Insecure | Unassigned | Unassigned | No - Never | Unassigned |
| Santiago Xiacuí | La Trinidad Ixtlán | 31 | Female | 93 | Trade/temp | Unassigned | Medium | Insecure | Unassigned | Unassigned | No - Never | Unassigned |
| Santiago Xiacuí | La Trinidad Ixtlán | 32 | Male | 70 | Other agriculture | Forest management unit | Low | Secure | Secretario CBC | Presidente vigilancia CBC | Unassigned | Comisariado |
| Santiago Xiacuí | La Trinidad Ixtlán | 33 | Male | 70 | Government programs | Other agriculture | High | Secure | Agente municipal | Presidente CBC | No - Not anymore | Both |
| Santiago Xiacuí | La Trinidad Ixtlán | 34 | Male | 60 | Small business | Trade/temp | Medium | Secure | Secretario municipal | Forest management unit | Yes | Both |
| Santiago Xiacuí | La Trinidad Ixtlán | 35 | Female | 29 | Small business | Unassigned | Low | Secure | Iglesia | Unassigned | No - Never | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 36 | Male | 60 | Other agriculture | Unassigned | Medium | Wealthy | Tesorero CBC | Consejo consultivo | Yes | Comisariado |
| Santiago Xiacuí | La Trinidad Ixtlán | 37 | Male | 86 | Mining | Forest management unit | Unassigned | Insecure | Suplente agente municipal | Unassigned | No - Not anymore | Municipality |
| Santiago Xiacuí | La Trinidad Ixtlán | 38 | Female | 49 | Trade/temp | Unassigned | Medium | Wealthy | Unassigned | Unassigned | No - Never | Unassigned |
| Santiago Xiacuí | La Trinidad Ixtlán | 39 | Male | 65 | Trade/temp | Government programs | High | Wealthy | Agente municipal | Presidente vigilancia CBC | Unassigned | Both |
| Santiago Xiacuí | La Trinidad Ixtlán | 40 | Female | 80 | Trade/temp | Other agriculture | Low | Secure | Presidente DIF | Comité de escuelas | No - Never | Other - Comites |
| Santiago Xiacuí | La Trinidad Ixtlán | 41 | Male | 66 | Migration and remittances | Trade/temp | High | Secure | Agente municipal | Forest management unit | Unassigned | Both |
| Santiago Xiacuí | La Trinidad Ixtlán | 42 | Male | 40 | Forest management unit | Unassigned | High | Secure | Unassigned | Unassigned | Yes | Unassigned |
| Santiago Xiacuí | La Trinidad Ixtlán | 43 | Female | 32 | Government programs | Unassigned | Low | Secure | Unassigned | Unassigned | Yes | Unassigned |
| Santiago Xiacuí | La Trinidad Ixtlán | 44 | Male | 40 | Forest management unit | Unassigned | Unassigned | Unassigned | Forest management unit | Unassigned | Yes | Unassigned |
| Santiago Xiacuí | La Trinidad Ixtlán | 45 | Male | 30 | Unassigned | Unassigned | Unassigned | Unassigned | Forest management unit | Unassigned | Yes | Comisariado |

## APPENDIX IV – 2024 consent form and interview guide

These interviews were conducted in 2024 in San Juan Lachao, Santa María Jaltianguis, Santa María Peñoles and Santiago Xiacuí by my collaborators and myself, and were originally published as part of the Masters' Project by Duke University students Brooke Rose and Melissa Arcila in 2025.

### A. Consent form for interviews

**CONSENTIMIENTO VERBAL DE LA INVESTIGACION ISEO ENTREVISTAS SOBRE VISION Y ESTRATEGIAS DE RESILENCIA COMUNITARIA**

Buenos días/tardes. Somos Elizabeth Shapiro-Garza, Brooke Rose, Melissa Arcila, Santiago Izquierdo Tort y Andrea Alatorre, y somos investigadores de la Universidad de Duke en los Estados Unidos, la Universidad Nacional Autónoma de México y la Universidad de Quebec en Outaouais. Nos complace invitarlo/a a participar en nuestro proyecto, Investigaciones de Sistemas Socio-Ecológicos de Oaxaca (ISEO) que tiene como objetivo ayudar a ICICO y a nuestro equipo de investigación a entender la visión de su comunidad y otras sobre cómo éstas pueden sostener a sus habitantes y sus bosques.

