David Barton Bray and Elvira Duran-Medina

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Options for Reducing Carbon Emissions in Forest Management in the Oaxaca and Chihuahua Áreas de Acción Temprana REDD+ (AATR)

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EXECUTIVE SUMMARY-ENGLISH

In this study we evaluate the management regimes present in Mexican community forestry in *Áreas de Acción Temprana REDD+* in Oaxaca (Sierra Norte and Mixteca) and Chihuahua (southern Sierra Tarahumara) and the potential for reduction of carbon emissions through improved silvicultural and harvesting practices. The Mexican regulatory framework for forest management and timber harvesting is composed of three levels: the General Law of Sustainable Forests Development (LGDFS), its regulations in 178 Articles, and the official Mexican Norms which provide detailed guidelines for what Forest Management Programs (FMP) should contain. Enforcement of the regulatory framework is carried out by the *Secretaría de Medio Ambiente y Recursos Naturales* (SEMARNAT) and the *Procuraduría Federal de Protecciόn al Ambiente* (PROFEPA). This regulatory framework largely corresponds to principles of IFM or RIL as laid out in multiple publications. The permitting procedures require extensive evidence of planning and careful implementation of the entire logging process through Forest Management Programs (FMPs). The magnitude of the Mexican community forestry sector (~2000 CFEs) has also required an official classification of the universe on the basis of vertical industrial integration, with Type I communities having forests with commercial potential but not currently logging, Type II communities selling “on the stump” with most extraction operations handled by contractors (but with variable degrees of community control over the process), Type III

communities, selling roundwood, where the CFE owns some extraction equipment, from skidders to logging trucks, and Type IV communities, industrially integrated to sawmills or in some cases to advanced wood processing such as furniture or plywood factories. Mexican silviculture for temperate forests is characterized by one principal uneven-aged method (The Mexican Method for Ordering Irregular Forests-MMOBI) and several variants of an even-aged system (the Silvicultural Development Method-MDS). Studies elsewhere suggest that whether or not an uneven-aged or even-aged system is superior in terms of carbon capture depends greatly on specific practices, the time horizon considered, and the fate of the wood products. One is not inherently superior to the other. Extending rotations may be an option in either system for increasing carbon capture.

The final study universe includes 19 community forest enterprises (CFEs) in the Sierra Norte AATR and 59 CFEs in the Chihuahua AATR. The Mixteca AATR was initially included and we have basic data on logging practices in 6 Mixteca communities with permits. However, within the Mixteca AATR there only one CFE actually operating for one year so it was not further considered in this study. We extracted extensive data from the logging permit files in SEMARNAT and some basic demographic and socio-economic data from Mexican government agencies for all communities. We conducted semi-structured interviews with samples of community leaders and forest engineers in each AATR, as well as a more limited sample of direct observations of harvesting impacts. Sample sizes varied due to logistical and, in Chihuahua, security situations. In the Sierra Norte AAT we interviewed 15 of 19 community leaders, 8 of 19 forest engineers, and made 8 direct observations of harvest impacts. In Chihuahua we interviewed 17 of 59 for both community leaders and forest engineers, and made 5 direct observations in the forest. In each case a distribution of sampling occurred also across the vertical integration typology.

The Sierra Norte has a trajectory of over 30 years of increasingly mature CFEs with some of the leading examples in Mexico and a predominance of completely vertically integrated Type IV communities, now including an entrepreneurial alliance between 3 communities that has a national chain of furniture stores. All but one of the CFEs is in indigenous communities (*comunidades*), including Zapotec and Chinantec ethnic groups. Five of the 19 CFEs in the AATR have boundary

conflicts but in only one case is it seriously impacting logging activities. Eight of the communities have FSC certification. In economic terms, the majority of communities are not considered economically marginal. With several exceptions, subsistence agriculture is no longer important and there is only very small-scale commercial agriculture and very little cattle raising, with a single exception. Over 70% of the AATR is in forest cover, evenly divided between forests managed for timber and forests under mostly informal community conservation. The economy is relatively diversified, with only about half saying that forestry is the most important source of income. Thirteen of the 19 (68%) CFEs in Sierra Norte are Type IV, possibly the highest percentage of advanced industrial vertical integration in the country. Most CFEs in Sierra Norte practice variants of MDS, including a recent innovation in strip clear-cutting. The approved FMPs require land use zoning across the entire community territory and the community assembly approves this process. Harvest impacts are evaluated with respect to felling, skidding, and hauling. SEMARNAT practices in Oaxaca include extensive requirements pertaining to various aspects of these practices. There appears to be virtually no incidence of entire trees being felled as collateral damage, with typical damage being light to moderate and restricted to scraping of trunks and damage to branches. Skidding is carried out with monocables mounted on trucks and skid trails generally appear to be narrower than allowed for in regulations and to be relatively low impact. Manual skidding is used on some uphill slopes. Leaving slash in contours to prevent erosion is widely practiced. Logging roads are also within regulations and do not appear to be wider than necessary. There is evidence that harvest practices in the Sierra Norte AATR have improved in the last decade and there appears to be little opportunity to achieve significant further reductions in carbon emissions through improved practices.

The Chihuahua AATR presents much different conditions. Forest communities in the southern Sierra Tarahumara, site of the AATR, have on average much larger territories, larger, poorer and more ethnically diverse populations and much less productive forests. The latter is due to much lower rainfall, colder winters and possibly historical overharvesting, since these forests have been commercially logged for much longer periods and with less control than in Sierra Norte. Fifty-two of the 59 communities are *ejidos*, including some of the earliest *ejidos* in Mexico, established in the 1920s. Five of the 17 communities sampled have boundary conflicts, but none appear to affect

timber harvesting. FSC certification is historically underdeveloped, with only two communities having been certified in the 2000s. However, due to a Conafor-Rainforest Alliance program, six more communities are now in the process of becoming certified. Less than 25% (13) of the ejidos have more than 80% indigenous peoples (principally Rarámuri (Tarahumara) and some Tepehuan). However, almost all of the ejidos have some indigenous members, who are commonly marginalized in CFE employment and in community decision-making. There is great poverty in general, with all of the communities in *municipios* ranked as being very high in economic marginality. Rates of participation in the primary sector (agriculture) are very high and 100% of the profits from the CFEs are distributed to community members (in Sierra Norte, most profits are invested in public goods and reinvested in the enterprise). Emigration is mostly regional to commercial agriculture in northern states, and in general does not appear to be high. 37.2% of the community's territories are in production forests and 28.2% in conservation, and 31% in other uses, which includes both agriculture and in some ejidos canyon lands and semi-arid brush. There is a substantial dependence on forestry as virtually the only source of cash income in most of the ejidos, with 14 of 17 in the sample reporting as the primary source of income. This would appear to be primarily from profit-sharing since less than 20% of the population has equivalent full-time employment in a CFE. Subsistence agriculture and livestock raising are practiced by most community members, and there is widespread grazing of livestock in the forests. Until 2012-2013 the uneven-aged MMOBI was the only silvicultural system practiced but in that year a Conafor-Semarnat program began requiring the use of MDS. As in Oaxaca, the forest management programs require land use zoning in the entire territory, and the community assembly approves the management programs and their elected leadership represents them in interactions with government agencies.

In the entire AATR, Type II roundwood production communities predominate, with 38 Type IIs, 7 Type IIIs and 14 Type IVs. However, an analysis by *municipio* shows that the Type IV communities are concentrated in Guachochi (9 of 17) while the less-organized Type II communities are concentrated in Guadalupe y Calvo (22 of 31). The regulatory framework and relevant government agencies are the same in Chihuahua as in Oaxaca. However, in the Chihuahua AATR, the *Unidades de Manejo Forestal* (UMAFORs-Forest Management Unit) are much more important. These units do not carry out the

forest management plans, but have forest engineers and other staff that collect data and provide general technical assistance within their regions. The UMAFOR Guachochi and UMAFOR Guadalupe y Calvo have both recently published extensive reports. The UMAFOR Guachochi finds that forests in the region are generally reasonably well-managed. However, the UMAFOR Guadalupe y Calvo reports problems with felling, skidding, changes in forest density, construction and maintenance of roads, inadequate disposal of slash and inadequate carrying out of logging. The report implies that these problems may be concentrated in the numerous Type II communities where poorly supervised contractors carry out most extraction activities. A review of forest management plans suggests very high amounts of detail in planning. As noted, MMOBI was exclusively practiced until recently and for 2013-2014 in many communities 70% of the harvest is conducted with MMOBI and 30% with MDS. Interviewed foresters suggested few problems with felling, skidding and hauling. However, the direct forest observations by a highly experience forester found more problems in 2 of the 5 communities surveyed. Issues observed including poor use of directional felling, anchoring winches to unprotected trees resulting in damage, and other poor logging practices, both in Type IV communities in Guachochi. An unusual practice skidding practice in Chihuahua is the widespread but unquantified use of animal traction (known locally as *troncos*), principally by horses but in some cases by oxen. In the sample of 17, 10 use both motorized winches and *troncos* and one used exclusively *troncos*. The *ejido* Aboreachi over the last ten years has reduced its number of truck-mounted winches from 3 to 2, and now the greatest percentage of its harvest is done with *troncos*. *Troncos* are cheaper than mechanized skidding, generate more employment and have less impact on the forest, so can be an important element in low carbon forestry. Leaving slash in contours is a relatively new practice in the AATR, but is now being more widely introduced as an element in MDS. Opening of forest clearings for illegal drugs may be a problem in the Chihuahua AATR.

There may be more opportunities to reduce emissions from harvest practices in Chihuahua than in Sierra Norte. These are; 1) Supporting Type II communities, particularly in Guadalupe y Calvo to either a) more closely supervise and participate in some aspects of logging carried out by contracts or b) acquire extraction equipment and training that would allow them to exert greater control over the harvest process and make the transition from Type II to Type III. 2) Carry out a more extensive study

of carbon impacts of harvesting and expand training in directional felling, skidding, and other harvest practices to Type IV communities in Guachochi and 3) carry out a survey of current use of animal traction in the AATR and conduct a study of the carbon impacts of its expanded use where topographically feasible.

In sum, we find forest management practices in the Sierra Norte AATR to be generally good, with few opportunities for Improved Forest Management that would warrant the investment of time and effort to reduce emissions. In the Chihuahua AATR, there are targets of opportunity for reducing carbon emissions from harvest activities in the Type II communities, in some Type IV communities and particularly in documenting, revaluing and expanding the use of animal traction.

RESUMEN-ESPAÑOL

En este estudio se evaluaron los regímenes de manejo forestal en los bosques comunitarios de las llamadas Áreas de Acción Temprana REDD + en Oaxaca (Sierra Norte y Mixteca) y Chihuahua (sur de la Sierra Tarahumara). Así como el potencial de reducción de las emisiones de carbono que podrían operar en dichos casos, a través de mejores prácticas silvícolas y de aprovechamiento de la madera. El marco normativo mexicano para el manejo forestal, con fines de extracción de madera, se compone de tres niveles: la Ley General de Bosques de Desarrollo Sostenible (LGDFS), sus reglamentos en los artículos 178 y las Normas Oficiales Mexicanas, las cuales establecen directrices detalladas del contenido de los Planes de Manejo Forestal (PMF). El cumplimiento del marco regulatorio es misión de la *Secretaría de Medio Ambiente y Recursos Naturales* (SEMARNAT) y la *Procuraduría Federal de Protección al Ambiente* (PROFEPA). Este marco normativo se corresponde en gran medida a principios establecidos en múltiples publicaciones de lo que se denomina Manejo Forestal Mejorado (Improved Forest Management; IFM) o Extracción de Madera de Bajo Impacto (Reduce Impact Logging; RIL). Los procedimientos de autorización requieren una amplia evidencia de la planificación y la aplicación cuidadosa de todo el proceso de registro. La magnitud del sector de la silvicultura comunitaria mexicana (~ 2000 Empresas Forestales Comunitarias; EFC) ha requerido una

clasificación oficial del universo y éste se ha hecho sobre la base de la integración vertical de las empresas. Así, las comunidades de tipo I, son aquellas que tienen bosques con potencial comercial, pero que no están extrayendo madera. Las comunidades de tipo II son las que venden "a pie de árbol", donde la mayoría de las operaciones de extracción son realizadas por el contratista o comprador (en este caso, el control de la comunidad sobre el proceso es variable). Las comunidades de tipo III son aquellas donde la EFC posee algún equipo de extracción (grúas de arrastre, camiones madereros, etc.). Finalmente, las comunidades de tipo IV, son aquellas que cuentan con mayor integración industrial, y tienen aserraderos y, en algunos casos, capacidad para la transformación avanzada de la madera, por ejemplo la fabricación de muebles de madera o chapas.

La silvicultura comunitaria mexicana se caracteriza por usar principalmente un método para masas forestales de distintas edades o incoetáneos (el Método Mexicano de Ordenación de Bosques Irregulares -MMOBI); así como distintas variantes de un sistema para bosques de la misma edad o coetáneos (Método de Desarrollo Silvícola - MDS). Numerosos estudios sugieren que ninguno de ambos métodos es mejor en términos de captura de carbono, sino más bien esto depende en gran medida de prácticas de manejo del bosque específicas, el tiempo considerado, y el destino de los productos de madera. Por ejemplo, las rotaciones extendidas pueden ser una opción en cualquiera de los dos sistemas para aumentar la captura de carbono; por lo que, intrínsecamente uno no es superior al otro.

El universo de casos analizado en este estudio incluyo 19 EFCs en la AATR-Sierra Norte y 59 EFCs en la AATR- Chihuahua. La AATR- Mixteca fue inicialmente incluida, y se generaron datos básicos sobre las prácticas de aprovechamiento de madera en 6 comunidades mixtecas con planes de manejo forestal autorizados. Sin embargo, dentro de la AATR-Mixteca, sólo una EFC es la que efectivamente realizó por un año el aprovechamiento, el resto no, por lo que para el resto de la investigación ya no se consideró. Para todas las comunidades de las AATR Sierra Norte, Oaxaca y Chihuahua, se revisaron los contenidos de los planes de manejo forestal autorizados, en los archivos de la SEMARNAT, de donde se obtuvieron datos detallados del manejo. Asimismo, se reunieron datos básicos demográficos y socio-económicos de distintas agencias gubernamentales mexicanas. En una muestra de las comunidades de cada AATR, se realizaron entrevistas semi-estructuradas a líderes comunitarios

(Comisariados de Bienes Comunales o Ejidales) y a los ingenieros forestales y, en una submuestra más reducida, se realizaron observaciones directas de los impactos de aprovechamiento de madera. El tamaño de la muestra y la submuestra fue variable en cada caso, y en gran parte dependió de factores logísticos, de seguridad (sobre todo en Chihuahua) y de la apertura que dieron los Comisariados/Prestadores de Servicios Técnicos para hacer el estudio. Aun así, se trató de que la muestra tuviera representación entre la tipología integración vertical del grupo de comunidades que integraron cada AATR. En la AATR Sierra Norte se entrevistó 15 de 19 Comisariados, 8 de 19 ingenieros forestales, y se hicieron sólo 8 observaciones directas de los impactos del aprovechamiento de madera. En Chihuahua se entrevistó a 17 de 59 Comisariados e ingenieros forestales, y se hicieron sólo 5 observaciones directas en el bosque para registrar impactos de la extracción de madera.

La AATR-Sierra Norte cuenta con una trayectoria de más de 30 años con EFCs, y tiene ejemplos más maduros y que destacan entre los casos más emblemáticos de silvicultura comunitaria en México, con predominio de comunidades tipo IV, las de mayor integración vertical; inclusive, está el caso el caso de 3 comunidades que ahora han establecido una alianza empresarial (2 comunidades de la Sierra Norte) que tiene una cadena nacional de tiendas de muebles. Existen también ejemplos de organización intercomunitaria para el manejo del bosque, como es el caso de la Unión de Comunidades Zapotecas y Chinatecas (UZACHI). Por otra parte, cabe destacar que ocho de las comunidades de la AATR cuentan con la certificación del Forest Stewardship Council (FSC).

Una problemática recurrente son los conflictos por límites territoriales entre las comunidades. Cinco de las 19 EFC en la AATR-Sierra Norte tienen conflictos de límites, pero sólo en un caso parece afectar seriamente el aprovechamiento de madera. En términos económicos, la mayoría de las comunidades no son económicamente marginalizadas. Con unas pocas excepciones, la agricultura de subsistencia ya no es importante y sólo hay agricultura comercial a muy pequeña escala y , con una sola excepción, se puede decir que hay poca ganadería. Más del 70% de la AATR-Sierra Norte tiene cubierta forestal, dividido a partes iguales entre los bosques manejados para la madera y los bosques bajo conservación comunitaria, en su mayoría de tipo informal. La economía está relativamente diversificada, sólo el 50% de los comisariados entrevistados reconocen que la actividad forestal es la

fuente más importante de ingresos. Los PMF aprobados presentaron la zonificación de usos del suelo de todo el territorio comunal, el cual debió pasar por un proceso de aprobación de la asamblea de la comunidad.

Los impactos de la extracción de madera se evaluaron con respecto al sitio donde se hace el derribo, el canal de arrastre y de carga de la madera. En el caso de los requerimientos de la SEMARNAT en Oaxaca, existen una serie de requisitos explícitos en relación a estas prácticas. Aparentemente, la tala induce un daño colateral muy menor, al no afectar arboles completos, e inducir solo el daño típico es de ligero a moderado y restringido a raspar los troncos y los daños a las ramas.

El arrastre de troncos de árboles con monocables montados en camiones, parecen ser una técnica de poco impacto, y aunque no está dentro de las regulaciones podría ser más común de lo que se pensaba. El arrastre manual es también recurrente y se utiliza frecuentemente en sitios con pendientes ascendentes. También es casi generalizada la práctica de acomodar los residuos (puntas y ramas) a manera de fajas o cinturones perpendiculares a las curvas de nivel, y con ello se evita la erosión de suelo. Los caminos de extracción se ajustaron a las regulaciones y no parecen ser más anchos de lo necesario. Hay evidencia de que las prácticas de cosecha en la AATR-Sierra Norte ha mejorado en la última década y dado que son casi optimas en algunos sentidos, parece haber poca posibilidad de lograr más reducciones significativas en las emisiones de carbono, a través de la implementación de prácticas mejoradas de manejo.

En la AATR-Chihuahua se presentan condiciones muy diferentes a las de la AATR-Sierra Norte. Las comunidades forestales en el sur de la Sierra Tarahumara, lugar de la AATR, tienen en promedio territorios mucho más grandes, con poblaciones más pobres y étnicamente más diversas. En contraste con Oaxaca, sus bosques son mucho menos productivos. Esto último podría estar relacionado con menores precipitaciones, inviernos más fríos y, posiblemente, a la sobreexplotación histórica. Los bosques de Chihuahua han sido talados para fines comerciales durante mucho más tiempo que en la Sierra Norte, y con menos control. 52 de las 59 comunidades fueron ejidos, entre ellos se encuentran uno de los primeros ejidos en México, creado en 1920. 5 de las 17 comunidades muestreadas tienen conflictos de límites, pero ninguno parece afectar la extracción de madera. La

certificación del Forest Stewardship Council es históricamente escasa, durante la década del 2000 sólo dos comunidades fueron certificadas. Sin embargo, debido a un programa de CONAFOR-Rainforest Alliance, seis comunidades más están ahora en el proceso de lograr la certificación. Menos del 25% (13) de los ejidos tienen más del 80% de los pueblos indígenas (principalmente rarámuri o tarahumaras y tepehuanos algunos). Sin embargo, casi todos los ejidos tienen algunos miembros indígenas, y estos comúnmente suelen estar marginados del empleo que genera la empresa forestal (EFC), y de la toma de decisiones comunitarias. En general, hay una gran pobreza, los municipios donde se ubican todas las comunidades han sido clasificados como de muy alta marginalidad socio-económica. Las tasas de participación en el sector primario (agricultura) son muy altos, y el 100% de las ganancias de la EFC se distribuyen a los miembros de la comunidad (en contraste, en la AATR-Sierra Norte, la mayoría de las ganancias se invierten en bienes públicos y se reinvierten en la empresa). La emigración no es muy alta, pero de ocurrir la gente se queda en la región y se emplea en la agricultura comercial en los estados del norte. El 37.2% de los territorios de la comunidad corresponden a bosques para producción de madera, 28,2% son bosques que se encuentran en conservación, mientras que el 31% de la superficie restante es de áreas para agricultura, en algunos ejidos son barrancas y acantilados o matorrales semi-áridos. Hay una dependencia sustancial sobre la actividad forestal, en 14 de 17 ejidos en que se entrevistó al Comisariado se constató que es prácticamente la única fuente de ingresos en efectivo. Esto parece ser principalmente a través del reparto de las ganancias y no necesariamente por empleo, ya que menos del 20% de la población tiene empleo de tiempo completo en las EFCs. La agricultura de subsistencia y la cría de ganado son practicadas por la mayoría de los miembros de la comunidad, prevaleciendo la práctica de ganadería extensiva dentro de las zonas forestales.