Su participación en este proyecto es completamente voluntaria. Si da su consentimiento, realizaremos una entrevista de 30 a 45 minutos de duración. Durante la entrevista, le haremos preguntas relacionadas con sus experiencias, pensamientos, perspectivas y visión para construir comunidades humanas y forestales resilientes. Puede negarse a responder cualquiera de las preguntas o dejar de participar en cualquier momento. No existen riesgos previsibles ni beneficios directos por la participación en el estudio.

Con su permiso, nos gustaría grabar el audio de la entrevista. Almacenaremos estos archivos en DukeBox, un sistema de almacenamiento seguro en la nube de la Universidad de Duke. La información que comparta con nosotros será utilizada por nuestro equipo de investigación para analizar temas comunes e informar nuestros estudios sobre la resiliencia de las comunidades y los bosques de Oaxaca. La información que nos proporcione es confidencial y no la compartiremos con nadie de una manera que permita identificarlo/a. También puede indicarnos al final de la entrevista si no desea que utilicemos alguna parte o la totalidad del contenido de la misma, en cuyo caso el archivo será borrado.

Reiteramos que su participación en esta investigación es totalmente voluntaria, y puede dejar de participar en cualquier momento.

> ¿Tiene alguna pregunta sobre nosotros y nuestra investigación?
> ¿Da su consentimiento para participar en la investigación tal como se ha descrito? ¿Nos da permiso para grabar el audio durante la entrevista?
> ¿Nos da permiso para analizar su entrevista para informar nuestras preguntas de investigación?
> ¿Nos da permiso para guardar la información que nos proporcione y utilizarla para nuestras futuras investigaciones?

**B. Interview guide**

# GUIA DE ENTREVISTA DE LA INVESTIGACIÓN ISEO FUNDAMENTO Y PERCEPCIONES DEL IMPACTO DE LAS PRÁCTICAS SILVICULTURALES

**Fecha:**
**Lugar:**
**Nombres de los entrevistadores:**

**Nombre(s) de los entrevistados/as:**

**Nombre de la persona que toma notas:**

- **Comunidad de origen:**
- **Edad:**
- **Género:**
- **Cargo actual:**
- **Cargo más alto que ha ocupado:**
- **Ocupación actual:**
- **Grado de escolaridad más alto:**
- **¿Es usted ciudadano/a? ¿Es usted comunero/a?**
- **¿Usted ha estado involucrado en el manejo forestal en su comunidad?**

o **Tequio (Sí/No):**
o **Cargo (Sí/No):**
o **Trabajo pagado (Sí/No):** o **Personal técnico (Sí/No):** o **Otro:**

**TEMA: LA VISIÓN PARA RESILENCIA COMUNITARIA**

**1.1. Visión hacia el futuro de la comunidad**

1.1.1. ¿Qué es lo que más valora de su comunidad?

*1.1.1.1. ¿Qué es lo que más valora de su bosque? (Si no lo menciona en 1.1.1)*

1.1.2. ¿Cómo le gustaría ver a su comunidad en los próximos 10 a 20 años?

*1.1.2.1. ¿Cómo le gustaría ver en su bosque en los próximos 10 a 20 años? (Si no lo menciona en 1.1.2)*

**2. Problemas principales hacia la comunidad**

2.1. ¿Cuáles son los problemas principales que afectan la capacidad de la comunidad para lograr el futuro que usted desea? *[Sugerencias: Pandemia, cambio climático y sus impactos directos, migración, cambio económico, falta de oportunidades educativas o empleo para los jóvenes, etc.]*

**3. Fundamento de las estrategias empleadas para poder sostener la comunidad a largo plazo**

3.1. ¿Qué estrategias podría utilizar su comunidad para enfrentar esos problemas y lograr el futuro que usted desea?

3.2. ¿Cree que todos en la comunidad comparten sus ideas sobre las mejores estrategias para sostener la comunidad a largo plazo? ¿Cuáles son algunas ideas diferentes y qué las motiva?

**4. Uso y decisiones sobre los bosques en la comunidad y sus reglas**

4.1. ¿Cuáles son los usos del bosque que hay aquí en la comunidad y qué proyectos se ha tenido en el bosque?

4.2. ¿Cómo se toman las decisiones sobre el uso del bosque?

4.3. ¿Cuáles son las reglas en la comunidad sobre el uso del suelo y los recursos naturales?

4.4. ¿Qué pasa si alguien no cumple con estas reglas?

**TEMA: COMPENSACIÓN DE BONOS DE CARBONO BASADA EN BOSQUES**

**4.5. Preguntas preliminares**

4.5.1. ¿Qué tanto has escuchado hablar del programa de bonos de carbono en que participa la comunidad?

4.5.2. ¿Cómo es que los miembros de la comunidad se enteran de este tipo de programa? ¿Por qué cree usted que hay algunas personas que no se enteran?

4.5.3. ¿Qué haría falta para que más gente se entere de este tipo de programa?

**4.6. Fundamento para la participación en el programa de bonos de carbonos**

4.6.1. ¿Cuáles fueron algunas de las preguntas que usted u otros miembros de la comunidad tenían cuando escucharon por primera vez sobre la venta de bonos de carbono?

4.6.2. ¿Cuáles cree que son las principales razones por las que la comunidad decidió participar en estos programas?

**TEMA: MANEJO Y PLANIFICACIÓN FORESTAL**

**5. Planificación del uso del bosque**

5.1. ¿Qué factores se tomaron en cuenta cuando se designaron las áreas para el programa de venta de bonos de carbono? ¿Hubo desacuerdos sobre qué áreas designar? Si es así, ¿por qué?

5.2. ¿Qué importancia tienen las áreas que han designado para conservación? ¿Hubo desacuerdos sobre qué áreas designar? Si es así, ¿por qué?

5.3. ¿Las áreas designadas como zonas de conservación pueden ser modificadas? Por ejemplo, ¿se pueden incluir nuevos espacios? ¿por qué?

5.4. ¿Cómo decidieron qué áreas se incorporarán al programa de manejo forestal? ¿Hubo desacuerdos sobre qué áreas designar? Si es así, ¿por qué?

5.5. ¿Las áreas designadas para manejo forestal pueden ser modificadas? Por ejemplo, ¿se pueden incluir nuevos espacios? ¿por qué?

**6. Interacción de las prácticas de manejo y prioridades**

6.1. ¿Cómo cree que puede afectar el manejo forestal a otras plantas, animales y recurso hídrico en esas áreas?

6.2. ¿Qué trabajos se realizan en las áreas de corte para minimizar los impactos del aprovechamiento forestal? ¿Se cortan todas las especies? ¿Se dejan algunas especies? ¿por qué?

6.3. ¿Hay otros trabajos complementarios que le gustaría implementar para reducir los impactos, pero que no pueden implementar? Si es así, ¿por qué no?

6.4. ¿Qué otras actividades consideran necesarias realizar en el bosque para producir bonos de carbono?

6.4.1. ¿Hay alguna diferencia en las actividades de manejo forestal cuando se producen bonos de carbono y cuando no se produce?

**6.5.** ¿La producción de bonos de carbono tiene algunos requisitos que han afectado la forma en que se manejan los bosques?

6.5.1. Si es así, ¿Cuáles son estas actividades en qué forma afectan el manejo de los bosques?

6.6. ¿Qué resultados ha observado en el bosque en la venta de bonos de carbono?

6.7. ¿Considera que al ingresar al programa de bonos de carbono los beneficios se han reducido o aumentado? ¿De qué manera? [Sugerencias: productos forestales no madereros, carbón/leña, vida silvestre, biodiversidad, agua limpia y abundante, etc.].

**7. Fundamento para decisiones específicas de manejo**

7.1. ¿Podría describir cuales son las actividades que se llevan a cabo en cada rodal? ¿Cada cuánto se realizan las podas? ¿Cada cuánto se realizan los chapeos? ¿Cuándo se lleva a cabo la matarrasa en cada rodal? ¿Qué factores influyen en esta toma de decisiones?