Hasta 2012-2013 el MMOBI para bosques incoetáneos fue el único sistema silvícola practicado, pero a partir de este periodo, un programa de CONAFOR-SEMARNAT ha comenzado a promover el uso de MDS. Al igual que en Oaxaca, los Planes de Manejo Forestal requieren la zonificación de usos del suelo en todo el territorio ejidal/comunal, y que sean aprobado por la comunidad en asamblea, mientras que el comisariado es el encargado de gestionar las autorizaciones antes la dependencias de gobierno. En toda la AATR, predominaron las comunidades de Tipo II (38), que venden madera a pie

de árbol; 7 comunidades fueron de tipo III y 14 comunidades de Tipo IV. Sin embargo, analizando los datos a nivel de municipio, es evidente que las comunidades de tipo IV se concentran en Guachochi (9 de 14), mientras que las comunidades de tipo II, menos organizadas para la producción, se concentran en el municipio de Guadalupe y Calvo (22 de 31).

Aunque el marco normativo y de los organismos gubernamentales pertinentes son las mismas en Chihuahua como en Oaxaca, en la AATR-Chihuahua las Unidades de Manejo Forestal (UMAFORs-Unidad de Gestión Forestal) son mucho más importantes. Estas unidades no implementan los planes de manejo forestal, pero tienen a los ingenieros forestales y otros miembros del personal que colectan los datos y proporcionan asistencia técnica dentro de sus regiones. La UMAFOR Guachochi y UMAFOR Guadalupe y Calvo tienen ambos publicados recientemente extensos informes. La UMAFOR Guachochi encontró que, en lo general, los bosques de la región están razonablemente bien manejados. Sin embargo, en la UMAFOR de Guadalupe y Calvo se reportaron problemas con el derribo de árboles, los arrastres de troncos, cambios en la densidad del bosque, construcción y mantenimiento de caminos, inadecuada disposición de productos de desechos de la extracción y un inadecuado proceso de extracción de madera. El informe indica que estos problemas se pueden concentrar en las numerosas comunidades de Tipo II, donde los contratistas realizan la mayoría de las actividades de extracción y suelen estar pobremente supervisados . No obstante, la revisión de los planes de manejo forestal mostró que estos contienen una gran cantidad de detalle en la planificación que casi no se llevan a cabo. Como se ha señalado, hasta hace poco prevaleció la practicaba de usar MMOBI, durante 2013-2014 en muchas comunidades el 70% de la cosecha se lleva a cabo con este método, mientras que sólo el 30% fue con MDS. Las entrevistas con los ingenieros forestales mostraron que existen algunos problemas con el derribo, los carriles de arrime y las áreas de carga; sin embargo, las observaciones directas dentro de los bosques de particular a una experiencia muy forestales mostraron más problemas en 2 de las 5 comunidades visitadas. Entre las observaciones destacaron malas prácticas de derribo direccional y el anclaje de las motogrúas, que dañaron severamente a los árboles y otras prácticas inadecuadas de manejo durante la extracción. Esto, aun en algunas de las comunidades de tipo IV ubicadas en Guachochi. Una práctica de arrastre que es aún recurrente en la AATR en Chihuahua, aunque aún poco analizada, es el empleo de tracción

animal (conocido localmente como *troncos*), principalmente por los caballos y algunos casos por bueyes. En la muestra de 17 comunidades donde se entrevistó al comisariado, en 10 utilizaron tanto motogrúas como *troncos*, y en un caso sólo se utilizaron *troncos*. En los últimos diez años, el ejido Aboreachi ha reducido el número de grúas montadas en camiones de 3 a 2, y ahora usa un mayor porcentaje *troncos* para el arrastre de los rollos de madera. El uso de los *troncos* es más barato que el arrastre mecanizado, genera más empleo y tienen un menor impacto en el bosque; por lo que pueden ser un elemento importante de considerar en aras de promover que el aprovechamiento del bosque tenga un bajo impacto en carbono forestal. La colocación de franjas de materiales de la extracción (ramas y puntas) siguiendo curvas de nivel, es una práctica relativamente nueva en la AATR-Chihuahua, pero ahora está siendo más extendida como un elemento de manejo con el sistema MDS. La apertura de claros en el bosque para cultivo de drogas ilícitas sin duda parece ser un problema en la AATR-Chihuahua.

Como resultado del estudio consideramos que es posible que existan más posibilidades de reducir las emisiones de carbono relacionadas con las prácticas de aprovechamiento de la madera en la AATR-Chihuahua, que en la AATR-Sierra Norte. Entre las alternativas, señalamos las siguientes: 1) Apoyar a las comunidades de tipo II, sobre todo en Guadalupe y Calvo, para que participen y supervisen más de cerca el proceso de la extracción de la madera del bosque que hacen los contratistas o compradores, para que adquieran equipos para la extracción de la madera y con capacitación para cuidar el proceso de la cosecha, mientras hacen la transición de comunidades de tipo II a tipo III. 2) Llevar a cabo un estudio más amplio de los impactos de carbono del aprovechamiento de la madera. 3) Ampliar la capacitación para el derribo direccional, el arrastre y otras prácticas para el aprovechamiento en las comunidades de tipo IV comunidades, como las de Guachochi. 4) Hacer un análisis acerca del uso actual de los *troncos*, tracción animal, en toda la AATR-Chihuahua y sobre todo enfocado a estudiar sus impactos en carbono, a fin de intensificar su uso donde la topográficamente lo hace más factible.

En resumen, se encontró que las prácticas de manejo forestal en la AATR-Sierra Norte en general son buenas, con pocas oportunidades para mejorar las prácticas de manejo, que justifiquen una alta inversión de tiempo y esfuerzo a promover IFM o RIL. En la AATR-Chihuahua, hay oportunidad puntuales que de atenderse podrían ayudar a reducir las emisiones de carbono de las actividades de

aprovechamiento de madera de los bosques de las comunidades de tipo II, y en algunas comunidades de tipo IV, y en particular, una necesidad es lograr una mejor documentación y revalorización del uso de la tracción animal.

I. GENERAL INTRODUCTION[1]

This report is the final narrative product under contract CNOMEX-071513 with The Nature Conservancy for the project Alianza Mexico REDD+ funded by the United States Agency for International Development (USAID). We focus on outlining the significant forest management regimes and harvest practices within the Alianza MREDD Áreas de Acción Temprana REDD+ (AATRS) for

- the AATR Sierra Norte
- to a much lesser extent the AATR Mixteca (where there is only one active forest management community that began logging in 2012-2013).
- the AATR in the southern Sierra Tarahumara in Chihuahua.

We analyze the opportunities for Improved Forest Management (IFM) as defined by TNC in publications by TNC staff scientists and the implications for reducing or removing Greenhouse Gas emissions from different types of community forest enterprise (CFE) governance and harvest management regimes. We present data from two major study components. These are a "Field Survey" of basic forest community and forest management data based on semi-structured interviews with a sample of community leaders and forest engineers and an "Improved Forest Management"

[1] The authors would like to acknowledge the very able research assistance of Ing. Elías Santiago, Maestra Guadalupe Pacheco, Lic. Mary Pérez Pérez and Tec. Rogelio Antonio Rodriguez in Oaxaca and Ing. Ivan Grijalva Martínez and Ing. Guadalupe Cedillo in Chihuahua. In Oaxaca, Ing. Miguel Angel Galeote, *Jefe de* la Unidad de Aprovechamiento y Restauración de Recursos Naturales in Oaxaca helped us greatly in getting access to the permit files there of SEMARNA. In Chihuahua, Ing. Arturo Heredia, Subdelegate, and Ing. Arturo Cedillo, Chief of the Unidad de Aprovechamiento y Restauración de Recursos Naturales of SEMARNAT-Chihuahua and Lic. Bernardo Ruiz, Conafor Delegate-Chihuahua, were extraordinary helpful and generous with their time. The staff of Rainforest Alliance in Oaxaca and Chihuahua also went out of their way to support the project, so thanks to Raul Benet, Jose Canto Vegara, Lizeth Hernández and Luis Antonio Moreno in Chihuahua and Jose Leonardo Hernandez and Zenaido Garnica in Oaxaca, and not forgetting Ian Starr from headquarters. Peter Ellis and Bronson Griscom of TNC have been patient and supportive beyond all reason, and demanding when they had to be. Thanks also to Eddie Ellis and Dawn Ward, our collaborators in the parallel IFM and Field Survey studies in the Yucatan and Cutzamala. Errors and omissions in the narrative and databases are of course entirely the responsibility of the authors.

component based on the collection of data from the logging permits files in the state offices of the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT-Secretary of the Environment and Natural Resources). The quantitative and qualitative data that provides the foundation for this report is collected in a series of databases that form a separate deliverable that accompanies this narrative report. These components provide context for the analysis of the harvest regimes and practices taking into account the overall goal of the project, to determine the current state of management and silvicultural practices and how they impact forest carbon stocks. We also discuss the Mexican regulatory framework for timber management and harvesting and its implications for IFM. Appendices I-IV provide further information on the study universe and samples, the data capture instruments used, and the databases that were compiled as a component of the project.

1. The Mexican Forest Regulatory Framework and Its Relationship to Improved Forest Management (IFM) and Forest Stewardship Council (FSC) certification.

In this section we will analyze the Mexican regulatory framework for timber harvesting. Silvicultural regimes in both the Oaxaca and Chihuahua AATRs are heavily regulated by the federal government's legal framework governing forestry in Mexico. They are thus a first overarching determinant of the impacts of both silvicultural regimes and harvesting, and the potential for reducing GHG emissions or increasing carbon capture. There are three levels of regulation of commercial forest extraction in Mexico, for both timber and non-timber forest products, in Mexico. These are:

- The General Law of Sustainable Forest Development (*LGDFS-Ley General de Desarrollo Forestal Sustentable*; 2003, modified in 2008 and 2013).
- The regulations (*Reglamento)* of the LGDFS composed of 178 articles in 44 pages, from 2005 (hereafter *Reglamento*).
- The *Norma Official Mexicana* (NOM) 152-SEMARNAT-2006 (hereafter NOM-152) "that establishes the guidelines, criteria and specifications of the contents of the forest management programs or the exploitation of timber forest resources in forests, rainforests,

and arid zone vegetation", approved in 2008 and composed of 24 pages of detailed instructions.

As noted, the three levels of regulations are quite extensive and detailed, so in order to analyze what is most relevant for this study we will take the guidelines which have been proposed to constitute Improved Forest Management (IFM) or Reduced Impact Logging-Carbon (RIL-C) (Griscom and Cortez, 2013; see also Putz et al. 2008). Griscom and Cortez (2013) divide the IFM practices into categories of better harvesting, protection, and growth with specific activities under each one as detailed in Table I below[2]. The first column in Table I shows the major categories and specific practices, Column 2 indicates some of the regulations in the *Reglamento* that respond to the particular IMF concern, and Column 3 has the greater regulatory detail sometimes found in the NOM-152. The LGDFS is not included since the *Reglamentos* represent the implementation of the law.

Of the practices in "Better Harvesting" covered in Table I, road and skid trail planning, reduced felling of defective trees and proper identification of commercial species before cutting are all explicitly addressed in Mexican regulations. Directional felling is not explicitly mentioned in the regulations, but is considered to be covered in language on environmental mitigation, and it is frequently mentioned in the actual authorizations. Low impact logging equipment is not mention either, but monocable, manual, or in Chihuahua, animal traction yarding are exclusively used. There is no use of bulldozers as in Indonesia. Improved cutting of log sections is not mentioned, and cutting vines is not relevant in Mexican temperate forests.

With respect to "Protection", riparian buffer zones and high conservation value forests are both required in the regulations, with the latter being embodied in measures to protect species listed in Mexico's threatened and endangered species legislation. Steep slopes are also mentioned, but due to the rugged terrain in the AATRs in both states, logging on slopes steeper than the requirement

[2] Griscom et al. (2014) use a different categorization for evaluating RIL-C, focusing on felling, skidding, and hauling, and the analysis could be reworked to reflect that.

occurs, but mitigation through leaving chopped slash in contours is required. Corridors are not mentioned in the legislation, but in AATRs in both states logging occurs in a context where contiguous masses of non-logged forest occur, so corridors are not relevant. Finally, the criterion of "Growth" in IFM is amply met both by the regulations and practices in AATRs in both states.

Table I: Comparison of Improved Forest Management Guidelines and Mexican Logging Regulations

Planning for IFM (Griscom and Cortez 2013)	*Reglamento* of the LGDFS	NOM-152-SEMARNAT
Better Harvesting		
1.Road and Skid Planning	Various sections say that road network must be described	5.2.11 Existing and new roads and skis trails must be extensively described. New roads must be justified, volumes of trees to be removed documented-other safeguards. 5.2.11a skid trails should be 3.5-6 m wide. Specified in program. Post-harvest treatments of skid trails required.
2. Directional Felling	Not explicitly mentioned	5.2.13.1 says that prevention and mitigation of environmental impacts must take into account felling.
		Not mentioned, but in field visits

3. Improved Cutting of Log Sections	Not mentones	cutting low on stump observed
4. Cutting Vines	Not mentioned, not relevant for Mexican temperate forests.	Not mentioned, not relevant for Mexican temperate forests
5. Low-Impact Logging Equipment	Not explicitly mentioned	5.2.2 says extraction should be carried out with "minimal damage to ecosystem". Monocable, winch and manual extraction universally used in Mexico. No bulldozers.
6. Reducing the felling of defective trees	Article 96 requires marking of all commercial species	5.2.7.1 Detailed description of inventory method to be used
7. Properly identifying commercial species before cutting	Article 96 requires marking of all commercial species	5.2.7.1 Detailed description of inventory method to be used
Protection		
Riparian buffer zones	Article 37 requires buffers for riparian areas	5.2.5 20 m of riparian vegetation maintained for permanent water courses, 10 m for seasonal
High Conservation Value Forests	Article 14 includes protected areas, habitat for species at risk, slopes of greater that 45^{o}, areas above 3,000 m, and cloud forest and montane tropical	5.2.13.2 Prevention and mitigation of environmental impacts.

	forest (*bosque mesofilo de montana*)	
Steep Slopes	Article 14. No logging on slopes above 45 ^{o}	5.2.13.2 Prevention and mitigation of environmental impacts. (widely ignored and not enforced-but leaving slash in contours required)
Corridors	Not mentioned	Not mentioned. But in Oaxaca and Chihuahua AATRs many production forests are blocks in a matrix of non-logged forests
Growth		
Silvicultural Practices to ensure regeneration and growth of native trees species and long-term timber production, income and employment	Required by law and regulation and governed by rules and norms in community forest enterprises.	Required by law and regulation and governed by rules and norms in community forest enterprises

This analysis suggests that this elaborate regulatory framework in large part provides guidelines for what would be considered RIL-C and IFM elsewhere in the world. For example, Putz et al. (2008:1428) have noted that that "Basic implementation of RIL regime requires detailed inventories in which the trees to be harvested are mapped, marked, and measured." Such forest inventories are a basic requirement in Mexican forests law and the regulatory apparatus, along with a series of other practices which have been defined as RIL in the context of Indonesia (Applegate et al. 2001).

In addition to the concordance of guidelines for RIL-C and IFM and current regulations for forest management in Mexico, there is also substantial concordance with the guidelines of the Forest

Stewardship Council (FSC) and their Principles and Criteria for Forest Stewardship. There are 10 of these principles, but here we will only give as an example Principle #7 Management Plan cited below

Principle #7: Management plan

A management plan -- appropriate to the scale and intensity of the operations -- shall be written, implemented, and kept up to date. The long term objectives of management, and the means of achieving them, shall be clearly stated.

7.1 The management plan and supporting documents shall provide:

a) Management objectives.

b) Description of the forest resources to be managed, environmental limitations, land use and ownership status, socio-economic conditions, and a profile of adjacent lands.

c) Description of silvicultural and/or other management system, based on the ecology of the forest in question and information gathered through resource inventories.

d) Rationale for rate of annual harvest and species selection.

e) Provisions for monitoring of forest growth and dynamics.

f) Environmental safeguards based on environmental assessments.

g) Plans for the identification and protection of rare, threatened and endangered species.

h) Maps describing the forest resource base including protected areas, planned management activities and land ownership.

i)Description and justification of harvesting techniques and equipment to be used.

7.2 The management plan shall be periodically revised to incorporate the results of monitoring or new scientific and technical information, as well as to respond to changing environmental, social and economic circumstances.

7.3 Forest workers shall receive adequate training and supervision to ensure proper implementation of the management plan.

7.4 While respecting the confidentiality of information, forest managers shall make publicly available a summary of the primary elements of the management plan, including those listed in Criterion 7.1.

The management program required in the *Reglamentos* and the *NOM-152* satisfy most of these FSC requirements. In addition to the broad regulatory framework outlined above, further regulation of logging occurs in the actual authorizations, to be discussed further in the state sections below. Actual practices may vary widely from the laws and regulations, and in the sections below evaluating actual silvicultural practices in the Oaxaca and Chihuahua AATRs, we will attempt to ascertain the degree of compliance.

2. Significant Forest Management Regimes

By "forest management regimes" we mean the characteristic forms of organization that CFEs in the Oaxaca and Chihuahua AATRs. The analysis of forest management regimes and organizational forms in Mexican CFES in general has been extensively covered in Antinori and Bray (2005) and elsewhere. The principal criteria for classifying Mexican CFEs has been through industrial vertical integration, in a typology developed by Mexican government forest agencies in the 1990s, and largely unmodified since then. This classification requires interpretations and modifications have been proposed. Table III includes both the text of official definitions and further explanations of the category in italics (Bray and Merino, 2005). In brief, Type I communities have commercial potential, and may have logged in the past, but do not have current permits and so are not considered in this study; Type II communities sell "on the stump" and contract with logging companies for most extraction activities; Type III communities sell roundwood and may have skidders, tractors and/or logging trucks for extraction of the logs from the forest and delivery to the sawmill; Type IV communities have sawmills and may have other forms of advanced processing (drying, furniture factories).

Table 2: Forest Management Regimes/Forms of Organization of Mexican CFEs

	Potential producers. Owners and/or possessors of forestlands with capacity for sustainable commercial production that

Type I	currently do not carry out logging because they lack an authorized forest management plan or sufficient means to pay for its elaboration.
Type II	Producers who sell timber on the stump (*rentistas*). Owners and/or possessors of parcels subject to timber exploitation where the activity is carried out by third parties through commercial contracts, without the owner or possessor participating in any phase of the extraction process. *Usually interpreted to mean that an outside contractor does all tasks associated with felling, yarding, and hauling logs to the sawmill, and the community has no involvement whatsoever. In practice, most of these "classic" Type II communities have members with chainsaws who do the felling, and the rest is done by the contractor, and they may also exercise varying degrees of control not reflected in the criteria of not "participating in any phase of the extraction process.*
Type III	Producers of forest raw materials; owners and/or possessors of forest parcels and that directly participate in some phase of the production chain*. The latter clause is usually interpreted that the community owns extraction equipment, including tractors, winches, skidders and logging trucks, or any one of those.*
Type IV	Producers with capacity for transformation and marketing: producers of raw forest materials that have infrastructure for its primary transformation and directly carry out the marketing of its products. *Primary transformation is interpreted to mean that they have a sawmill and sell most of their production as sawnwood. They may also have other advanced processing equipment such as dryers and furniture factories*

3. Silvicultural Practices: Uneven-aged and Even-Aged Systems in Mexico and Their Variants.

SEMARNAT officially recognizes only two principal silvicultural or tree selection methods, one uneven-aged and one even-aged. The uneven-aged or selection method is 1) the Mexican Method of Regulating Irregular Forests (MMOBI-*Método Mexicano de Ordenacion de Bosques Irregulares*). 2) The even-aged, seed tree method is called the Silvicultural Development Method (MDS-*Método de Desarrollo Silvícola*). As we shall see below, in the Chihuahua AATR, until very recently, MMOBI was exclusively practiced. In the Oaxaca AATRs, both MMOBI and MDS are practiced, frequently in the same community forest depending on local forests conditions, along with variants. The three principal variants in the Oaxaca AATRs are 3) the Conservation and Silvicultural Development System (SICODESI-*Sistema de Conservacion y Desarrollo Silvicola)* which is considered a form of MDS 4) "group selection" or "strip clear-cuts" which clear out all trees of all diameter in .5-1.25 patches, and is thus not a seed tree method, and 5) "Restoration Logging", a variant of MDS developed by Japanese International Cooperation Agency (JICA) which is focused on restoration of young and highly degraded forests. Further description of each one of these 5 silvicultural practices follow below.

3.1 MMOBI

MMOBI was formerly known as the Mexican Method of Forest Regulation (MMOM-Método Mexicano de Ordenación de Montes), but in 1980 the name was formally changed to MMOBI. MMOBI is a management practice for uneven-aged stands, or stands with a variety of age classes and diameters. MMOBI incorporates the use of the Liocourt Curve, which establishes the number of trees in different diameter categories and manages towards the achievement of an "ideal" uneven-aged structure (Hernández-Díaz et al 2008). It uses exclusively "selection cuts". Up until the 1970s it was frequently used to just take out large diameter trees, but in more recent periods it was applied to take out a balanced distribution of the age classes. However, it has also been observed that maintaining a balanced distribution is not necessary and that managing for density and variable

structures can maximize both timber and ecosystem services (Torres Rojo, 2000). The historic practice of taking out only large diameter pine has been widely observed to drive a transition to oak-dominated forests, which is influencing current silvicultural practices to restore a pine-dominated forest in some community forests. MMOBI is considered to be the more environmentally friendly of the two, since it maintains more of the structure of a natural forest and a continuous canopy.

3.2 MDS

The silvicultural development method emerged in Mexico in the 1970s as a management response to extensive second growth forests that developed in northern Mexico after intensive logging earlier in the 20th century, and was originally called "intensive silviculture". The sequence of cutting typical of MDS methods is outlined below, consisting of a varying series of precommercial thinning and thinning stages (*preaclareos* and *aclareos*), a regeneration cut which leaves seed trees, and a liberation cut which takes out the seed trees (*arboles padres*). The goal here is to maintain a more even-aged forest, or to convert a moderately uneven-aged forest to an even-aged one through a complete cutting cycle. As Mexican foresters gained experience with MDS, they also began to observe that a given forest or even a forests stand could present diverse conditions, so began combining MMOBI and MDS in the same forest (Hernandez-Diaz et al. 2008). As noted above, forests in the Oaxaca AATRs frequently employ these "mixed methods". MDS was introduced in the Sierra Norte of Oaxaca AATR for the first time in the early 1990s and is now in widespread use. Due to a new CONAFOR-SEMARNAT policy, MDS began to be applied in Chihuahua for the first time in the 2012-2013 harvest season.

Typical cutting sequences in MDS are:

3.2.1 Regeneration Cut.

Takes out all trees except a selection of mature trees with a straight trunk, well-formed crowns, undamaged, and with good seed production capacity. Trees are spaced at 40-50 meters. It is after a regeneration cut that there would be a rapid accumulation of carbon in both the regeneration and in the seed trees (See Figure 1 below).

Figure I: A Regeneration Cut in a community in the Sierra Norte AATR

3.2.2 Liberation cut

Occurs when the new growth above reaches a certain height, then the standing seed trees are felled to eliminate competition with the regeneration, as well as to generate income from the timber. It is recommended for cost and other purposes that at the same time as the liberation cut is conducted that a *preaclareo* (precommercial thinning) is carried out.

3.2.3 *Preaclareo* (precommercial thinning)

A thinning of the regeneration under the seed trees, where the best individuals are given more space to develop and weaker or smaller saplings are eliminated. The combination of the felling of the seed trees and the pre-commercial thinning would result in a sharp fall in captured carbon in the stand

3.2.4 *Aclareos* (thinning).

These are periodic thinnings which can take place anytime between the liberation cut and precommercial thinning, and the regeneration cut. Thinnings generally take out trees that are deformed, diseased, dominated, noncommercial species, with some better trees taken out for

economic reasons. The purpose is to improve conditions of light, space, and nutrients for rapid development of commercial stock. The number and intensity of thinnings, and the use of the trees removed, will have varying implications for carbon storage, as noted above.

3.3 Group Selection or Strip Clear-Cutting (seleccion grupal o matarassa en franjas).

These two terms are sometimes used interchangeably but can also refer to two variants. Group Selection can refer to taking out all trees of all diameters in block of .25-.75 ha while strip clear-cutting occurs in .5-1.5 ha and in more of a strip. It is thus not a seed tree method. In both cases, normally natural regeneration is used relying on the seed rain from the surrounding forest. In the Sierra Norte AATR, this practice was introduced by Ixtlán de Juarez in the mid-2000s and is now being adopted by some other communities. Figure 2 below shows a strip clear-cut in Ixtlán, which also shows the chopped slash arranged in contours, a requirement from SEMARNAT usually found in the logging authorization. Figure 3, following, shows a landscape view of the practice. The aesthetics of this practice have created some controversy in the community, but it continues for now. Figure 4 below shows healthy natural regeneration in a strip clear-cut.

Figure 2: A strip clear-cut in Ixtlán de Juarez showing arrangement of chopped slash in contours to prevent erosion

Figure 3: A Landscape View of Strip Clear Cuts in Ixtlán de Juárez

Figure 4: Natural Regeneration in a Strip Clear-Cut-Ixtlán de Juárez

3.4 SICODESI

SICODESI was Introduced by Finnish foresters in the early 1990s. It is not so much a separate silvicultural practice, but a software management plan. Nonetheless, when foresters use SICODESI it is given that classification in the management plan. SICODESI includes long-range planning (Strategic Planning) and a short-term plan (Operative Plan) while MDS includes only the short-term plan. SICODESI also includes Dasnometric, Socio-economic, and technological studies, as well as environmental impact studies.

3.5 Restoration Logging

The forester for San Martin Buenavista argues that "restoration logging" is neither MDS or MMOBI, but a method for heavily degraded forests developed by the Japanese International Cooperation Agency (JICA) during a long-running project in the 1990s and 2000s. However, it is classified as MDS by SERMARNAT. In this case, restoration is occurring in the wake of a big fire in 1986, resulting in

high density in the regeneration. The thinning is done in the very young forest. The management program for San Pedro Nuxiño in the Mixteca was developed by a forester who also worked on the JICA project in Sierra Norte, and a brief case study of restoration logging in this community follows.

3.5.1 Restoration Logging in San Pedro Nuxiño

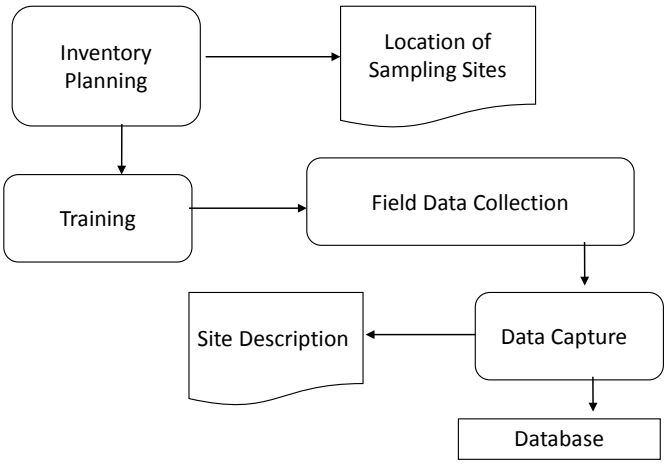
San Pedro Nuxiño has a total of 6,311 ha and about 3,000 hectares of forest. Of this, around 2,000 hectares has been informally privately parceled where unauthorized logging occurs for firewood and charcoal. Another 1,000 hectares is currently managed as a common property by the community CFE. The forest was logged under concessions from the early 1970s until 1989. During this period, when the community had little control or knowledge of forestry, logging roads were built in a haphazard fashion and a form of MMOBI practiced which took out only large pines. This drove a transition to a significantly oak-dominated forest. The community stopped all logging in the 1,000 ha forest in 1989 and from 1989-2004 the forest was protected by the community, although about half was impacted by a fire in 1991, after which the community undertook reforestation activities. The community began logging for the first time as a CFE in 2005. However, due to previous logging practices, the forest was estimated to be about 70% oak and 30% pine. Due to the varying conditions of the forest, and with the interest in logging the oak for charcoal and the goal of what the foresters describes as “restoration” to a pine-oak forest, both MMOBI and MDS are used in different parts of the forest. MDS is used to clear out oak-dominated stands, and to open sufficiently large spaces to encourage pine regeneration. As well, the community is slowly rationalizing the placement of logging roads, eliminating the more haphazard placement from the concession period, and thus reducing the amount of forest dedicated to roads. The community was observed to have good control of the commercial forest and visual inspections showed only very minor residual stand damage in areas logged in the last 2-3 years. Directional felling is planned as part of the initial marking of trees to be logged in each year.

4. The Forest Management Program Planning Process.

The LGDFS and the NOM-152 together call for a systematic and detailed process for the development of the Forest Management Programs (FMPs). Some of the essential elements relevant to IFM were

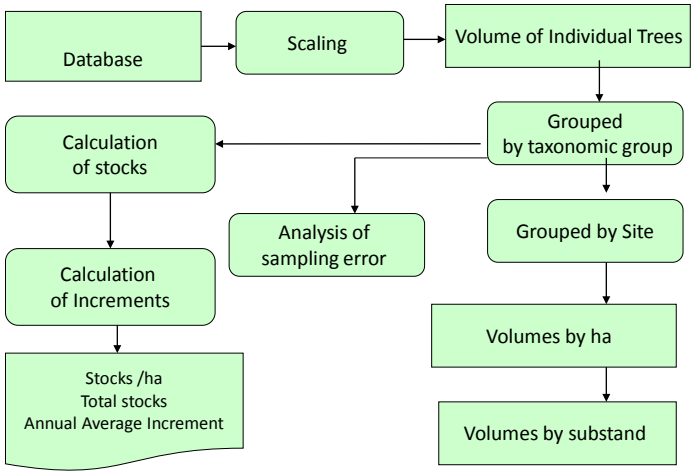
detailed above, but here we will review the process of development and approval of the FMP, which also incorporates many elements of IFM. The process begins with the forest inventory, with the steps outlined in Figure I[3] below (figures modified from versions provided by UZACHI)

Figure I: Forest Inventory Process



[3] Figures on forest planning process follow a separate numbering (Figures I, 3,3). They were obtained in files that can't be modified.

Figure 2: Data Processing and Calculations



Figures I and 2I show the inventory process and the data collection process. The inventories and stand selection are done prior to seeking authorization from SEMARNAT, as part of the proposed management program. In the AATRS in both Oaxaca and Chihuahua, teams of community members participate in the inventories, using systematic or random sampling strategies with sample parcels of 500 to 1000 m2. The inventory methods required in the NOM-152 are highly detailed and can be found in section 5.2.7 (pp. 8-10; NOM-152 included in documentation that accompanies this report).

On the basis of the inventory, the stand selection is then done in the office of the forest engineer and is carried out using the inventory field data and criteria such as soil, climate, slope, topography, microwatersheds, species composition and other vegetation characteristics. Orthophotos and Google Earth images are also used. Stand selection is then checked with field observations. Stands and substands *(subrodales*) are classified as to quality (low, medium, high). In the Chihuahua AATR analysis is only carried out at the level of the stand, not the substand. In most communities, the management programs are discussed with the community assembly before being presented to SEMARNAT, so it is frequently a highly participatory process.

The orography in all of the AATR communities is mountainous with moderate to strong and abrupt slopes. These factors, together with the exposure and the presence of streams can influence the productivity of a site and the vegetation. Watershed divides and arroyos are common criteria to delimit stands and substands. Terrain and the road network are also evaluated in the planning for

timber extraction, and in management actions during and after logging. Road location with respect to the stand and the slope of the site determine the placement of the skid trails and the extraction method for the trunks. In sites where there are more pronounced slopes, there is more susceptibility to soil erosion as a result of surface run-off, which requires immediate protection measures. A typical end result in the stand selection process is shown in Figure 5 below of stands in Ixtlán de Juárez in the Sierra Norte AATR

Figure 5: Stands in an 8 year cutting cycle for Ixtlán de Juarez

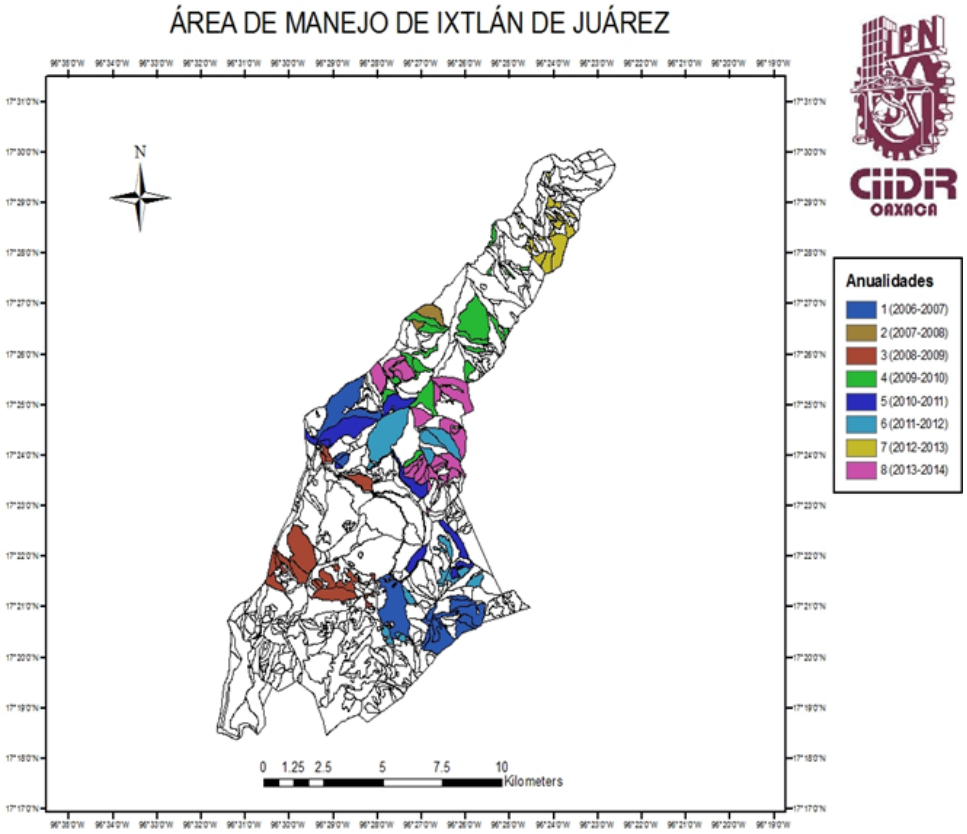
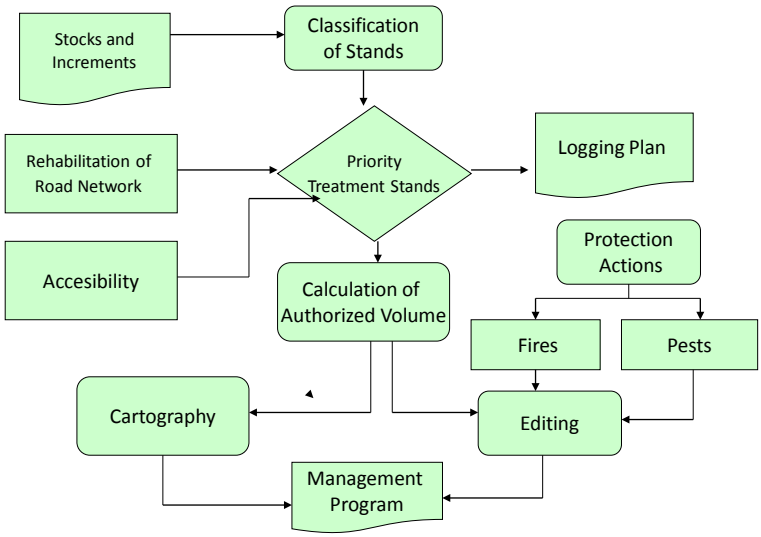


Figure 3 below shows the development and principal elements that go into the Management Program, which as noted are largely determined by the *Reglamento* and the NOM-152. The same general process is followed for all silvicultural regimes, although the nature of the inventory and

some other steps changes substantially in how they are implemented between uneven-aged and even-aged systems practiced in the Oaxaca AATRs.

Figure 3: Logging Plan



Once the stands are determined and the authorization is given by SEMARAT, the trees are then marked for harvesting.

5. Notes on Silviculture for both Timber and Carbon Capture and Extending Rotations.

As noted in the introduction, the IFM sections of this report focus on the impacts of harvesting practices on release of carbon and carbon capture. Another subject of interest, however, are whether or not there are quantifiable differences in long-term C capture between uneven-aged and even-aged silvicultural practices (MMOBI and MDS and its variants). To address this in the AATRs would require a longer and more technical study than this one. However, drawing on some of the

literature on the subject, we will undertake some speculation on the subject. Long-term C capture is related both to the rates of biomass accumulation under each practice and to the harvest impacts in releasing carbon, which may only be partially related to the silvicultural system. That is, carelessly managed extraction could increase carbon release under either system.

Forest management for timber "creates a cyclical pattern of carbon release and sequestration, with intensively managed stands storing less carbon than unmanaged forests." (Tyrell et al. 2012). However, different degrees of intensity, such as those between the two principal systems under consideration here, can also vary substantially in their implications for carbon, as well as the time horizon considered in carbon capture. The amount of carbon released and captured and the time period over which it occurs can vary greatly between and within different silvicultural treatments. As well, the final destination of harvested trees needs to be taken into account as integral to the different harvesting practices. Bragg and Guldin (2010) have defined as "fast pool" biomass smaller roots, bark, foliage, and other slash that decomposes quickly and tree products that are converted into short-lived paper products. "Slow pool" biomass is larger pieces of the bole that may be left behind and timber that goes into long-term storage in furniture and buildings (Carroll et al. 2012). In the Mexican AATRs, most of the harvest goes into long-lived forest products, and the requirement to chop slash and arrange it in contours to prevent erosion likely significantly reduces carbon emissions from soil disturbances and the decomposition of the slash.

Bragg and Guldin (2010) conducted a highly suggestive study of the carbon capture implications of uneven-aged systems and even-aged systems in a USDA experimental forest (one uneven-aged treatment) and adjacent industrial forestry lands (two even-aged treatments) in southern Arkansas. The study found that there were tradeoffs in terms of carbon in the different practices. Uneven-aged treatments were not as productive of carbon as even-aged; due to the discrete establishment events with rapid growth in the latter, but uneven-aged pine stands produced a stable flow of captured C in the form of sawnwood. It also maintained a stable stock of 61.5 to 78.5 tons/ha of live aboveground biomass, with substantial additional capture in coarse roots, although

even-aged stands have more live belowground biomass for most of the turn. At the end of a 100-year simulation, even-aged stands had "sequestered approximately 120 tons/ha of C in live tree and product pools, or about 50 percent more than the uneven-aged stand. The uneven-aged stand, however, maintained a more stable residual live tree C store, and fluctuated (only ± 2 tons/ha/yr) far less than either even-aged treatment" (Bragg and Gulden, 2010). Thus, even-aged treatments sequester more carbon over the long-term but with sharper fluctuations in emissions. They further conclude however that "it may be possible to manage uneven-aged southern pine stands on a more irregular basis with cutting cycles longer than conventional 5-year intervals. Doing so would likely result in increased rates of C accumulation somewhat similar to that seen in the seed tree method, and concurrently would increase C sequestration while retaining the continuous cover canopy attributes sought by managers who utilize this silvicultural system." (Bragg and Guldin, 2010).

Thus, whether or not an uneven-aged or even-aged system, as practiced in Mexico, would be superior in terms of C capture seems to demand largely on the specific management practices and the time horizon considered, with neither system being clearly superior in terms of C capture. It should be noted that much of the data in the database, such as logging intensity and reforestation density, is relevant for eventual calculations of the varying C capture impacts of the different silvicultural systems. Specific impacts of harvesting practices are less clearly present in the database, since these practices are so tightly regulated by SEMARNAT.