7.2. ¿Utilizan regeneración natural o regeneración inducida? ¿Varía esto según el área?

7.3. ¿Cuáles son algunas de las ventajas y desventajas de la regeneración natural con respecto a la regeneración inducida ?

7.4. ¿Qué consideraciones toman en cuenta al momento de decidir si emplear regeneración natural o regeneración inducida?

7.5. ¿Qué consideraciones toman en cuenta al decidir de dónde recolectar semillas de árboles para la propagación?

7.6. ¿Qué factores consideran al momento de elegir las especies que plantarán en las áreas de regeneración inducida?

7.7. ¿Cuáles son las ventajas y desventajas que nota entre las plantas producidas acá en comparación con las que trajimos desde afuera? ¿Cuáles prosperan más?

7.8. ¿Cómo deciden cuales son las áreas de corte para el año correspondiente?

7.9. ¿Qué consideraciones toman en cuenta al decidir qué plantas permitir crecer y cuáles eliminar en áreas de regeneración inducida?

7.10. ¿Cuáles otros productos no maderables pueden obtener de las áreas de manejo forestal? Por ejemplo, plantas medicinales, plantas comestibles, orquídeas (especies ornamentales)

## APPENDIX V – PES rule changes

Data compiled by Javier Hernández under a project funded by the Tinker Foundation, where I am a co-author and lead of the impact evaluation.