Intentional delayed harvesting for purposes of carbon capture can be used in either an even-aged or uneven-aged system. It is not currently a silvicultural practice in Mexico, apparently not even in the CFE communities in the Sierra Norte AATR working with Servicios Ambientales de Mexico (SAO), which has been selling carbon bonds in the Mexican voluntary market. Studies on the subject have focused on "the optimal rotation age of a stand when timber and carbon reductions are jointly produced" (Amacher et al. 2009:72). The issue is complicated by the fact that carbon in a stand of trees can be found in four categories: trees, soil, litter and understory vegetation. A full accounting also has to establish how much carbon is released by harvesting and how much carbon continues in

long-term storage in furniture and buildings after harvesting (the "forest products pool"). The economics of the problem involve calculations of the marginal cost of delaying harvesting where "the optimal rotation age is to be chosen so that the marginal benefits of delaying harvest equal the opportunity costs of delaying harvest" (Amacher et al. 2009:74). These calculations depend greatly on the market value of carbon which is currently extremely low and likely not currently competitive with the price of timber.

The database for volumes authorized and volumes harvested shows that in both the Oaxaca and Chihuahua AATRs, it is common that the complete authorized volume for a logging year is not harvested, for a variety of reasons, from late arriving permits, to rains, to disorganization, or community conservation-oriented decisions to not harvest all of the volume. When this happens, the unlogged volume does not carry over to the next logging year. It is said that *queda al favor del bosque*, it is left for the forest. When this happens, it's a defacto partial lengthening of the harvest cycle, since that volume would not be harvested for another ten years. Thus, this practice is functionally carbon enhancement, which can emerge either unplanned or by positive decision. This raises the option of carbon payments for maintaining unharvested carbon stocks if it emerges from a conscious decision (Amacher et al. 2009).

II. Methods and the Databases

The original RFP called, with respect to the IFM component, for a sample of 'the range of significant forest management regimes and harvest practices within the MREDD AATRs" and with respect to the "Field Survey" component an "An extensive field survey…to gather information about all (or nearly all) the *ejidos* and *communidades* within AATRs that produce substantial commercial timber". The nature of the available data, and consultation with TNC and Dr. Edward Ellis, the contractor for the Yucatan and Cutzamala AATRs, indicated a modification of the initial proposal for what component would be sampled and what component would have a survey of the entire AATR

universe of logging communities. The richest single data source on silvicultural practices for IFM are the *expedientes* or files in the state SEMARNAT offices, containing the proposed management programs, amendments to them, authorizations by SEMARNAT, and required annual reports on harvest volumes and other issues from the responsible forester. These files are only available for consultation in the respective state SEMARNAT offices, from whom permission was sought and granted to review the files. This data source made it possible to collect information on the entire universe of communities with logging permits in the AATR, not just a sample. In the case of the Field Survey, in the Sierra Norte (N=19) and Mixteca AATRs (N=1), due to their relatively small size, it was possible to conduct the Field Survey in the majority, but not all, of the communities. However, the large size (N=69), logistical challenges, and security situation made it impossible to survey the entire universe of the Chihuahua AATR, so in this case a sample was taken. Sample size is further reviewed below.

Five data capture instruments (see Appendix II) were used in the study, covering the data requirements of both the IFM and Field Survey components. These were 1) Interviews with a sample of the elected community authority (*comisariados)* (field survey) 2) Interviews with a sample of forest engineers (IFM), 3) samples of direct observations of harvest impacts in the field (IFM) 4) data capture from the SEMARNAT logging permits files for the entire universe of the AATRs (IFM) and 5) a data capture instrument for other Mexican government agencies (Institute Nacional de Estadística, Geografía e Informática-(INEGI and the Secretaria de Desarrollo Social-SEDESOL, among others) (Field Survey). The surveys were first administered in Oaxaca and some adjustments were made to reflect different circumstances in Chihuahua. The surveys in Appendix *I* are the ones used for Chihuahua, but the Oaxaca versions are available upon request.

1. Study Universe and Sampling Issues

1.1 The Oaxaca AATRs study universe and sampling issues

An initial review of the communities with logging permits suggested that for Oaxaca there were 10 communities in the Mixteca AATR and 21 communities in the Sierra Norte AATR. However, further

review established that in fact there were only 2 communities with logging permits in the Mixteca AATR and 19 in the Sierra Norte AATR. The two communities in the Mixteca AATR are Santiago Yosundua and Santa Catarina Cuanana. Of these, Santiago Yosundua is not harvesting for conservation reasons and Santa Catarina Cuanana only began harvesting in 2012-2013. Thus, the presence of legal timber harvesting in the Mixteca AATR is extremely minor, reduced to one community in one recent year. There are only nine remaining communities in the Mixteca with logging permits. Of these, five are not harvesting, three for reasons of conservation and two due to internal conflicts. In addition to Cuanana, there are only four others who are harvesting, for a total of five active CFEs in the entire Mixteca. Thus, we do not discuss the Mixteca in this report, although data on the all Mixteca CFEs with logging permits can be found in the Oaxaca IFM database.

In Sierra Norte, we originally detected 21 CFEs in the AATR. Of these, we found one, San Isidro Lagunas, which was not exercising its management plan. It had been given a logging permit in 2008 but it had never been exercised due to internal disorganization and conflicts. Additionally, we had originally included the community of San Pedro Yolox. However, in the course of the study we discovered that San Pedro Yolox holds its logging permit as a *municipio*, not as a community and for a parcel with ejido status denominated "Zona 1 El Carrizal" which was also on the list of CFEs in the Sierra Norte AATR. Thus, the community of San Pedro Yolox was also eliminated from the list. This left 19 CFEs in the Oaxaca AATR (See Appendix II for complete list).

Originally, an approximately 50% random stratified sample was proposed for interviews with forest engineers and community leaders for the Sierra Norte AATRs, with the strata used being the CONAFOR typologies. However, due to the small size of the Sierra Norte universe, we attempted to survey all community leaders and forest engineers in the AATR. We were able to interview 15 of the 19 community leaders in the Sierra Norte AATR for a 79% sample. Several foresters attend more than one community in the Sierra Norte AATR and several forests also declined the interview, leaving a total of 7 forest engineers who were interviewed. This information was used to supplement the data from the management programs in the report below. In addition, a separate in-depth interview was

held with the forester for San Juan Evangelista Analco, Ing. Filemon Perez Ruiz. Dr. Ruiz also has a PhD in forest ecology so had many insights into the implications of the different forest management practices in Oaxaca. Interviews were also conducted with foresters in SEMARNAT and other forest management stakeholders.

Direct observations of logging impacts were also conducted in 8 Sierra Norte AATR communities. An initial visit was made with the contracted forester to test the protocol in both the Mixteca and Sierra Norte, and the forester made the remainder of the visits on his own. Brief observations were made about impacts on the forest from logging in the most recent logging period, and on regeneration in a stand that was logged 2-3 years earlier. The visits were made in the company of the forester or a forest technician from the community, and in four communities members of the Oversight Council *(Consejo de Vigilancia*) also accompanied the visit. Data from these interviews and forest observations are also incorporated into the analysis and narrative below and more detailed information is available in the respective databases.

1.2 The Chihuahua Universe and Sampling Issues

For Chihuahua, we received a database provided by Rainforest Alliance-Chihuahua for the Sierra Tarahumara AATR that included 66 communities. A first analysis of this database and comparing it to the logging authorizations in SEMARNAT Chihuahua shows that 7 of these communities did not have logging permits, leaving a universe of 59 CFEs, mostly in the municipios of Guadalupe y Calvo and Guachochi, with several in the municipios of Balleza, Batopila, Nonoava, and Urique. The complete list of logging communities in the Chihuahua AATR is found in Appendix I.

While we originally conceived a 50% random sample in the Sierra Tarahumara for interviews with community leaders and forest engineers, the challenges of distances, logistics and communication and the size of the universe made it impossible to achieve this in Chihuahua. For reasons detailed below, we were only able to achieve only a 29% sample (17 of 59). As in Oaxaca we attempted to sample using the stratification by the CONAFOR typologies of Type II (selling on the stump), Type III

(own extraction equipment) and Type IV (sawmill). Across all of the *municipios* there were 38 Type II's, 7 Type III's and 14 Type IV's. We first sought a 25% sample, which would have implied 3-4 Type IVs, 2 Type IIIs and 9 Type IIs, using a random number procedure. We did not stratify by *municipio*, but the universe is substantially weighted towards the municipio of Guadalupe y Calvo, with 31 agrarian communities in that entity, 16 in Guachochi and 12 in the four additional *municipios*. Thus, the 25% sample yielded larger numbers in Guadalupe y Calvo. However, Guadalupe y Calvo represents particularly challenging circumstances due to the security situation, logistics, communications, and remoteness.

The security situation in both Guachochi and Guadalupe y Calvo is very challenging, but particularly in the latter. In the last several years there have been multiple incidences of murders and armed confrontations between security forces and organized crime. The Chihuahua forester who collaborated on this project, Ing. Ivan Grijalva Martínez reported that he planned a trip to visit the Ejido El Pinito in Guadalupe y Calvo, but the day before the appointment there was an armed confrontation in the municipality between the police and criminal elements with deaths on both sides. Due to this event, the comisariado of El Pinito, who had been in Parral on business, postponed his return to his community and Ivan conducted the interview in Parral. On a different trip where he did enter the region, he observed a small community where all the houses had been abandoned, and they encountered a military checkpoint where they were advised to not travel in the late afternoon or at night.

In addition to the security situation in Guadalupe y Calvo, the remote, rugged and poorly served by roads region makes visits and even making contact with community authorities challenging. The main administrative town of the *municipio*, of the same name, is 8 hours from Chihuahua City. As examples of the difficulties, one *ejido* that came up in the random sample (Ejido La Quebrada) has no telephone communication, and it does most of its business in Sinaloa since that is closer for it, and it proved impossible to contact community authorities in a reasonable period of time. The next up in the sample was Ejido Coloradas. It was possible to contact the forest engineer but community authorities do not allow anyone to come to the ejido without prior authorization. To reach the ejido,

the usual procedure is to fly to *ejido* Baborigame, where a vehicle from the ejido is waiting. Ing. Grijalva finally reached the comisariado by phone, but after much questioning he declined the interview. Next on the list were the *ejidos* of San Juan Nepomuceno and Santa Rosa. Their forest engineers reported that the authorities in both communities "had a lot of problems" and it was very difficult to get in contact with them. For *Ejido* San Ignacio de la Cieneguilla, their forest engineer said that it was very difficult to get in touch with the authorities, and that he had authorization to represent them in SEMARNAT. Next in the sample was *Ejido* Barbechitos, where the forest engineer also reported that it was very difficult to communicate with them, and that he only went to the *ejido* by plane. In this case, Ing. Grijalva was finally able to interview the Comisariado on a visit to Chihuahua City. But other failures to be able to make contact with ejidos in the sample continued.

Thus, due to the security situation and the difficulty in communications and access, the random procedure essentially broke down and the procedure became more opportunistic, interviewing comisariados and foresters who were accessible. We thus ended up with a sample that was more heavily weighted towards Type IVs, since they tend to be better organized and easier to communicate with, and towards agrarian communities in Guachochi, which is more accessible (only 5-6 hours from Chihuahua City) and where the security situation is currently relatively less tense. We thus ended up with a sample for the community authority and forest engineer surveys a total of 17. These were composed of 8 Type IVs, 1 Type III, and 8 Type IIs, and with 8 of them in Guachochi, 8 in Guadalupe y Calvo and 1 in the municipio of Urique (See Appendix I).

Figure 6: Forester Ivan Grijalva conducting interview with a Comisariado

III. Results

1. Field Survey-Sierra Norte AATR

1.1 Introduction

Oaxaca is only the 6th largest producer of timber in Mexico and has fewer community forest enterprises (CFEs) than Chihuahua, Durango, and other states, but it has an outsized reputation in community forest management. Oaxaca's reputation in community forestry rests substantially on the trajectory of CFEs in the Sierra Norte, and to a somewhat lesser extent in Sierra Sur. The reputation of Sierra Norte begins with a history of activism against logging concessions on community lands going back to the 1970s. In 1976 the community of Pueblos Mancomunados carried out a stoppage against the private timber company Maderas de Oaxaca, seizing equipment in protest for illegal logging, and went on to form the first CFE in Oaxaca in 1977. The 1970s and early 1980s were

marked by new protest movements against concessions, with communities in Sierra Norte and Sierra Sur organizing production stoppages (*paros*) against various timber companies. In 1980 the Organización en Defensa de los Recursos Naturales y Desarrollo Social de la Sierra de Juárez (ODRENASIJ), composed of 17 communities, emerged fighting against the renewal of a 25-year concession to the parastatal pulp factory Fabricas de Papel Tuxtepec (FAPATUX) that was due to end in 1982. The communities combined legal strategies and seizures of logging company equipment and in 1983 were successful in reversing an effort by the government to renew the concession for another 25 years. Thus, in that year began the long and difficult struggle to construct viable CFEs. In the 1980s, many of the CFEs were beset by internal conflicts, problems in acquiring the additional skills needed to operate a CFE, and organizational issues in how to use the existing community governance bodies to administer an enterprise. But by the early 1990s, the communities had advanced on the learning curve, and began to organize increasingly more efficient and dynamic CFEs in a number of cases. In the most sophisticated cases, a crucial step was creating specialized governance bodies that administered the CFE, removing it from the direct management of the Assembly (Bray et al. 2006).

Another important step was to begin to hire professional managers for the CFE. Today, after a full generation of relative prosperity most managerial positions in the most vertically integrated CFEs are occupied by community members with university degrees in forestry, business administration, or other professional degrees. In the Sierra Norte AAT 13 of the 19 CFEs are vertically integrated Type IV's, almost certainly the highest percentage of Type IV's of any region in Mexico.

From 1997-2007, a World Bank-Government of Mexico program called the Programa de Conservación y Manejo Forestal (PROCYMAF) helped drive a diversification of Sierra Norte's forest-based industries. Today, many of the communities also have water-bottling plants and ecotourism operations. These provide substantially less employment than the timber industry, but nonetheless have generated new sources of income for the forest and employment for the communities. In the mid-2000s, support from the state and federal government and community initiatives marked a new stage in the entrepreneurialism of the CFEs with the formation of TIP Muebles. TIP Muebles

(Furniture) is an alliance between three of the most sophisticated CFEs. TIP stands for the first letters of the 3 partners-Textitlan (in Sierra Sur), Ixtlán de Juárez, and Pueblos Mancomundos. In this joint venture, each CFE has highly automated sawmills and sophisticated production factories where they produce different lines of furniture which are then jointly marketed. The effort, marketing exclusively FSC-certified furniture, now has 7 sales outlets, two in Oaxaca, 1 in Puebla, 3 in Mexico City, and one in Chiapas.

The incentive of the income that can be generated from highly productive forests and vertically integrated forest enterprises has helped stimulate high degrees of community organization and social capital, and close monitoring and concern for the performance of the forest industries and the state of the forest. This has also led to a strong sense of intergenerational equity, that the current generation of *comuneros* has the obligation to deliver a healthy productive forest to their grandchildren and beyond. Studies have shown that there is no net deforestation and widespread forest recovery in the pine-oak forests of Sierra Norte, although deforestation continues in dry and humid tropical forests (Gomez-Mendoza et al. 2006)[4]. However, there are still pockets of poor forest management as well as the launching of new forest enterprises that will require time to mature. The CFE of San Miguel Aloapam has had serious problems over boundaries with one of its population centers, known as San Isidro Aloapam. San Isidro is trying to establish its own agrarian community, and conflicts over the forest led to two deaths in 2004. This conflict remains unresolved and logging permits are not issue for the area in dispute. The community of San Juan Tepanzacoalco has a small forest and many internal conflicts which have made it difficult to consolidate a CFE. More recently, CONAFOR has been promoting a new generation of CFEs in the area of Sierra Norte known as El Rincón. This is a traditionally coffee-producing area with communities with smaller populations and larger territories. However, abandonment of agriculture has led to widespread forest recover of *Pinus chiapensis* a lower-elevation tropical pine which is endangered in other parts of southern

[4] As noted, this study finds continued deforestation in dry and humid tropical forests in Sierra Norte, but it uses an administrative definition of Sierra Norte that includes the adjacent Mixe ethnic region that is much more fragmented. There is evidence that both dry and humid (montane tropical and cloud) forests in the area defined as the Sierra Norte AATR are intact and/or recovering (Ponce-Reyes et al. 2012), although no credit for community ownership and management is noted for this outcome.

Mexico. However, abundant local population of the pine has led to the issuing of special logging permits in this region, such as the new CFE in San Juan Tabaa.

1.2 Legal and Historic Information[5]

1.2.1 Time since Tenure Established

The communities of the Sierra Norte AATR have had long and secure possession of their territories. However, for bureaucratic reasons, many of them did not get final title of their lands until comparatively recently. Only two of the communities have had title since the 1940s, 1 from the 1950s, 4 in the 1960s, 4 from the 1970s, 3 from the 1980s, and 5 in the 1990s.

1.2.2 Tenure Type.

All of the agrarian communities in the AATR Sierra Norte are *comunidades* with a single exception. There is an ejido denominated "Zona I El Carrizal" but where most of the ejidatarios are also *comuneros* en la *comunidad* de San Pedro Yolox. The management plan is actually given to the *municipio* of San Pedro Yolox, not the *comunidad.*

1.2.3 Title Conflicts

In the interviews with Comisariados, none reported having title conflicts. However, this does not appear to be accurate. A review of documents in the agrarian reform agency and personal knowledge of the region shows that several do have conflicts, at least one of which has led to violence in the last decade (San Miguel Alopam, mentioned above). Table 3 shows the conflicts of which we have records and this is also reflected in the Government Data database for the Field Survey.

[5] The sections follow the data requested in the RFP.

Table 3: Title/Boundary Conflicts in the Sierra Norte AATR

Community	Conflict Communities (hectares)	Comments/Status	Forested
Capulalpan de Méndez	San Miguel Yotao (1,595 ha) San Juan Tepanzacoalco (199 ha)	Unresolved. However, in 2012 Capulalpam and Yotao agreed to jointly log 85 ha affected by the pine bark beetle	Yes
Pueblos Mancomunados	Internal (composed of three different *muncipios*)	Conflicts over logging between *municipio* de Yavesia and *municipios* de Amatlan and Lachatao led to voluntary suspension of all logging except for removal of diseased trees.	Yes
San Miguel Aloapam	San Isidro Aloapam (6,239 ha).	Unresolved. San Isidro Aloapam is a separate community within the municipio of San Miguel Aloapam that has been trying to get separate recognition as a *comunidad*. This conflict resulted in two deaths in 2007. No logging permit issued in conflict area.	Yes
Santiago Comaltepec	San Pedro Yolox (~800 ha)	Unresolved. Former agricultural lands now in secondary succession. Not in management plans	Yes
San Juan Luvina	San Juan Baustista Atepec (893 ha) La Chupparosa Comaltepec (150)	Unresolved. Confusion in agrarian titles. Not in logging area	Yes

1.2.4 Certification Status

The communities of the Union Zapoteco-Chinanteco (UZACHI) (La Trinidad, Santiago Xiacui, Capulalpam de Méndez, and Santiago Comaltepec) were the first communities to receive FSC certification as a group in 1996. These communities are now in the process of their fourth re-certification. The second to be certified was Ixtlán de Juárez in 2001. Table 4 below shows the current status of FSC certification in the Sierra Norte AATR. There are only two currently active and five in the process of certification or re-certification, and one community with chain of custody certification only, for a total of 7 with forest management certifications active or in process. Pueblos

Mancomunados stopped all logging except for *saneamiento* (logging of diseased trees) several years ago due to internal conflicts, but has chain of custody certification for its sawmill.

Table 4: Current Status of FSC certification in Sierra Norte AATR

Community	Current Status	Type of Certification
UZACHI (La Trinidad, Santiago Xiacui, Capulalpam de Mendez, Santiago Comaltepec)	In process of fourth group renovation.	Forest Management and Chain of Custody (latter 14/10/2010-13/10/2015)
Ixtlán de Juárez	Active (5/12/2012-4/30/2017)	Forest Management
Santa Catarina Ixtepeji	Active (5/12/2012-4/30/2017)	Forest Management
San Juan Bautista Atepec	In process of first certification	Forest management
Pueblos Mancomunados	Recently expired 31/03/2009-30/03/2014	Chain of custody

Blackman et al. (2013) show only 2 communities in Oaxaca with FSC certification (Blackman et al. 2013:15). We are not sure of the origin of this discrepancy, since 6 of the 7 communities active or in process would have been active through their 2013 study period. This study of Corrective Action Requests (CARs) found that " relatively few CARs issued to Mexican Forest Management Units (FMUs) required large changes in forest and environmental management" and that one of the explanations is the "initial group of Mexican FMUs to obtain FSC certification has likely been disproportionately comprised of "already-green" ones—that is, FMUs that, prior to certification, already were already doing a relatively good job of forest management and environmental protection" (Blackman et al. 2013:23). This would appear to be the case with the certified communities in the Sierra Norte AATR.

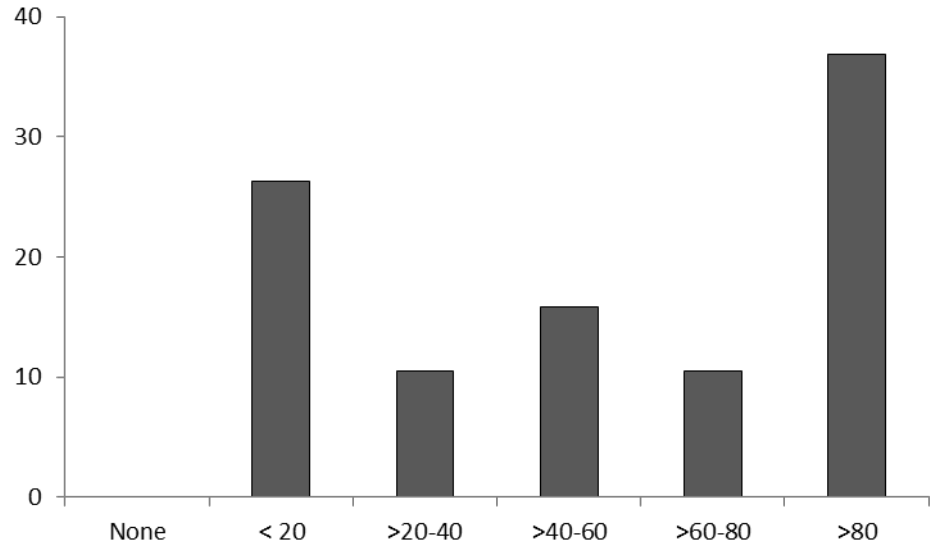
1.3. Demographic Information

1.3.1 Ethnic Group

All of the communities in the Sierra Norte AATR are classified as indigenous in census reports and self-identify as indigenous, but some of the communities now have few speakers of an indigenous language. Our secondary sources did not specify ethnicity of the indigenous groups, but the sample survey of 15 community leaders shows that 12 are Zapotec and 4 are Chinantec, which corresponds to the two major ethnic groups in Sierra Norte. As noted, some communities are identified as belonging to a particular ethnic group, and may self-identify as belonging that group, but few people in the community still speak the indigenous language. Figure 7 below shows the distribution among the entire universe of 19 of percentages who speak an indigenous language by *municipio*. The community leader interview database also contains estimates which vary from the official estimates.

The figure shows that 37% or 7 of the 19 communities have more than 80% indigenous speakers. At the other extreme, 26% or 5 of the 19 have fewer than 20% speaking an indigenous language, usually the elderly. For example, the municipio of Ixtlán de Juarez contains several communities with high numbers of Zapotec speakers, while there are comparatively few in the agrarian community of Ixtlan.

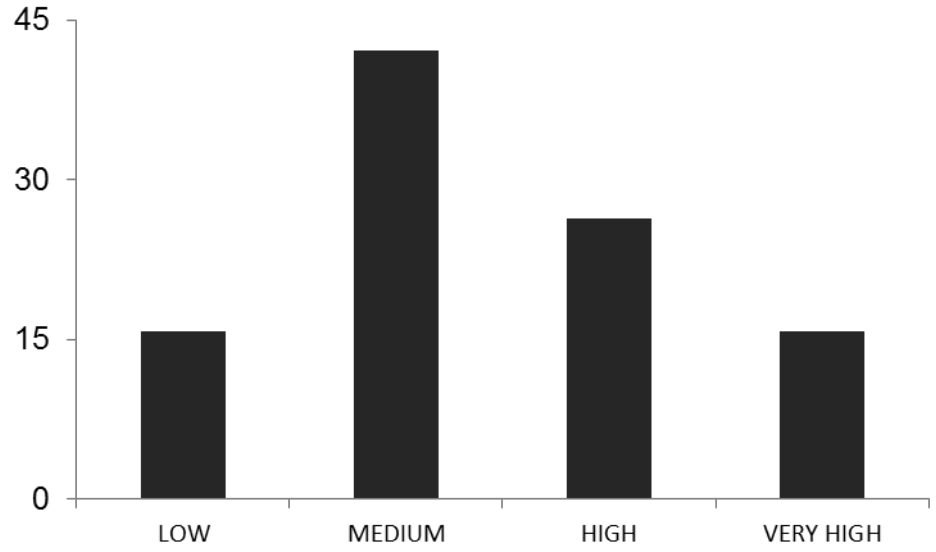
Figure 7: Percentages of Indigenous Speakers in Sierra Norte AATR by *Municipio*



1.3.2 Average Household Wealth

It is difficult to obtain direct data on household wealth or assets at the level of the agrarian communities. Most census and economic data is collected at the level of municipalities. As a result, we used various indirect measures to evaluate the economic status of the community in general. The first is the level of "marginalization" as defined by the Mexican government. The government defines marginalization using 9 socio-economic indicators, the most important of which, as predictors of great poverty, are the percentage of the population that are illiterate, the percentage of the population who has less than a primary school education, and the percentage of the population with dirt floors in their housing. Using these indicators, the government classifies degrees of marginalization as very low (*muy bajo*), low (*bajo*), moderate (*medio*), high (*alto*) or very high (*muy alto*). Using these indicators, the municipalities in the Sierra Norte AATR, as Figure 8 below shows, are considerably more prosperous on average than those in Chihuahua. Whereas Chihuahua's communities were all very high in marginalization, only 3 of 19 are very high in Sierra Norte, with 5 being "high", 8 being "medium" and 3 being "low".

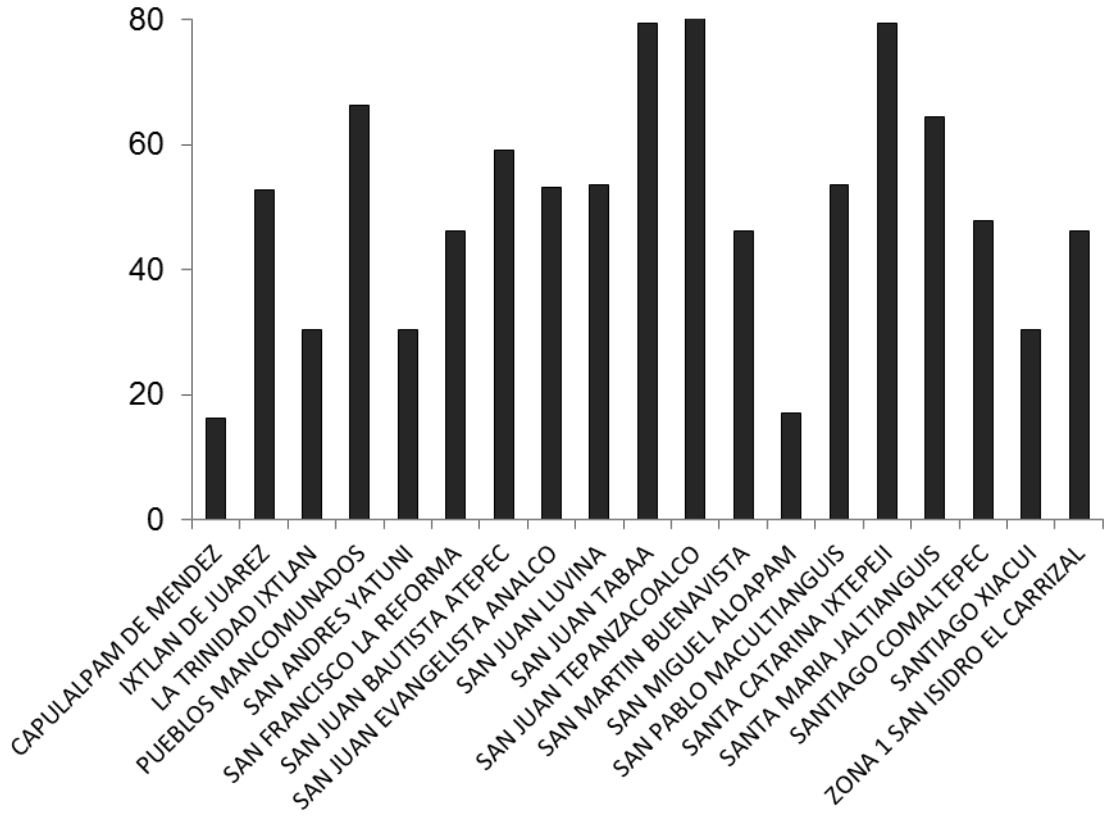
Figure 8: Percentages of *Municipios* by Degree of Marginalization in Sierra Norte AATR



Since these express municipal level data, this can also cloak importance differences in communities. For example, the *municipio* of Ixtlán de Juarez is classified as "medium" because it includes a number of smaller, poor, coffee-producing *comunidades*. If it were only the *communidad* of Ixtlán, it would certainly be classified as "low" or even "very low".

Another indirect indicator of household wealth is the percentage of the population at the level of the *municipio* whose principal occupation is in the "primary sector" which is to say agriculture. Since almost all agriculture in the region is at the subsistence level, this is a strong indicator of relative poverty. The national average in Mexico for percentage of the population occupied in the primary sector is 18.8% (http://www3.inegi.org.mx/sistemas/biinegi/#A accessed 5/2/14). Figure 9 below shows the percentage of adult population employed in the primary sector in the AATR. We are not certain of the reliability of these figures and again, they are distorted for our purposes since it is measured at the level of the municipio. For example, it accords with our personal knowledge that less than 20% of the population of Capulalpam de Méndez is employed in the primary sector. But in Ixtlan de Juárez, few people currently occupy themselves principally in agriculture, and that fact that is around 50% is due to the small, poor, coffee-producing communities in the municipio. Another inconsistency is that the community of San Miguel Aloapam is reported as having less than 20%, which seems unlikely.

Figure 9: Percentage of Population Working in the Primary Sector by Municipio in the Sierra Norte AATR (N=19)



1.3.3 Emigration (Transience)

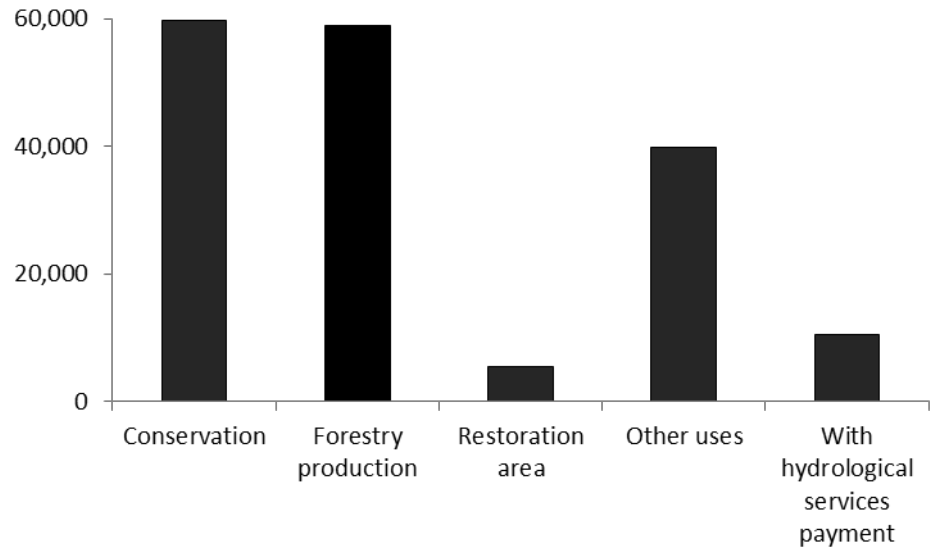
The interviews with the comisariados on this subject did not produce numbers in which we can have any confidence. In several cases, the comisariado reported larger numbers for the number of *comuneros* who live outside the community than the actual official number of *comunero*s. The same was true for the children of *comuneros.* Sierra Norte has a long history of emigration and many of the communities have significant numbers of their members living in Oaxaca, Mexico City, and the United States. However, the exact number of *comuneros* who live outside the community may be difficult to pin down because some give up their status. We are therefore not able to report on numbers of emigrants in this section. We would add that we don't think emigration has much influence on extraction practices.

1.4. Land Use and Economic Information

1.4.1 Percentage of land use in different production systems.

Figure 10 below from the Oaxaca IFM database shows the results of the *cuantificación de superficies* section, it shows that equal amounts of land, a total of around 120,000 hectares each is in conservation and forestry, a reflection of the high degree of forest cover in the region. Around 40,000 hectares are in "other uses" which would include agricultural lands. The percentage of agricultural lands varies greatly by community but available sources do not give us firm figures on this. For example, it is known that in communities like Ixtlán de Juarez and Capulalpam have almost completely abandoned agriculture, while in other communities it is still an important land use. The hydrological services component is a part of the conservation land use, not additional.

Figure 10: Number of hectares in 4 major land uses in the Sierra Norte AATR (N=19)



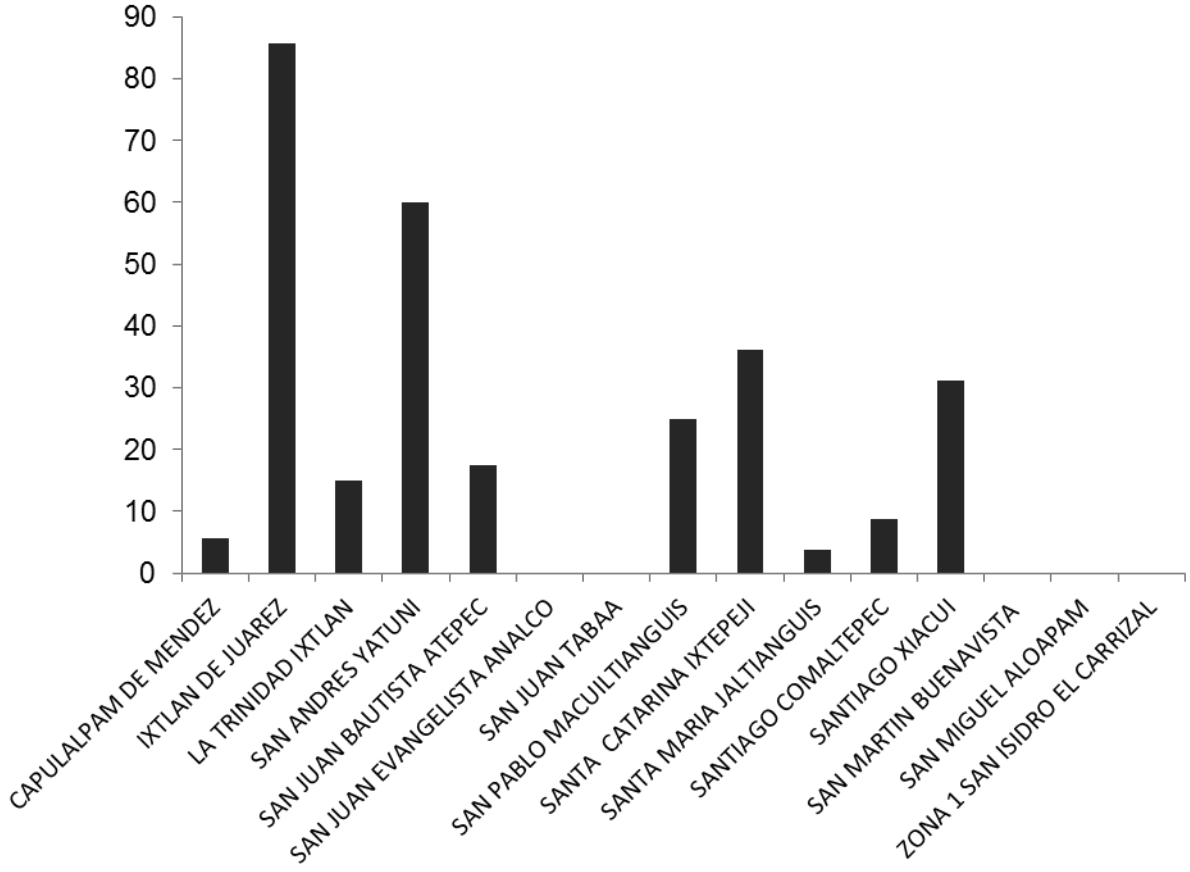
In only one community, San Juan Tabaa (a new CFE), is coffee growing important, although Santiago Comaltepec also has small amounts. Pasture for cattle is not significant in most of the communities. Four of the 15 in the sample report no cattle at all. Of the 11 who have cattle, the numbers are small

and the amount of pasture land is generally 100 ha or less. Only one community (San Miguel Aloapam) reports significant number of cattle (3,000)'

1.4.2. Percentage of Income Generated From Different Production Systems

The economy of the Sierra Norte AATR is relatively diversified. Seven of the 15 in the sample say that forestry is the primary source of income, while 4 specify retail/government jobs, 3 report agriculture, and 2 remittances from emigrants. Two mention forestry as the second most important source of income and two mention it as the third most important source of income. Distribution of profits from the CFE in general is not important as a source of income. Ten of the 15 in the sample reported that all profits went into a communal fund (used for both reinvestment in the CFE and public works). Two had both distribution of profits to community members and investment in the communal fund, and only three distributed all profits. Figure 11 below shows the percentage of community members employed in the CFE. Five of the community leaders did not respond to this question, so here we report on 10. We did not ask in this survey (as we did in Chihuahua) the number of months employed, but we think most of these employment figures are likely to be throughout the year.

Figure 11: Percentage of community members employed in the CFE-Sierra Norte AATR (N=10)



The survey of 15 comisariados shows that only 3 communities have some commercial agriculture and in only one of them is it significant (a coffee-producing community-San Juan Tabaa).

As noted above, cattle would not be a significant source of income except for one community. Nine of the 15 harvest non-timber products, but on minor extensions of territory. Earth appears to be the most important NTFP, with mushrooms, flowers and moss also figuring. There is very little small scale production of vegetables. Beekeeping is not practiced except by a few people in a single community.

1.4.3 Subsistence Products from different land production systems.

The two principal subsistence products in the region are corn and cattle. Figure 12 below shows the percentages of community members who still have *milpa* (corn fields), from the community leader interview (N=11). This shows that only a few communities have as many as half of their members with corn field, and several much less, showing the declining importance of subsistence agriculture in many communities in the region.