| | **Priority*** | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONAFOR criteria | Have not received CONAFOR support in the last 5 years | | 12.5 | 28.0 | 30.4 | 35.0 | 25.9 | 15.9 | 15.2 | 13.2 | 7.1 | 8.1 | 9.1 | 12.5 | 16.7 | 9.8 | 10.2 | 10.2 | 10.2 |
| | Self-identi es as Indigenous (and/or agrarian community) | 16.7 | 12.5 | 12.0 | 13.0 | 15.0 | 14.8 | 9.1 | 8.7 | 7.6 | 9.5 | 10.8 | 12.1 | 15.0 | 16.7 | 19.6 | | | |
| | Presented by an ejido, community, or other form of social property | | | | | | | | | | | | | | | | 30.6 | 30.6 | 30.6 |
| | Project to be developed in Indigenous or Afro-Mexican towns | | | | | | | | | | | | | | | 11.8 | 18.4 | 18.4 | 18.4 |
| | Municipalities within the 100x100 strategy (low HDI average DS) | | | 20.0 | 22.0 | | | | | | | | | | | | | | |
| | In municipality with very high or high social lag | 41.7 | 31.2 | 12.0 | 13.0 | 25.0 | 18.5 | | | | | | | 15.0 | 16.7 | 9.8 | 10.2 | 10.2 | 10.2 |
| | Applicant is a woman or member of a legal entity | 16.7 | 12.5 | 8.0 | 8.7 | 10.0 | 14.8 | 9.1 | 8.7 | 7.6 | 9.5 | 10.8 | 12.1 | 15.0 | 16.7 | 19.6 | 10.2 | 10.2 | 10.2 |
| | Applicant is a youth or member of a legal entity (18 29) | | | | | | 14.8 | 9.1 | 8.7 | 7.6 | 9.5 | 10.8 | 12.1 | 10.0 | 16.7 | 19.6 | 10.2 | 10.2 | 10.2 |
| | Application within the Hunger Crusade program | | | | | | | 22.7 | 6.5 | 13.2 | 16.7 | 18.9 | | | | | | | |
| | Is or has been bene ciary of OPORTUNIDADES or PROSPERA | | | | | | | | 10.9 | 9.4 | 11.9 | 13.5 | | | | | | | |
| | Application submitted through CONAFOR platform | | | | | | | | | | | | | 7.5 | 16.7 | | | | |
| | P-PREDIAL approved and in force for agrarian communities | | | | | | | 22.7 | 21.7 | 18.9 | 11.9 | 13.5 | 15.2 | | | | | | |
| | With high or very high AVCC (vulnerability to climate change) | | | | | | | | | | | | | | | 9.8 | 10.2 | 10.2 | 10.2 |
| | Forestry certi cate (with higher weighting) | 25.0 | 19.0 | 12.0 | 13.0 | 15.0 | 11.1 | 6.8 | 15.2 | 18.9 | 23.8 | 13.5 | 15.2 | 25.0 | | | | | |
| | Environmental and forestry awards or recognitions | | | | | | | 4.6 | 4.3 | 3.8 | | | | | | | | | |
| | Sale of certi ed nished product and certi ed roundwood | | | | | | | | | | | | 24.2 | | | | | | |
| | **Tiebreaker** | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| | Ejido or community, Indigenous people or Afro community (if applicable) | 1° | 2° | 3° | 3° | 3° | 1° | 1° | 1° | 1° | 1° | 1° | 1° | 1° | 1° | 1° | 1° | 1° | 1° |
| | With forestry certi cate or according to current Forest Management Program | 4° | 3° | 4° | 4° | 4° | 4° | 5° | 5° | 2° | 2° | 2° | 2° | 2° | | | | | |
| | Has an approved and current P-PREDIAL | | | | | | | 2° | 2° | 3° | 3° | 3° | 3° | | | | | | |
| | In very high or high marginalization area | 2° | 1° | 1° | 1° | 1° | 2° | 3° | 3° | 4° | 4° | 4° | 4° | 3° | | | | | |
| | Is a woman | | | | | | | | | | | | | | | | 2° | 2° | 2° |
| | Greater viable area | | 5° | 2° | 2° | 2° | 3° | 4° | 4° | 5° | 5° | 5° | 5° | 4° | 3° | 3° | | | 3° |
| | Application submission date | | | | | | | | | | | | | | 4° | 2° | | | 4° |
| | Within the productivity subcategories | | | | | | | | | | | | | | 2° | 4° | 3° | 3° | 5° |
| | Is an association of foresters or part of a productive chain | 3° | 4° | | | | | | | | | | | | | | | | |
| PES-specific criteria | Located in a Natural Protected Area | 5.6 | 4.0 | 4.7 | 5.2 | 5.4 | 5.4 | 5.8 | 5.8 | 3.9 | 3.6 | 4.4 | 4.4 | 4.0 | 4.2 | 4.5 | 7.6 | 7.6 | 6.7 |
| | Micro-watershed with PES | | | 4.7 | 5.2 | 5.4 | 5.4 | 5.4 | 5.8 | 9.5 | 8.6 | 8.9 | 8.9 | 8.1 | 8.4 | 9.0 | 5.7 | 5.7 | 6.7 |
| | Ecological or territorial planning | 5.6 | 4.0 | 4.7 | 4.2 | 4.3 | 4.3 | 4.3 | 4.7 | 2.4 | 2.2 | | | | | | | | |
| | With forest cover | 5.6 | 4.0 | 4.7 | 5.2 | 5.4 | 5.4 | 5.4 | 5.8 | 12.6 | 11.5 | 8.9 | 8.9 | 8.1 | 8.4 | 9.0 | | | |
| | Biomass density | | 4.0 | 4.7 | 5.2 | 5.4 | 5.4 | 5.4 | 5.8 | | | | | | | | | | |
| | AICA or Ramsar site area | 5.6 | 4.0 | 4.7 | 4.2 | 4.3 | 4.3 | 4.3 | 5.8 | 4.7 | 4.3 | 4.4 | 4.4 | 4.0 | 4.2 | 4.5 | 5.7 | 5.7 | 6.7 |
| | Priority or strategic areas (not social), several points | 16.7 | 14.5 | 19.7 | 14.6 | 15.1 | 15.1 | 15.1 | 14.0 | 17.3 | 15.8 | 20.0 | 20.0 | 24.9 | 25.9 | 28.3 | 20.8 | 20.8 | 22.5 |
| | Within biological corridors | | 4.0 | 4.7 | 4.2 | 4.3 | 4.3 | 4.3 | 5.8 | 4.7 | 4.3 | | | | | | | | |
| | Specialized technical study | 5.6 | 4.0 | 4.7 | | | 4.3 | 4.3 | 4.7 | 4.7 | 4.3 | | | | | | | | |
| | Has a shaded agroforestry system | | 4.3 | 4.7 | 5.2 | 5.4 | | | | | | | | | | | | | |
| | Area of natural deforestation risk | 5.6 | 4.0 | 4.7 | 6.3 | 6.5 | 6.5 | 6.5 | 7.0 | 9.5 | 8.6 | 11.9 | 11.9 | 13.4 | 14.0 | 15.0 | 15.1 | 15.1 | 13.5 |
| | Area of natural disaster | | | | 6.3 | 6.5 | 6.5 | 6.5 | 7.0 | 7.9 | 7.2 | 7.4 | 7.4 | 6.7 | 7.0 | 7.5 | 7.6 | 7.6 | 9.0 |
| | Soil degradation | | 4.0 | 4.7 | 3.1 | 3.2 | 3.2 | 3.2 | 3.5 | | | | | | | | | | |
| | Potential changes in climatic variables | | | | | | | | | | | | | | 4.2 | 4.5 | 11.3 | 11.3 | 6.7 |
| | Within an aquifer | 5.6 | 4.0 | 4.7 | 6.3 | 6.5 | 6.5 | 6.5 | 7.0 | 9.5 | 8.6 | 8.9 | 8.9 | 8.1 | 8.4 | 9.0 | 7.6 | 7.6 | 9.0 |
| | Within a basin with available water | | 4.0 | 4.7 | 7.3 | 7.5 | 7.5 | 7.5 | 8.1 | 9.5 | 8.6 | 8.9 | 8.9 | 8.1 | | | | | |
| | Area within a CONAGUA-identified water reserve | 5.6 | | | | | | | | | 8.6 | 8.9 | 8.9 | 8.1 | 8.4 | 9.0 | 7.6 | 7.6 | 9.0 |
| | Re-forested network | | 2.4 | 2.8 | 3.1 | 3.2 | 3.2 | 3.2 | 4.7 | 3.9 | 3.6 | | | | | | | | |
| | Area of influence of a sustainable MLPPA initiative | | | | 4.2 | 4.3 | 4.3 | 4.3 | 4.7 | | | | | | | | | | |
| | Commitment to a project or monitoring | | | | | | | | | | | 7.4 | 7.4 | 6.7 | 7.0 | 7.5 | 11.3 | 11.3 | 10.1 |
| | Specific points with a maximum of 3 years (extended lease) | 33.3 | 30.6 | 12.2 | 10.4 | 7.5 | 8.6 | 8.6 | | | | | | | | | | | |