Figure 12: Percentages of community members who have milpa-Sierra Norte AATR (N=11)

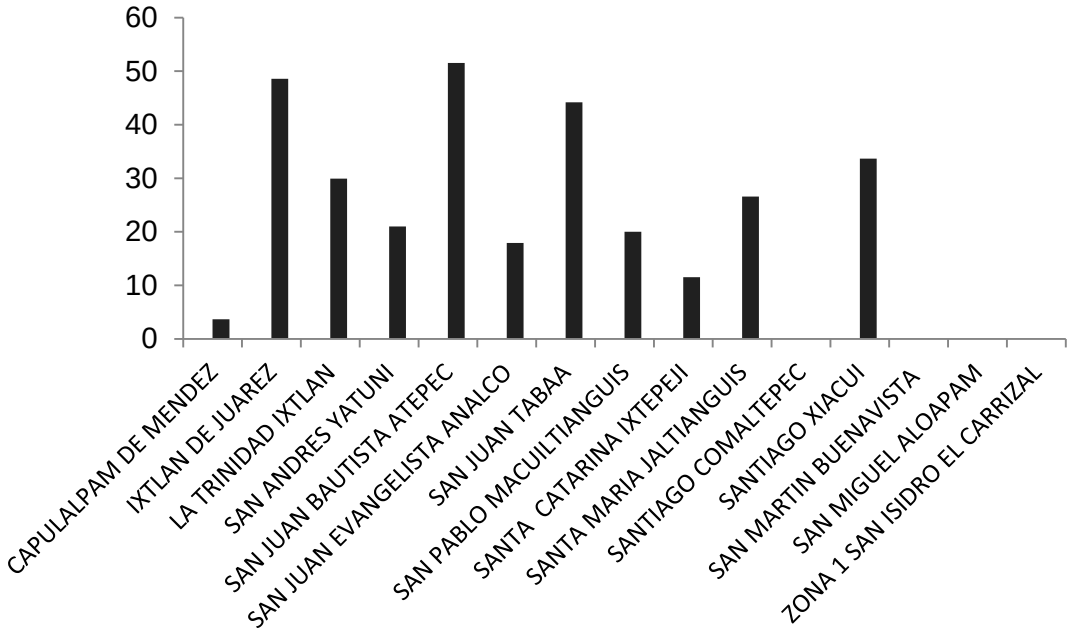
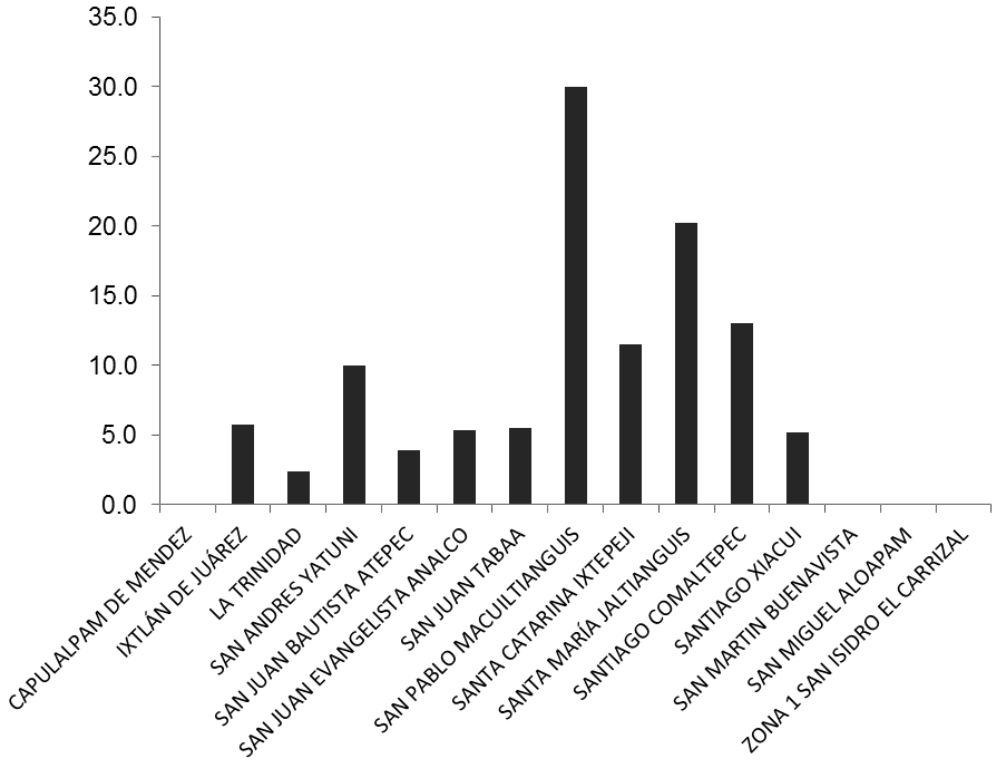


Figure 13 below shows the importance of cattle raising across the region. Only 11 community leaders responded to this question and of those only two exceed 20% of *comuneros* who have cattle and 6 of the 11 have less than 5%. As the database also indicates, these are usually very small numbers for personal consumption or local sale. However, there is one community in which cattle raising has created new deforestation and that is in a lower tropical area of Santiago Comaltepec. More concentrated work is necessary in this region to promote improved pasture and reduce pressure on the forest.

Figure 13: Percentage of Community Members with Cattle (N=11)



1.4.4 Payment for Ecosystem Services

Table 5 below shows the communities, as of 2013, receiving payment for environmental services in the Sierra Norte AATR, as reflected in the IFM AATR database. The list we received from CONAFOR did not list all of the areas, thus there is some missing data

Table 5: Current Communities Receiving Payments for Environmental Services in Sierra Norte AATR (2013)

Community	Area Receiving Payments (ha)
Ixtlán de Juárez	1,186.71
Pueblos Mancomunados	NA
San Francisco La Reforma	NA
San Juan Luvina	NA
San Miguel Aloapam	482.46
San Pablo Macuiltianguis	2,204.43
Jaltianguis	NA
Santiago Comaltepec	2,524.55
San Juan Bautista Atepec	1,963.46
Santa Catarina Ixtepeji	2,010.2

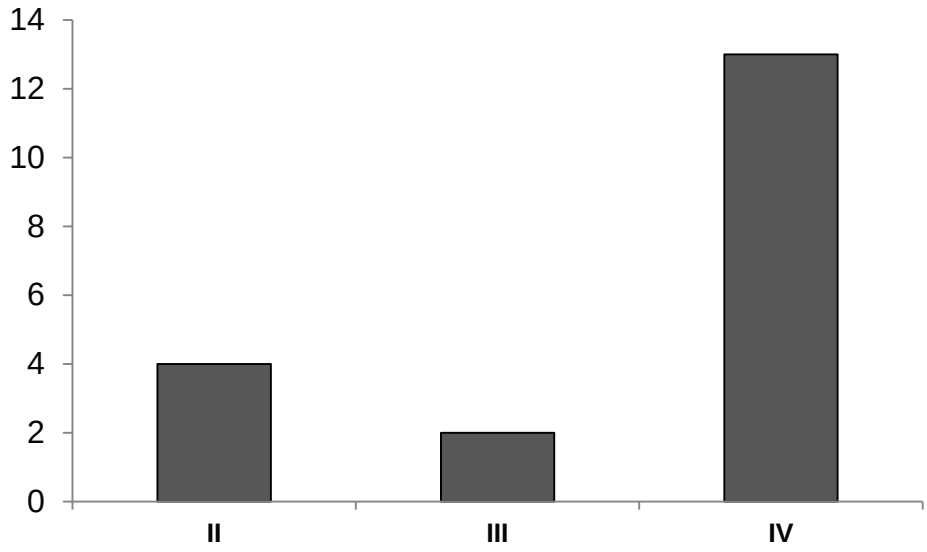
Source: Conafor

In the sample of 15, 11 of them reported having received payments for environmental services, likely some of them not current. Five were for hydrological services, 3 for biodiversity services, 1 agroforestry and 3 for carbon (totaling 12, since one had payments for both hydrological services and biodiversity.

1.4.5 Type of Wood Products Generated

As noted elsewhere, the type of product and the place of processing is largely reflected in the CONAFOR typology. Figure 14 below shows the distribution of typologies for Sierra Norte. Thirteen of the 19 (68.5%) are Type IV, 2 (10.5%) are Type III, and 4 (21%) are Type IV. This is very likely the highest percentage of Type IV of any region in Mexico

Figure 14: CFE Typology in the Sierra Norte AATR



Some of the Type IV communities sell small percentages of their production as roundwood, but most sell exclusively sawnwood. In all cases the sawmill is in the community and owned by the community (with the exception of Pueblos Mancomunados where the sawmill is in the outskirts of Oaxaca City). All sell exclusively to the national market. As noted in the introduction, two of the Sierra Norte AATR communities, Ixtlán de Juárez and Pueblos Mancomunados, are in the joint venture of TIP Muebles and are producing and jointly marketing furniture.

1.4.6 Timber Production System: native forest or plantation.

All timber produced in the region is from native forests. There are no plantations.

1.4.7 Status of Land Use Planning and Monitoring.

As has been noted, the management programs approved by SEMARNAT include the section on "Quantification of Surfaces" which has varying levels of details about land uses. The management programs have to be consulted and approved by the communities, so they participate in the specification of these land uses. The approved management program then becomes a document which must be followed under Mexican environmental law. However, enforcement of many aspects of the management program may be non-existent or spotty. However, another layer of more participatory land use zoning and planning is very common in the Sierra Norte AATR. These are called *ordenamientos territoriales comunitarios*-OTCs. The OTC methodology was developed in Sierra Norte by the non-governmental organization Estudios Rurales y Asesoría (ERA) in the early 1990s and its application in the region is now widespread. Thirteen of the 15 sampled communities have them, and they are in the process of being elaborated in the other two. The OTCs have variable levels of detail on land use planning in them. It is also highly relevant whether the OTC has been incorporated into community statutes, and we do not have information on that. If the OTC has not been incorporated into community statutes, then there is the risk that it just a document in the drawer and the community has little knowledge of it. However, it is our impression that land use zoning and the OTCs, whether formally adopted by the community Assembly or not, is now widely recognized and followed in the Sierra Norte communities. Most of the Sierra Norte communities have high to relatively high social capital, and the community Assembly does monitor compliance with formal or informal land use regulations. In egregious cases of non-compliance with the management plan, the Procuraduría Federal de Protección al Ambiente (PROFEPA) may intervene and suspend logging operations. However, there are no reported cases of PROFEPA punitive actions in the Sierra Norte AATR.

1.4.7 Presence of a cooperative management institution to facilitate land use decision and negotiations.

In all cases the CFE is administered by elected or appointed managers and supervised, directly or indirectly, by the community Assembly.

1.4.8 Interactions with non-profit organizations promoting conservation or other social benefits.

None of the communities currently receive any support from an NGO and only four in the sample receive support from government natural resource agencies other than CONAFOR. ERA, mentioned above, is a Mexican NGO that was historically important in promoting the UZACHI communities beginning in the late 1980s but by the late 1990s UZACHI was largely autonomous in a planned transition. ERA has continued to be active in the region, mostly through carrying out OTC exercises under contracts with Mexican government agencies and short-term technical assistance. The World Wildlife Fund-Mexico had a long-running project in the 1990s and early 2000s in a cluster of communities in the northwestern part of the Sierra Norte AATR that included the community of San Martin Buenavista. But this project had ended by 2007. More recently, WWF-Mexico has supported Ixtlán de Juarez in biodiversity monitoring of their logging practices and with some of their industry infrastructure. Currently, WWF-Mexico and the Fundación Carlos Slim include Sierra Norte-La Chinantla as one of their program areas, but it does not appear they are very active in the region. The Mexican Civil Council for Sustainable Silviculture (CCMSS) and Rainforest Alliance have conducted the certification studies for FSC certification in recent year and Rainforest Alliance has begun working in the region recently under the MREDD program providing technical assistance and business planning to community forest enterprises, but community leaders apparently still do not recognize them as actors in the region, since the support is focused on the CFEs.

2. Sierra Norte AATR Improved Forest Management Study

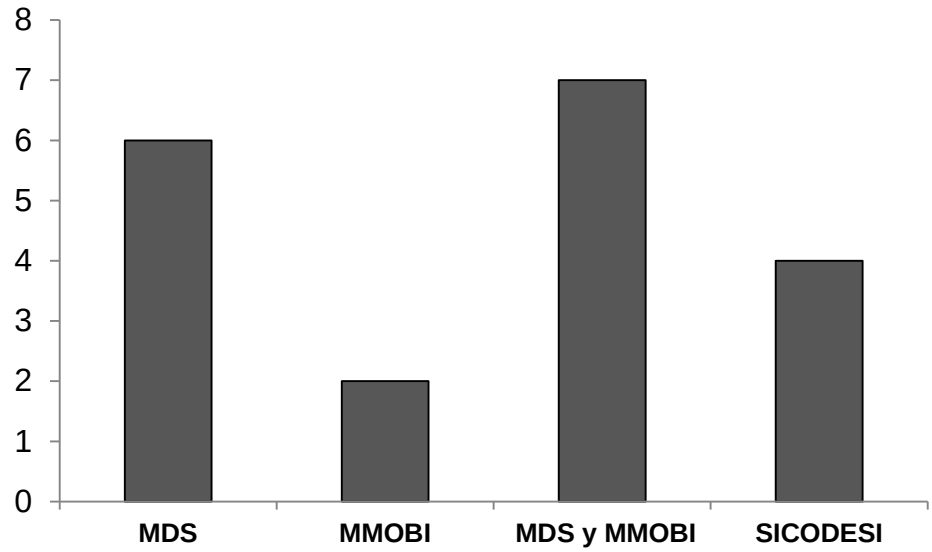
This section of the report is a first approximation of the possible implications for carbon capture and emissions of the silvicultural and harvest practices in the Sierra Norte AATR. It concludes with preliminary recommendations for what forms of Improved Forest Management (IFM) could enhance carbon capture and reduction of carbon emissions in the region.

2.1 Silvicultural Practices

Descriptions of the accepted silvicultural practices across both Oaxaca and Chihuahua AATRs were presented in the introduction. These were MMOBI (uneven-aged) and four variants of even-aged systems (MDS, SICODESI, strip clear-cuts, and restoration logging). All 5 of these practices are present in the Sierra Norte AATR and are frequently used in combination, depending on conditions in different parts of the forest. Table X below shows the distribution of the different practices across Sierra Norte, although restoration logging is not included here as a separate treatment. All of the methods have multiple variations depending on the forest characteristics and the species to be logged. The foresters consider the type of soil, slope, precipitation levels, and other variables. They also consider the purpose and quantity of logged trees and current or future markets. Thus, the characteristics of each method can vary including the cutting cycle, the turn, and sequences of thinning. In Sierra Norte, the typical cutting cycle is 10 years with a turn of 40-50 years (see database).

Figure 15 below shows the distribution of the different silvicultural treatments in the Sierra Norte AATR (restoration logging is not included here as a separate treatment.) The figure shows that 6 practice exclusively MDS (which includes strip clear-cutting), 2 practice exclusively MMOBI, 7 combine MDS and MMOBI, and 4 practice SICODESI (which may also be considered a variant of MDS).

Figure 15: Silvicultural practices in the Sierra Norte AATRs, in Oaxaca, Mexico (N=19)



As noted in the introduction, it is not clear whether any of these silvicultural practices will be superior to the rest in terms of long-term carbon capture, since that depends on specific techniques, whether extended rotations are applied, and the time horizon used. Uneven-aged systems will have less dramatic fluctuations in carbon release and capture and are more biodiversity-friendly since they maintain more continuous canopy cover, while even-aged systems have patterns of large carbon flux and can present more issues with respect to scenic beauty

2.2 Timber extraction practices (felling, skidding, and hauling)

Residual stand damage, in trees, soil, litter and other vegetation can variably induce the release of carbon from harvesting, irrespective of other silvicultural practices and whether or not harvests are delayed to maximize carbon storage. As noted in the introduction, a focus on reducing impact on C emissions from harvest practices has been termed Reduced Impact logging for Carbon or RIL-C (Griscom et al. 2014). The discussion of timber extraction methods will be divided into the categories of felling, skidding, and hauling. These are the categories that Griscom et al. (2014) used in their analysis of RIL-C, with specific indicators for each category as follows: felling (percent of felled trees abandoned, collateral trees felled per harvest tree), skidding (dozer skid trail width, dozer skid trail length) and hauling (haul road corridor width, logyard area). These particular indicators are either not relevant in Mexican temperate forests or specific data on them was not collected in this phase of

the study. However, we will use these categories and indicators as reference points for the analysis that follows.

Before examining evidence on the empirical practices in the Sierra Norte AATR, we will return to the regulatory framework as exercised in Oaxaca. In addition to the broad regulatory framework outlined in the introduction further regulation of logging occurs in the actual authorizations, and these can vary from state to state. The authorizations in Oaxaca commonly detail a series of other practices which the community must observe, mostly focused on harvest and post-harvest practices. Here we will present an example of the restrictions on 1) felling 2) extraction, including issues connected with the design and management of skid trails and types of equipment used and 3) post-harvest treatments and reforestation. All of these issues are covered in the *Reglamento* and the NOM-152, in addition to these additional restrictions on logging impacts contained in the authorizations. For example, the authorization for logging in the second *anualidad* for the Sierra Norte community of San Miguel Aloapam in 2005 contained the following injunctions (not always a literal translation, summarized in some cases). These restrictions all speak to reduction of logging impact and some post-harvest treatments.

> 7. In addition to the restrictions for ecological protection anticipated in the Forest Management Program (FMP), during the execution of the work the following should be observed.
> a) The specific residual density for each substand treatment should be respected, as stipulated in the FMP. That is, before beginning the tree marking an estimate should be made of the stocks and cutting intensity applied.
> b) In cutting areas where the topographic conditions of the terrain and vegetation cover present a high risk of erosion, works to protect the soil should be implemented, such as chopping and scattering the waste according to the slope of the land or following contours.
> c) the owner of the land with advice from the forester has the obligation to reforest a minimum surface of 9 ha after the logging and during the rainy season of 2006, with the species Pinus pseudostrobus which should be planted with a minimum of 1,111 seedlings per ha, preferably in degraded areas next to the logged area.

d) Once logging has been carried out in the proposed areas, it will be necessary to carry out conditioning, with a strict control of branches and waste.

e) Avoid grazing through the construction of fences or through the constant vigilance of the logged areas.

f) Water bodies of a permanent or temporary nature, should be protected in strips of protection with a minimum width of 20 m on both sides of rivers and 50 m around springs. In these strips the original vegetation should be respected in all strata.

g) It is necessary to respect as much as possible areas of feeding, nesting, and reproduction of fauna and under no circumstances can the capture, collection, or marketing of species of wild flora and fauna considered in any protection status be allowed, according to Official Mexican Norm NOM-059-SEMARNAT-2001, published in the Official Publication of the Federation March 6, 2002.

h) A strict control of inorganic wastes generated during the development of work should be carried out. For no reason can materials such as used oil, metallic pieces, plastics etc. be buried, spilled, or thrown away in the place or nearby areas.

i) For existing roads and skid trails whose use is temporary, and once concluded the labors of logging, reforestation, and protection, the necessary measures will have to be implemented for their abandonment, assuring the maximum reduction of problems of erosion.

8. The owner of the present authorization is obligated to fulfill with everything established in Article 62 of the General Law of sustainable Forest Development.

Article 62, referred to in point No. 8 above, calls for some of the things stipulated in the cited text, such as reforestation and soil conservation, in general terms, but also requires legal documentation of forest products, the submitting of periodic reports, reporting of any outbreaks of forest pests, and fire prevention measures. In an authorization given to the Sierra Norte community of San Andres Yatuni in 2008, most of the above requirements were retained, but some new ones added. These were:

a) In a period no greater than 30 working days, counting from the date of receipt of the present, the owners should present a program that contains the necessary measures to

prevent, control and combat fires, pests, and forest diseases. This should detail the proposed activities and the calendar of their execution.

b) In a period no greater than 30 working days, counting from the date of receipt of the present, the owners should present a work plan to monitor the natural regeneration in the logged areas, including the timing of reforestation, the species, and planting density.

c) Trees located at altitudes above 3,000 meters may only be logged through a restricted permit, based in Article 28, faction I, indent e of the regulation of the General Law of Sustainable Forest Development

These requirements are repeated, with some variation, in all of the examined authorizations. Variations tend to be around the number of ha and specific species to be reforested

Thus, these very specific regulations cover residual density, tree marking, leaving slash in contours, reforestation with a stipulated number of trees, grazing, protection of riparian areas, biodiversity protection, and waste disposal.

As will be noted below, we found little evidence of significant damage from felling, skidding or hauling. However, we will also review a study from 2007 (Arenas Casas, 2007) that found more significant damage from harvesting in some of the Sierra Norte communities along with comments on improvements since 2007 by Ing. Zenaido García of Rainforest Alliance-Oaxaca.

2.2.1 Felling

The felling indicators used in in Indonesia (percent of felled trees abandoned, collateral trees felled per harvest) by Griscom et al. (2014) were not explicitly considered in this phase of the study. However, some comments are possible. Informal conversations with foresters suggest that the percent of trees felled and subsequently abandoned is quite low, and the percentage of these that are abandoned because they were found to be hollow after felling is virtually non-existent. This would be due to the systematic forest inventories that are conducted and the marking of clearly healthy trees for felling. We also did not measure number of collateral trees felled. However, our interviews and the small sample of direct observations also suggest that collateral damage in general

is currently low. As well, there is one undergraduate thesis which systematically examined logging damage in the AATR community of Xiacuí (Luna Bautista, 2011). In this thesis, varying degrees of damage were classified with respect to 1) the crown and 2) the trunk of the tree. However, it is notable for these purposes that the complete felling of a an entire tree as collateral damage was not reported. .

The Indonesian indicators imply the use of directional felling and the degree to which it is practiced is an important indicator for Sierra Norte. As noted earlier, directional felling is not explicitly mentioned by name in the regulations and is not specified in the authorizations. However, in Section 5 of the NOM-152 "Criteria and Specifications of the Content of the Management Program", Section 5.2.13.1 says that "the measures of prevention and mitigation of environmental impact should include the following: a) *felling,* extraction, transport, construction and rehabilitation of road infrastructure" italics added). In all of the management programs that we examined directional felling is mentioned in this section.

As well, based on our field observations and interviews with forest engineers, it appears that directional felling is pretty universally observed in both Sierra Norte and Mixteca, although there may be variations in skill level which would have to be measured on the ground. Felling is done with individual trees, and the chainsaw operators observe directional felling towards areas where impact on residual trees is reduced. Only in areas where it can be seen that the felling would not provoke significant damage is "natural felling" (defined as felling with the slope) observed. Normally, experienced chainsaw operators are employed, but if they are new they are trained in directional felling in order to reduce collateral damage. It was noted to us that since chainsaw operators frequently do not have adequate safety equipment (a separate issue) this also means that they take their time in planning the felling. As community forest enterprises, besides the participation of the forester and forest technicians, the logging process is usually supervised by the Comisariado and Oversight Council (Consejo *de Vigilancia).* In both the Mixteca and Sierra Norte field observations, some collateral damage was observed, but this was considered to be minor, with the damage to ends

of some branches of trees on the edge of the stand and occasional entire branches that were knocked off, as well as scraping of trunks, but no entire trees felled.