## APPENDIX VI – Diversity of visions in La Trinidad Ixtlán and San Juan Lachao

The following charts illustrate the importance that different groups within each community assign to the topics discussed in the interviews. Each row represents a topic, and each column groups interviewees who share a specific characteristic. For example, someone who has served as a municipal agent but not on the *comisariado* would fall into the first column, whereas someone who has served in both the municipal and communal sectors would fall into the third column. Women make up the majority of those who have participated in committees. The darker the cell colour, the more frequently that topic was mentioned during the interviews.

### La Trinidad Ixtlán

| | Age | | Sex | | Highest *cargo* type | | | |
|---|---|---|---|---|---|---|---|---|
| | < 50 | > 50 | Men | Women | Municipality | Comisariado | Both | Committees |
| **Natural forces** | | | | | | | | |
| Biodiversity | 8 | 21 | 18 | 11 | 2 | 1 | 15 | 10 |
| Climate change | 5 | 23 | 19 | 11 | 4 | 7 | 10 | 10 |
| Hurricanes and storms | 3 | 4 | 2 | 5 | 0 | 0 | 2 | 3 |
| Pandemics | 6 | 5 | 2 | 9 | 1 | 0 | 2 | 7 |
| Water sources | 3 | 19 | 15 | 7 | 1 | 2 | 12 | 6 |
| **Social forces** | | | | | | | | |
| Fertilizers and pesticides | 1 | 17 | 14 | 5 | 1 | 4 | 9 | 4 |
| Food security | 8 | 14 | 14 | 8 | 1 | 3 | 11 | 5 |
| Generational change | 14 | 42 | 24 | 34 | 2 | 2 | 20 | 28 |
| Health problems | 8 | 35 | 25 | 23 | 9 | 2 | 14 | 21 |
| Markets and prices | 3 | 15 | 12 | 6 | 1 | 1 | 11 | 4 |
| Population change | 5 | 8 | 5 | 8 | 0 | 1 | 4 | 7 |
| War or conflics | 1 | 14 | 14 | 1 | 0 | 2 | 12 | 0 |
| **Livelihoods** | | | | | | | | |
| Agriculture | 36 | 127 | 94 | 77 | 8 | 13 | 70 | 65 |
| Animal rearing | 7 | 13 | 8 | 13 | 2 | 4 | 3 | 13 |
| Cattle | 0 | 10 | 10 | 1 | 1 | 3 | 6 | 1 |
| Forest management | 27 | 88 | 73 | 46 | 7 | 13 | 54 | 38 |
| Sawmill | 4 | 18 | 13 | 10 | 3 | 0 | 11 | 9 |
| Carbon | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 5 |
| Oportunistic wood extraction | 2 | 13 | 13 | 2 | 2 | 0 | 13 | 2 |
| Government programmes | 1 | 7 | 7 | 2 | 1 | 0 | 6 | 1 |
| Migration and remittances | 16 | 36 | 23 | 29 | 1 | 2 | 20 | 24 |
| Mining | 4 | 29 | 25 | 8 | 4 | 0 | 22 | 7 |
| Small businesses | 11 | 12 | 11 | 14 | 9 | 0 | 9 | 14 |
| Trades and temp. jobs in community | 35 | 65 | 47 | 58 | 16 | 1 | 36 | 52 |
| **Infrastructure** | | | | | | | | |
| Band | 3 | 14 | 14 | 3 | 10 | 0 | 5 | 1 |
| CONASUPO | 0 | 11 | 8 | 3 | 0 | 2 | 6 | 3 |
| Houses | 2 | 14 | 7 | 9 | 2 | 0 | 7 | 9 |
| Auditorium / sports court | 1 | 7 | 7 | 2 | 1 | 1 | 5 | 2 |
| Clinic / Health center | 3 | 13 | 6 | 10 | 0 | 0 | 6 | 9 |
| Drinking water | 0 | 11 | 7 | 4 | 0 | 1 | 6 | 4 |
| Electrification | 1 | 10 | 7 | 4 | 0 | 0 | 7 | 3 |
| Schools | 18 | 27 | 22 | 25 | 4 | 1 | 18 | 21 |
| Roads and highways | 9 | 43 | 26 | 28 | 6 | 1 | 21 | 24 |
| **Government policies** | | | | | | | | |
| Agricultural programmes | 1 | 17 | 16 | 2 | 0 | 1 | 15 | 2 |
| Sembrando Vida | 1 | 3 | 3 | 1 | 0 | 0 | 3 | 0 |
| Forest programmes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Carbon offsets | 4 | 4 | 6 | 2 | 0 | 0 | 4 | 1 |
| Commercial logging | 1 | 27 | 26 | 2 | 1 | 2 | 24 | 2 |
| Certification | 1 | 2 | 3 | 0 | 0 | 0 | 2 | 0 |
| Concessions | 1 | 19 | 19 | 4 | 3 | 2 | 14 | 3 |
| Social development prorammes | 7 | 27 | 21 | 13 | 2 | 4 | 16 | 10 |

# San Juan Lachao

| | Age | | Sex | | Highest *cargo* type | | |
|---|---|---|---|---|---|---|---|
| | < 50 | > 50 | Men | Women | Municipality | Comisariado | Both |
| **Natural forces** | | | | | | | |
| Biodiversity | 9 | 15 | 11 | 13 | 8 | 1 | 2 |
| Climate change | 4 | 6 | 6 | 4 | 3 | 0 | 2 |
| Earthquakes | 1 | 6 | 6 | 1 | 5 | 0 | 0 |
| Hurricanes and storms | 9 | 17 | 16 | 10 | 8 | 1 | 2 |
| Pandemics | 2 | 3 | 4 | 1 | 1 | 0 | 3 |
| Pests and diseases | 5 | 18 | 15 | 8 | 10 | 1 | 5 |
| Water sources | 13 | 44 | 34 | 25 | 19 | 2 | 14 |
| Wildfires | 7 | 5 | 7 | 6 | 3 | 3 | 0 |
| **Social forces** | | | | | | | |
| Crop varieties | 1 | 7 | 6 | 2 | 4 | 0 | 3 |
| Fertilizers and pesticides | 5 | 6 | 6 | 5 | 3 | 0 | 4 |
| Food security | 3 | 7 | 5 | 5 | 3 | 0 | 2 |
| Generational change | 5 | 26 | 20 | 11 | 14 | 1 | 5 |
| Health problems | 6 | 20 | 17 | 9 | 13 | 1 | 5 |
| Markets and prices | 20 | 41 | 47 | 14 | 20 | 3 | 19 |
| Population change | 5 | 16 | 14 | 7 | 9 | 2 | 1 |
| Trash and waste | 3 | 4 | 6 | 1 | 2 | 1 | 3 |
| War or conflics | 20 | 36 | 35 | 20 | 17 | 5 | 12 |
| **Livelihoods** | | | | | | | |
| Agriculture | 26 | 96 | 86 | 37 | 50 | 2 | 32 |
| Tusta chili | 0 | 13 | 7 | 6 | 4 | 0 | 4 |
| Coffee | 20 | 92 | 75 | 37 | 37 | 0 | 29 |
| Sugarcane | 0 | 10 | 7 | 3 | 4 | 0 | 2 |
| Animal rearing | 3 | 18 | 11 | 10 | 6 | 2 | 3 |
| Cattle | 9 | 37 | 37 | 9 | 15 | 1 | 22 |
| Forest management | 31 | 33 | 48 | 16 | 12 | 17 | 14 |
| Oportunistic wood extraction | 4 | 15 | 13 | 8 | 13 | 1 | 2 |
| Government programmes | 11 | 3 | 8 | 6 | 1 | 1 | 6 |
| Migration and remittances | 15 | 23 | 25 | 13 | 20 | 1 | 7 |
| Small businesses | 2 | 11 | 8 | 5 | 6 | 1 | 3 |
| Trades and temp. jobs in community | 14 | 26 | 18 | 23 | 11 | 1 | 8 |
| **Infrastructure** | | | | | | | |
| CONASUPO | 2 | 8 | 9 | 1 | 2 | 1 | 3 |
| Houses | 5 | 26 | 14 | 17 | 10 | 0 | 3 |
| Clinic / Health center | 4 | 10 | 11 | 3 | 6 | 0 | 3 |
| Drinking water | 0 | 6 | 3 | 3 | 5 | 0 | 0 |
| Electrification | 0 | 14 | 8 | 6 | 7 | 0 | 1 |
| Municipal palace | 0 | 10 | 10 | 0 | 7 | 0 | 3 |
| Schools | 16 | 41 | 41 | 16 | 24 | 3 | 16 |
| Roads and highways | 11 | 36 | 34 | 13 | 23 | 2 | 8 |
| **Government policies** | | | | | | | |
| Agricultural programmes | 3 | 19 | 19 | 3 | 7 | 0 | 9 |
| Sembrando Vida | 0 | 5 | 5 | 0 | 0 | 0 | 4 |
| Forest programmes | | | | | | | |
| Biodiversity monitoring | 12 | 1 | 5 | 8 | 0 | 1 | 4 |
| Carbon offsets | 7 | 8 | 13 | 2 | 0 | 4 | 5 |
| PES | 9 | 11 | 18 | 2 | 1 | 4 | 10 |
| Matching funds PES | 6 | 3 | 8 | 1 | 3 | 1 | 4 |
| Commercial logging | 14 | 8 | 16 | 5 | 2 | 5 | 6 |
| Concessions | 4 | 9 | 11 | 2 | 4 | 3 | 4 |
| Social development prorammes | 14 | 34 | 40 | 9 | 22 | 1 | 17 |