Even in the Mixteca, where community logging generally has a more recent and spotty history, directional felling appears to be practiced. For example, San Andres Nuxiño is a Type III community in the Mixteca that only began systematically managing an approximately 1,000 ha common property forest under their own control in 2006. In a field trip to their managed forests with the responsible forest engineer and members of the community, the forest engineer noted, to the agreement of the community that "There are good chainsaw men in the community. They have been very careful. When I go around marking the trees to be felled (with members of the community), I say 'If we mark this tree towards where can we fell it?" Thus, planning of felling is incorporated in an early stage. In visits to stands there were logged just 2-3 years ago, trained foresters detected very little residual stand damage in this case.

Thus, the two important causes of carbon emissions in logging in Indonesia, percent of felled trees abandoned and collateral damage of trees felled, could be hypothesized to be almost entirely absent in Sierra Norte and directional felling appears to be now widely practiced. However, a study referenced above (Arenas Casas, 2007) found for an earlier period more serious problems. For Ixtlán de Juárez, this source found that "There is no method of felling and skidding. These activities are carried out without techniques of directional felling or security measures. Upon falling, the trees splinter with much frequency. Usually, the logger doesn't know how to place the trees towards the road during the felling and thus don't know that their work is not only felling and bucking, but also to facilitate the skidding" (our translation) (Arenas Casas 2007:47). He also notes that "Felling and bucking are carried out without adequate techniques in directional felling. The yield of the communities is 30 m3 per day, in comparison with other states in the country, like Jalisco and Durango that get average yields in felling and bucking of 80 m3 per day." (Arenas Casas, 2007:6) (Our translation). Two observations are in order. First, we could not find any immediate support for the much higher yields reported for Jalisco and Durango, and there is no citation. A study of four forest ejidos in Durango found that "the operational yield for the felling cycle is 28.67 m3·per hectare"

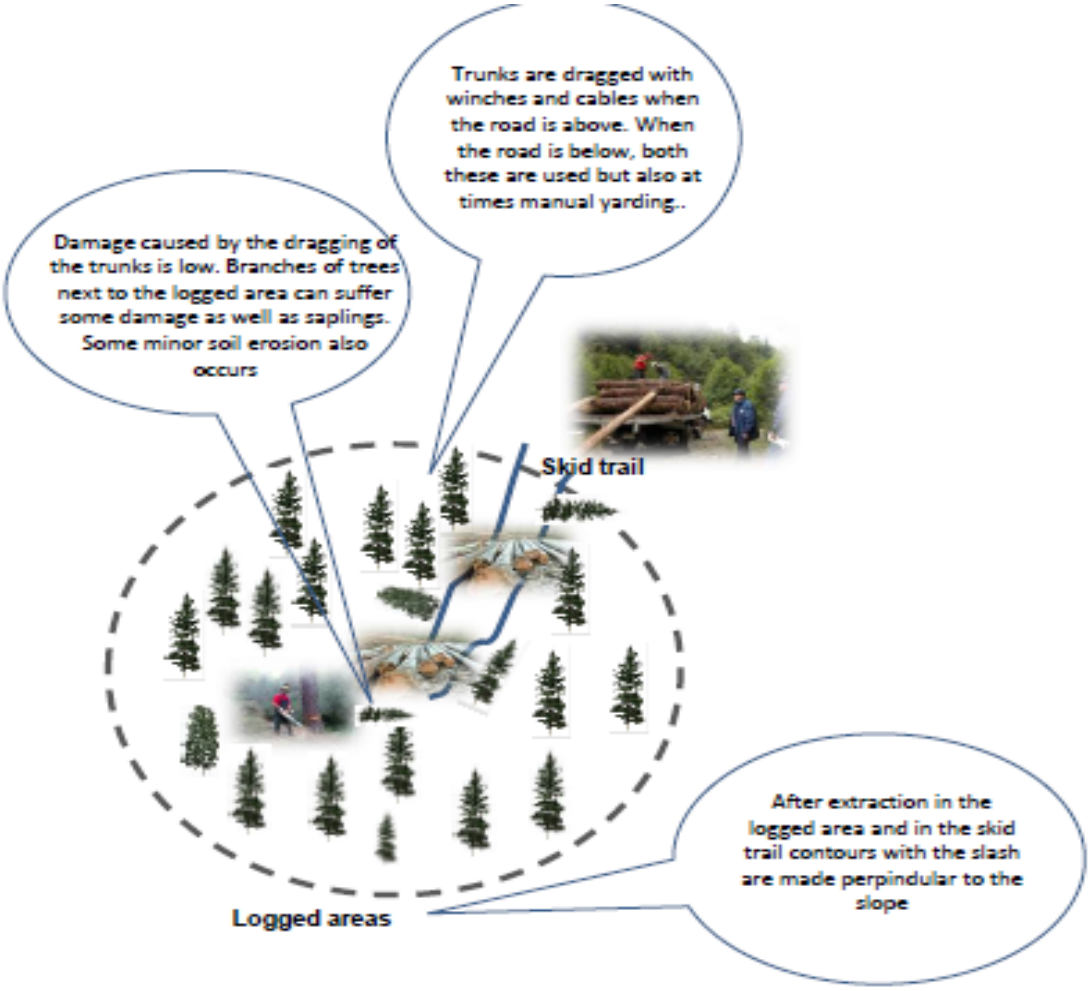
(Nájera-Luna et al. 2011). But different measures are used "per day" and "per ha" so it is not clear if the yields are similar. Second, Ing. Zenaido Garnica who is currently in charge of certification for Rainforest Alliance-Oaxaca, reviewed this study and commented for Ixtlán de Juárez "No damages are observed in questions of felling and extraction" (email communication, 7/11/14). Thus, it would appear that extraction practices in Ixtlán de Juárez have improved substantially since the 2007 report.

2.2.2 Skidding

Skid trails are variable depending on the topography of the terrain and the distance to the logging road, but in general they are more or less straight and run up or down in the direction of the slope. They can be as long as 100 m. but are generally shorter. By regulation they should be 3.5-6 meters wide, although our observations suggests that 2-4 meters is more common in the Sierra Norte AATR. This is in marked contrast to the much wider and longer skid trails noted for Indonesia by Griscom et al. (2014) The skid trail is generally in the middle of the stand , as an effort to reduce the impact of the extraction. Effort is also made to place them in areas with moderate slope, although this depends on topography of the terrain (40% to 70%). The skid trails do impact the soil, which can cause some erosion, compaction and stirring of the organic material and leaf litter, and it usually impacts the new regeneration, destroying most if in the skid trail itself. In all the observed cases, the impacts of the extraction was mitigated by the required practice of "contouring" the slash, strips perpendicular to the slope with the chopped branches of the felled trees. These are placed in the sites that appear to be most susceptible to erosion due to slope and the shape of the terrain. It was also widely noted that natural regeneration is strong in skid trails

With respect to equipment used, on the downhill slope and depending on the distance of the felled trees from the road, either a winch (*grua*) or a cable (*motogrua*) is used for extraction. On uphill slopes, the use of manual extraction is common, using specialized hooks known as *ganchos michocanos.* Thus, what Griscom and Cortez (2013:412) propose for improved forest management "innovative, low-impact logging equipment-such as the monocable winch system-that slides logs along the forest floor with long cables, reducing the damage to forests by conventional skidding equipment skidding equipment (e.g. bulldozers)" is what is conventional in log extraction in the

Oaxaca AATRs. There is no instance of bulldozers being used. Also, in the Sierra Norte AATR, only two communities, Analco and Tepanzacoalco, is the extraction equipment not owned and operated by the community. Skidding practices were also criticized by Areas Casas (2007) but Garnica (email communication 7/10/14) comments with respect to UZACHi that their practices have also improved, although disorganization in production is still a problem. See Figure 16 below for an illustration of extraction practices.



2.2.3 Hauling

Since nearly all forests in both Sierra Norte and the Mixteca have been harvested for decades, it is uncommon that new forest roads are constructed. Forest roads are generally well-maintained, although there are reported instances where extensive and poorly-planned road networks placed in the earlier concession period have been rationalized over the period of community management and some roads closed for regeneration. Observations suggest there is little opportunity to reduce emissions impacts from narrowing forest roads or that haul roads are unnecessarily wide. However, there are reported cases of erosion along forest roads, caused by heavy rains. See Figure 17I below

Figure 17: Erosion along a logging road in Sierra Norte: Such damage is not considered to be widespread

Logyards are not used in harvesting in the temperate forests, logs are just piled on the logging road itself and quickly loaded onto logging trucks.

2.2.4 Post-Harvest Treatments

Griscom et al. (2014) do not cover post-harvest treatments, but the restrictions accompanying the logging authorizations require the placing of chopped slash in contours along slopes. This is particularly important since they are frequently logging on slopes steeper than the required minimum. It was also widely noted, with respect to skid trails, that natural regeneration is generally strong in the disturbed soil of the skid trails

The smaller less capitalized operations all depend heavily or exclusively on natural regeneration, whereas the larger operations depend on reforestation. Regeneration took place through natural regeneration but in others plantings or reforestation takes place or a combination of the two. The observed natural regeneration in areas logged a few years before was abundant, somewhat less so in Jaltianguis and Analco. In both of these cases there was no reforestation.

This brief review suggest that both the Mexican forest regulatory apparatus as applied in Oaxaca and actual practices, to a very substantial and possibly complete degree, satisfy the formal requirements for RIL, RIL-C or IFM. From pre-harvest stand mapping to post-harvest reporting requirements, almost all details of these approaches to improved forest management are anticipated in Mexican forest regulations. It has been suggested that 20% of all emissions from degradation and deforestation in the Amazon region come from selective logging (Asner et al. 2005; Griscom et al. 2009) but it is likely that emissions from silvicultural and harvesting practices in the temperate forests of Mexico and Oaxaca are far less significant.

2.3 Forest Measurements, Management Units, Harvest Schedules and Timber Harvest Data

As noted earlier, the NOM-152 requires highly detailed forest measurements for timber harvests. However, growth rates are calculated using regional averages rather than growth rates specific to the managed stand, although CONAFOR and SEMARNAT currently have a program to get more detailed and local growth information. As also noted earlier, the inventory methods required in the NOM-152 are highly detailed and can be found in section 5.2.7 (pp. 8-10) of. The pdf does not permit copying, but we are including the NOM-152 in the submission of documentation. The shapefiles showing the

location and extent of the areas under management for the Sierra Norte and those collected to date are included in the submission package. With a few exceptions in Sierra Norte, the standard cutting cycle is 10 years. The turns are normally 50 years, with 10 of the communities have turns of that length, 5 have 60 year turns, 2 having variable 40-60 year turns in differents parts of their forest, and their was no data for 2 communities. Detailed information on harvest schedules (cutting cycles, turns) are found in the AMREDD+ Mixteca-Sierra Norte IFM database. Timber harvest data for 2003-2013, including both authorized volumes and volumes reported actually logged in the annual reports, for 2003-2013 are found in the same database. It is particularly noteworthy that across both the Mixteca and Sierra Norte AATRS, that only 71.08% of the authorized volumes are actually logged. Since unused authorized volumes cannot be carried from one year to the next, these are defacto extended rotations.

2.4 Preliminary Recommendations of Potential IFM Activities with Greatest Potential for Reducing or Removing GHG Emissions.

We suggest that the regulation and, likely to an uneven degree, the practice of logging in Mexico's temperate forests is substantially different than that typical of tropical rainforests. In tropical rainforests in Indonesia, it has been shown that most logging operations "are still carried out by untrained and unsupervised tree fellers and skidder drivers working without the benefit of topographic or stand maps, without planned log extraction paths, and without financial incentives to reduce the deleterious environmental impacts of their activities" (Putz et al. 2008:1427). If we take the definition of RIL as "intensively planned and carefully controlled timber harvesting conducted by trained workers in ways that minimize the deleterious impacts of logging" (Putz et al. 2008:1428), there is substantial evidence that logging in the Sierra Norte and even in the Mixteca currently meets this definition of RIL.

In Table 6 below we make our preliminary recommendations with respect to what IFM activities may be relevant for Sierra Norte. We find in virtually all cases little opportunity for improved forest management, given the reported high performance of current management. Given

that there is only one CFE in the Mixteca that has been operating for just one year, all recommendations are focused on the Sierra Norte AATR.

Table 6: Preliminary Recommendations on Potential for IFM activities in Sierra Norte for reducing or removing GHG emissions (IFM activities adapted from Griscom and Cortez (2013) and Griscom et al. (2014)[6].

Potential IFM Activities	Status in Sierra Norte	Recommendation
Better Harvesting		
1.Road and Skid Planning	Fairly comprehensive road and skid trail planning required in regulatory framework. Skid trail width regulated. Post-harvest treatments of skid trails required. Regulations appear to be widely observed	. Little opportunity for improvement to reduce carbon emissions
2. Directional Felling	Regulations say that felling must take into account environmental impact. Directional felling appears to be improved since the mid-200s and is widely observed.	Little opportunity for improvement to reduce carbon emissions
3. Improved Cutting of Log Sections	Not regulated. Cutting low on stump observed in Sierra Norte, but cutting of log sections not documented	Unclear opportunity for improvement in carbon emissions
4. Cutting Vines	NA	NA
5. Low-Impact Logging Equipment	Regulations say extraction should be carried out with "minimal damage to ecosystem". Monocable, winch and manual skidding used exclusive in Sierra Norte, No bulldozers.	Little to no opportunity for improvement to reduce carbon emissions.
6. Reducing the felling of defective trees	Further study required, but apparently not an issue in Sierra Norte	Little opportunity for improvement to reduce carbon emissions
7. Reducing collateral trees felled	No evidence of collateral trees being felled, damage limited to branches and bark scraping.	Little opportunity for improvement to reduce carbon emissions

[6] The column on Potential IFM Activities varies from that in Table I since this table includes indicators from Griscom et al. (2014).

8. Properly identifying commercial species before cutting	Trees marked by species before logging with a "hammer" with a code that identifies the forester	Little opportunity for improvement to reduce carbon emissions
Haul Road Corridor Width	Further study required, but apparently not an issue in Sierra Norte.	Little to no opportunity for improvement to reduce carbon emissions
Logyard Area	Logyards not used in temperate forests, loading done on secondary forest roads	No opportunity for improvement to reduce carbon emissions
Protection		
Riparian buffer zones	Regulations required strips of varying width around permanent and temporary water courses. Appears to be widely observed.	No opportunity for improvement to reduce carbon emissions
High Conservation Value Forests	Regulations require protection of environmentally sensitive forests. Most forests in Sierra Norte in a matrix of unlogged forest	No opportunity for improvement to reduce carbon emissions .
Steep Slopes	Logging does take place on steep slopes, steeper than called for by regulations. Mitigated by requirement to leave chopped slash in contours, widely practiced	Little to no opportunity for improvement to reduce carbon emissions
Corridors	Not mentioned in regulations. Not explicitly taken into account in management programs. Almost all Sierra Norte production forests in matrix of unlogged forests.	Little to no opportunity for improvement to reduce carbon.
Growth		
15, Silvicultural Practices to ensure the regeneration and growth of native trees species and long-term timber production, income and employment	Due to inter-generational values, communities concerned with long-term production, income, and employment. Regulations backed by community norms and culture.	Little to no opportunity for improvement to reduce carbon.

The preliminary conclusion that this study comes to, and the hypothesis for further study, is that there is very low potential for IFM activities to reduce or remove GHG emissions in the Mixteca and Sierra Norte AATR through formal logging practices. This is due to a regulatory framework that meets almost all requirements for IFM and community control of harvesting which generally means that the regulatory framework is observed. Community forest ownership provides a strong incentive for good forest management since community members have a strong sense that they are also managing the forest for their children, and they want it to be sustainable into the future. There are very likely variations in the degree to which communities may comply with the regulations, but they could not be detected in this phase of the study. The specific hypothesis is that the kind of careful study of carbon emissions performance of commercial logging carried out for Indonesia by Griscom et al. (2014) would find little to no opportunities for the deepening of RIL-C methods to reduce CO_2 emissions. This is, however, only a hypothesis, and more detailed field studies would be required to substantiate it. If the hypothesis were to be proved correct, this could also serve to highlight the degree of which Sierra Norte is a global model for management of temperate forests in developing countries (Bray et al. 2003), and the role of community forest management in reducing deforestation and degradation in both temperate and tropical forests.

However, this conclusion refers only to authorized logging in the zoned commercial forests. In the community of San Andres Nuxiño in the Mixteca (which is not in the Mixteca AATR), in addition to the 1,000 ha under authorized management, there are an estimated 2,000 ha of pine-oak forest which has been informally and illegally parceled out to individual community members. From these parcels, it is reported there is substantial illegal and unregulated harvesting, primarily for firewood and charcoal. Thus, in the same community, there is well-controlled authorized logging from some forests, and uncontrolled and unauthorized logging from other forests. However, these unregulated forests, which are reportedly common in the Mixteca, are not included in this consultancy, but their existence should be noted for purposes of REDD+

3. The Chihuahua AATR Field Survey

3.1 Introduction- Field Survey[7]

The Sierra Tarahumara has been relatively little studied compared to Oaxaca. A substantial literature exists on the Rarámuri peoples but most of it is ethnographic in nature and does not place them in the context of the timber production ejidos that predominate in the Sierra. In Chihuahua in general, forest ejidos account for more than 90% of the state's timber production. Given their geographic proximity to the United States, the Sierra Tarahumara became a source of timber for US companies beginning in the late 19th century. In this period, large logging concessions were given to U.S. timber and railroad companies. After the Mexican Revolution (1910-1917) these concessions were expropriated and given to national timber companies. New forest policies in the 1950s and 1960s gave large logging concessions to private and parastatal companies such as *Bosques de Chihuahua*, *Ponderosa de Chihuahua*, *Chihuahua Industrial*, *Comercial e Industrial Pacífico* and *González Ugarte*. For example, in 1952 a concession over 613,000 acres of forested land was given to the company *Bosques de Chihuahua* to supply a new pulp factor in Anáhuac, Chihuahua. It was during this period that many abuses of the indigenous peoples and forest ejidos in the Sierra Tarahumara begin to be reported in the national press. Tthe populist and redistributive policies of President Luis Echeverría (1970-1976) rescinded the *Bosques de Chihuahua* concession in the municipality of Madera, turning it over instead to 1,455 farmers which became the enormous ejido El Largo. In the same period, in response to reported abuses by concessionaries in the southern Sierra Tarahumara, a parastatal enterprise which provided technical forestry services to the ejidos was founded, *Productores Forestales de la Tarahumara* (PROFORTARAH). Although complaints about PROFORTARAH emerged in the 1970s and 1980s, it also brought a degree of order to logging in the region and began provide some training to people in the communities, including improved harvest practices such as directional felling.

[7] Most of the introduction is taken from Guerrero et al. (2001) and personal knowledge of the authors.

In 1989, as a part of policies to reduce state presence in the economy and encourage private investment, PROFORTARAH ceased operation, turning its infrastructure over to nine Unions of Ejidos. However, the ejido unions never operated in the region of the current Chihuahua AATR, and instead organizations of private foresters emerged to continue to provide technical assistance to the forest ejidos (Ivan Grijalva Martínez, personal communication). A succession of forest laws in the 1990s made efforts to organize the individual forest ejidos in order to provide more efficient technical services. In the early 1990s, a proposed major World Bank forest project for the Sierra Tarahumara was cancelled after a series of protests by Mexican and US NGOs over concerns about its social and environmental impacts. The current administrative structure for forests management composed of the *Unidades de Manejo Forestal* (UMAFOR) and *Asociaciones Regionales de Silvicultores* (Regional Associations of Silviculturalists), to be described further below, dates from the 2003 Forest Law. The great poverty and economic marginalization of the region, as well as limited government support until recently, has contributed to a relative backwardness of the community forest enterprises (CFEs) of the region. Ethnic divisions in many ejidos, where non-indigenous peoples (*mestizos*) dominate over varying percentages of indigenous Rarámuri, have contributed to social explosions of tensions in several ejidos (notably ejidos Pino Gordo and Chinatú in the municipality of Guadalupe y Calvo) beginning in the 1990s. The economic backwardness is exemplified by the fact that many ejidos still operate highly inefficient sawmills that were given to them in the early 1970s as part of the PROFOTARAH process.

In the 2000s the *Bosques Modelos* program of the Canadian government operated in 7 ejidos in the Sierra Tarahumara, but to little lasting effect, and the World Wildlife Fund had a project in the central Sierra in the mid-2000s as well which is no longer active. Currently, Rainforest Alliance, with funds from CONAFOR, is conducting studies and providing technical assistance to ejido El Largo and four ejidos in the AATR, and is also developing a new initiative in Forest Stewardship Council (FSC certification), as will be detailed further below. The National Forest Commission (CONAFOR) was created in 2001 and has had successively larger budgets in recent years. As a result, the government has been much more active in providing funds for technical assistance in the forest ejidos of the AATR. It has promoted more training in issues like directional felling and prevention of soil erosion,

and while there is no clear baseline, it is likely that forest harvesting and management practices in general have improved through the 2000s. Currently, CONAFOR and a federal investment funds have provided new and much more efficient sawmills in five ejidos in the AATR. Since the 2000s, marijuana and poppy cultivation and narcotics-related violence has become more of a factor in the region, and particularly in the municipality of Guadalupe y Calvo, as will be noted below.

The forest ejidos have substantial autonomy in the administration of their CFEs and as this report documents, forest management in the region has some deficiencies but it is not as deficient as its history might suggest. The low natural productivity of the forests (due to low rainfall and low winter temperatures), combined with historical over-exploitation, has led to likely, but not well-documented, declines in biomass and forest density. This, combined with the large and poor populations in most of the ejidos, means that the forest activity has not generally lifted most of the CFEs out of poverty, which is clearly the case with a significant number of CFEs in the AATR Sierra Norte-Oaxaca. Most community members still depend on subsistence agriculture and the herding of goats and cattle, which have been also suggested too have a deleterious impact on forest productivity. As will be documented below, emigration to the US is relatively low, and most emigration is seasonal for agricultural labor in Chihuahua as well as the nearby states of Sinaloa and Sonora.

The data discussed below is thus taken both from the sample survey of 17 comisariados and from the AMREDD+ Chihuahua IFM database.

3.2. Legal and Historic Information

3.2.1 Time since Tenure Established.

The AATR Chihuahua includes some of the oldest ejidos in Mexico, but with most established in the 1950s and 1960s. As the Chihuahua Government Data shows (54 of 59) there were 5 ejidos established in the 1920s, 10 in the 1930s, none in the 1940s, 12 in the 1950s, 17 in the 1960s, 6 in the 1970s, 4 in the 1980s, and 2 in the 1990s.

3.2.2 Tenure Type.

Of the 59 agrarian communities, 52 of them are *ejidos* and 7 are *comunidades*. Six of the *comunidades* are in Guadalupe y Calvo and 1 in the municipio of Nonoava. *Comunidades* are normally established as such when there is an existing title given by the Spanish crown during the colonial period. Since many of the *Rarámuri* (*Tarahumara*) populations were semi-nomadic, that likely limited the number of titles given in the region in the colonial period. As noted elsewhere, many of the ejidos actually have mixed mestizo and *Rarámuri* populations, and there are majority or exclusively *Rarámuri* populations that have ejido status. Thus, ejido status is not a reliable indicator of percentage of indigenous peoples present in the community, as it commonly is in other areas of Mexico. Below we will review percentage who speak an indigenous language.

3.2.3 Title Conflicts

We were not able to get data on title conflicts for the entire universe in the AATR Chihuahua. However, the sample of comisariados shows that 5 of the 17 agrarian communities sampled do have conflicts. In three of the cases the conflicts are with individuals for modest amounts of land, and in two the conflicts are with neighboring communities, although the amount of land in dispute was not specified.

3.2.4 Certification Status

Certification by the Forest Stewardship Council (FSC) was until recently little present in the Chihuahua AATR. For years, the only FSC-certified ejido was La Trinidad in Guadalupe y Calvo. La Trinidad first received certification in 2002. This certification was renewed in 2009 and it is currently in process for its third period of certification. La Trinidad was finally joined by a second ejido in Guadalupe y Calvo, El Tule y Portugal, in January, 2013. However, more recently, Rainforest Alliance, with support from CONAFOR, has undertaken a major effort to increase the number of certified communities in the AATR. Table 7 below shows the current status of certification processes grouped by UMAFOR[8]. It shows that six communities are in the process of being certified for the first time in the UMAFOR Guachochi and in Gudalupe y Calvo there is one current and La Trinidad in the process of its second

[8] UMAFORs can include agrarian communities in more than one municipio. In this case, the UMAFOR Guachochi includes the ejido Yoquivo, which is in the municipio of Batopilas.

renewal, as noted above. We were present at a meeting of the UMAFOR Guachochi where the comisariado of the ejido Caborachi commented to the group about their certification process. He noted that in general it was not difficult, that the ejido already met or nearly met many of the criteria, but that one of the most difficult things was getting the workers to use all of the required safety equipment.

Table 7: Status of FSC Certification Processes in the AATR Chihuahua

UMAFOR	Ejido	Status
Guachochi		
	Sehuerachi	In process
	Tecorichi	In process
	Caborachi	In process
	Santa Anita	In process
	Yoquivo	In process
	Samachique	In process
Guadalupe y Calvo		
	La Trinidad	In process of re-certification
	EL Tule y Portugal	Certified

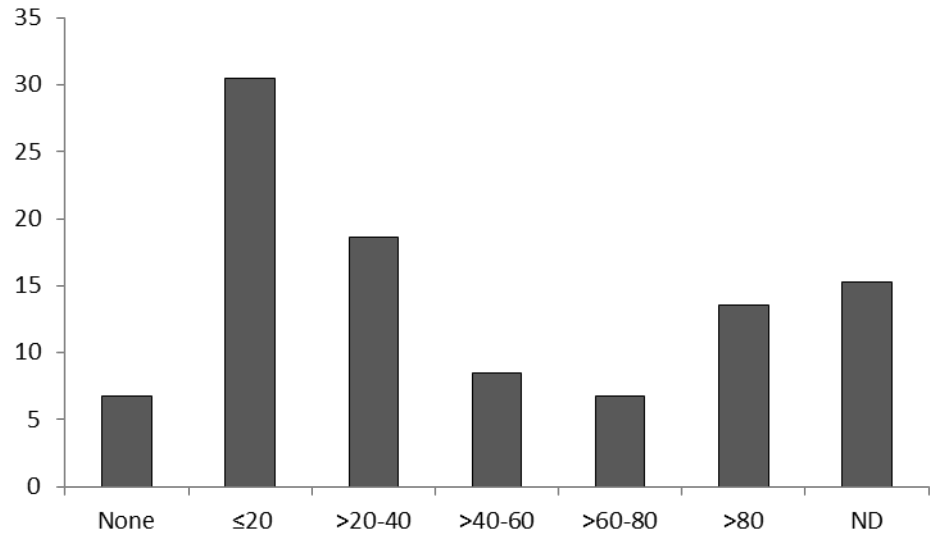
Source: Rainforest Alliance-Chihuahua

3.3 Demographic Information

3.3.1 Ethnic Group

Figure I8 below shows the percentage of the agrarian community members who are indigenous. Most are Rarámuri, with some populations of Tepehuan in Guadalupe y Calvo. The figure shows that it is a relatively small number (13) who have over 80% presence of indigenous peoples. However, almost all of the communities have some percentage of indigenous populations, ranging from less than 20% to 80%. This is a serious social problem since the indigenous populations commonly have little access to employment in the CFEs and are marginalized in community decision-making.

Figure 18: Percentage Indigenous in communities in Chihuahua AATR

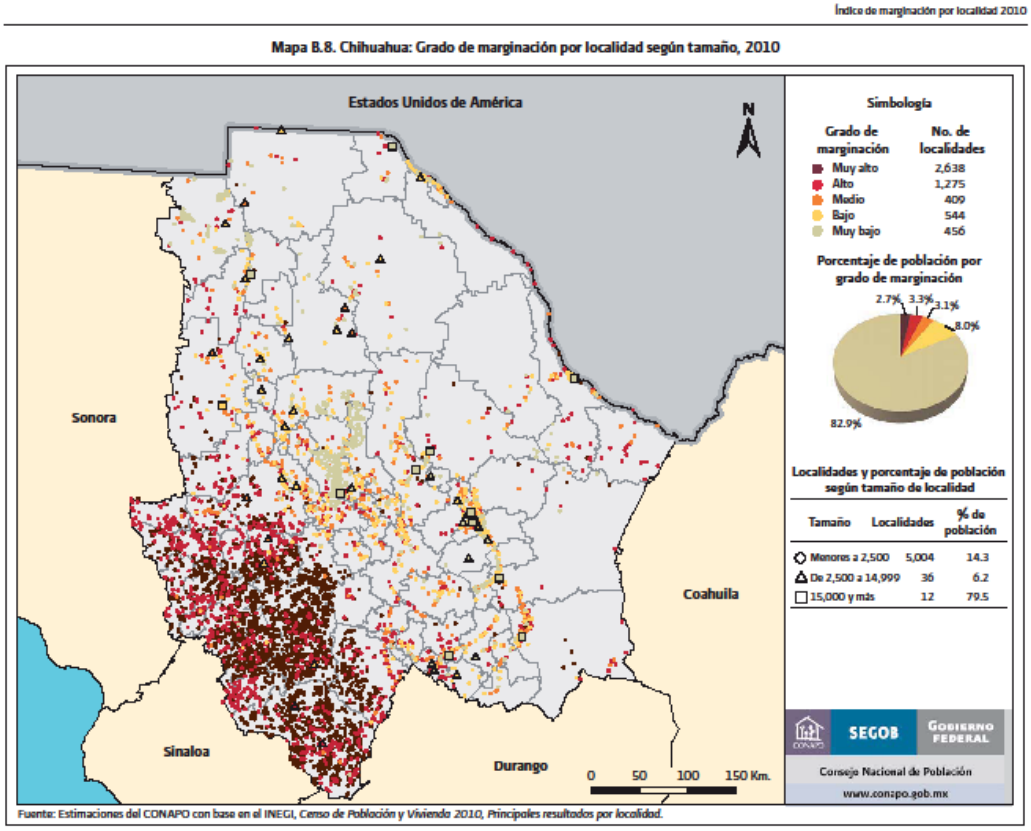


3.3.2 Average Household Wealth

It is difficult to obtain direct data on household wealth or assets at the level of the agrarian communities. Most census and other economic data are collected at the level of municipalities. As a result, we used various indirect measures to evaluate the economic status of the community in general. The first is the level of "marginalization" as defined by the Mexican government. The government defines marginalization using 9 socio-economic indicators, the most important of which, as predictors of great poverty, are the percentage of the population that are illiterate, the percentage of the population who has less than a primary school education, and the percentage of the population with dirt floors in their housing. Using these indicators, the government classifies degrees of marginalization as very low (*muy bajo*), low (*bajo*), moderate (*medio*), high (*alto*) or very high (*muy alto*). Using these indicators, the two principal municipalities in the AATR, Guachochi and Guadalupe y Calvo, are both classified as having very high marginalization. Figure 18 below shows the classification by "locality" at the level of the entire state. A "locality" is a population nucleus and is the minimum unit used by the Mexican census. Data is collected only at the level of the locality and the municipio, not the agrarian community. Particularly in Chihuahua, an agrarian community may

have a considerable number of localities or settlements, but we did not have access to a comprehensive listing of the localities per agrarian community to make a more precise determination. Figure II shows very high numbers of localities in the central and southern Sierra Tarahumara rated as both *alto* and *muy alto,* but on average all of the municipios in the AATR are ranked as being *muy alto* in marginality.

Figure 18: Degree of Marginalization by Locality-Chihuahua State

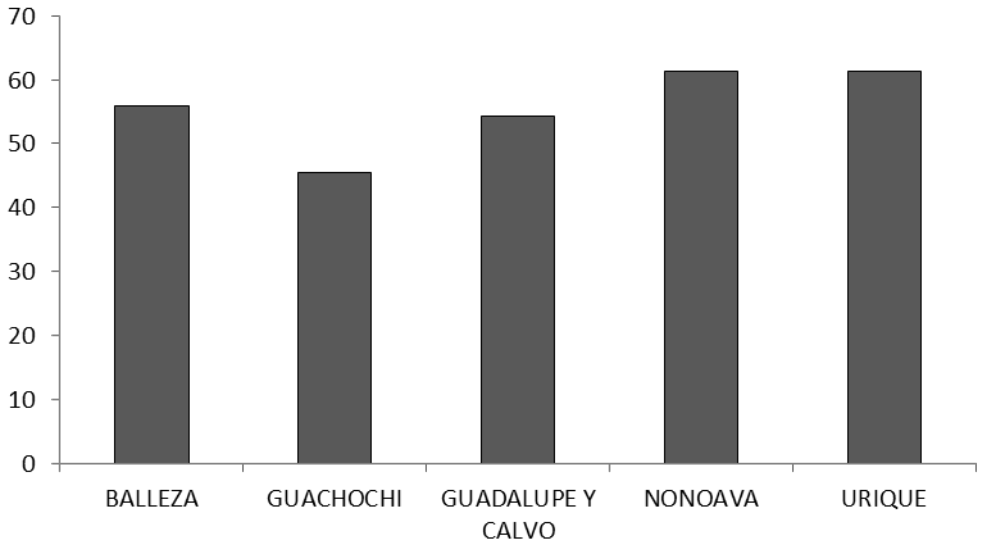


Source: http://www.conapo.gob.mx/es/CONAPO/Indice_de_Marginacion_por_Localidad_2010

Another indirect indicator of household wealth is the percentage of the population at the level of the municipio whose principal occupation is in the "primary sector" which is to say agriculture. Since

almost all agriculture in the region is at the subsistence level, this is a strong indicator of relative poverty. The national average in Mexico for percentage of the population occupied in the primary sector is 18.8% (http://www3.inegi.org.mx/sistemas/biinegi/#A accessed 5/2/14). As Figure 19 below shows, of the two principal municipios in the AATR, in Guachochi it is 45.47% and in Guadalupe y Calvo it is over half (54.33%). In the municipio of Batopilias it is as high as 71.85%. These are clear indicators of substantial poverty.

Figure 19: Percentage of Population Occupied in the Primary Sector by Muncipality-AATR Chihuahua



The survey of 17 comisariados confirms that there is no commercial agriculture in the sampled communities. The sample also underlines the importance of the community forest enterprises in the community economies. Fourteen of the 17 sampled say that the forest activity is the most important source of income in the community, with only two mentioning cattle and one mentioning government support (transfer payments). In these three communities, forestry is mentioned as the second most important source of income. We did not systematically ask about the amount of distribution of profits, but casual conversations suggested they are quite modest. The chief source of

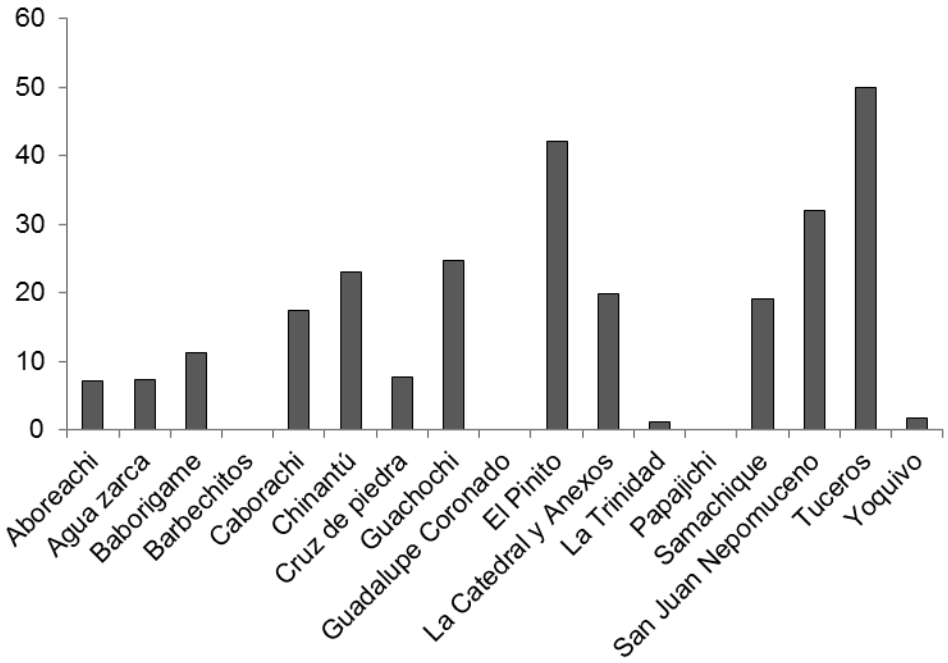
income from forestry then is likely to be paid employment in the CFE, and this would only be accessible to a smaller percentage of the total labor force, although there are some exceptions as we shall see below.

A final indicator of great poverty is that all but one ejido in the sampled communities reports that 100% of the profits from the CFE are distributed to community members. In Sierra Norte and in the more prosperous and successful CFEs in general, only modest amounts or none are distributed in direct payments, with all profits either being invested in community works (public goods) or reinvested in the CFE (to guarantee employment).

3.3.3 Emigration (Transience)

There is reportedly substantial labor migration from the agrarian communities in the AATR towards agricultural fields in Chihuahua, Sonora, and Sinaloa, as well as to Chihuahua City, but less so to the United States. However, Figure 20 below suggests that the numbers of community members who live permanently outside of the community is not large. The two outlier communities in the sample, Tuceros and El Pinito both have small populations, so are not representative of the rest of the communities. For the remainder of the sample, the average is fewer than 20%. Responses with respect to the number of children of ejidatarios who live outside of the community also show, for most of the communities, very low percentages.

Figure 20: Percentages of Community Members Who Live Outside the Agarian Community-Survey of Comisariados (N=17)



It is possible that the CFEs in the community do provide enough income to make the difference between having to emigrate or not. There are also likely cultural and historical factors which have created a particularly strong bond to the community of origin.

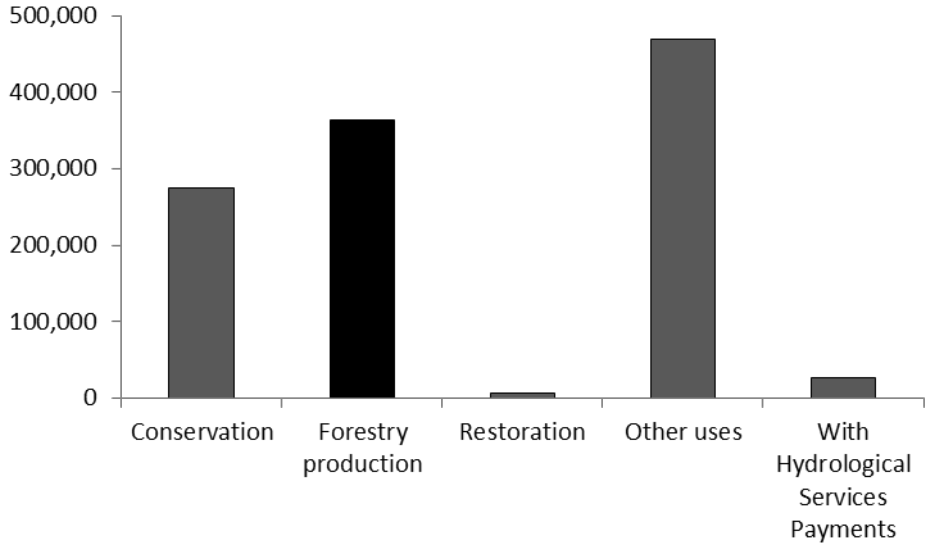
3.4 Land Use and Economic Information

3.4.1 Percentage of Land Use in different production systems.

Figure 21 below shows the percentages of different of land use in the major classifications used in the *Cuantificación de Superficies* sections of the forest management programs across all of the territories of the communities in the Chihuahua AATR (see Chihuahua IFM database, fourth tab). The percentages represented in the figure are: 28.2% in conservation or restricted for logging, 37.2% as production forests, far less than 1% (.0006) in restoration, and 31% in other uses. Also far less than 1% (.002) of the territory is covered by payment for environmental surfaces program,

presumably in areas zoned for conservation and restricted logging (this use is incorporated in one of the other uses, and is not additive). "Other Uses" would include agricultural areas, but no figures are available for what percentage of this is dedicated to cultivation. In some communities, very large areas are composed of semi-arid brushlands with little agricultural potential.

Figure 21 Number of Hectares in Four Principal Land Uses in Chihuahua AATR (Chihuahua IFM database)



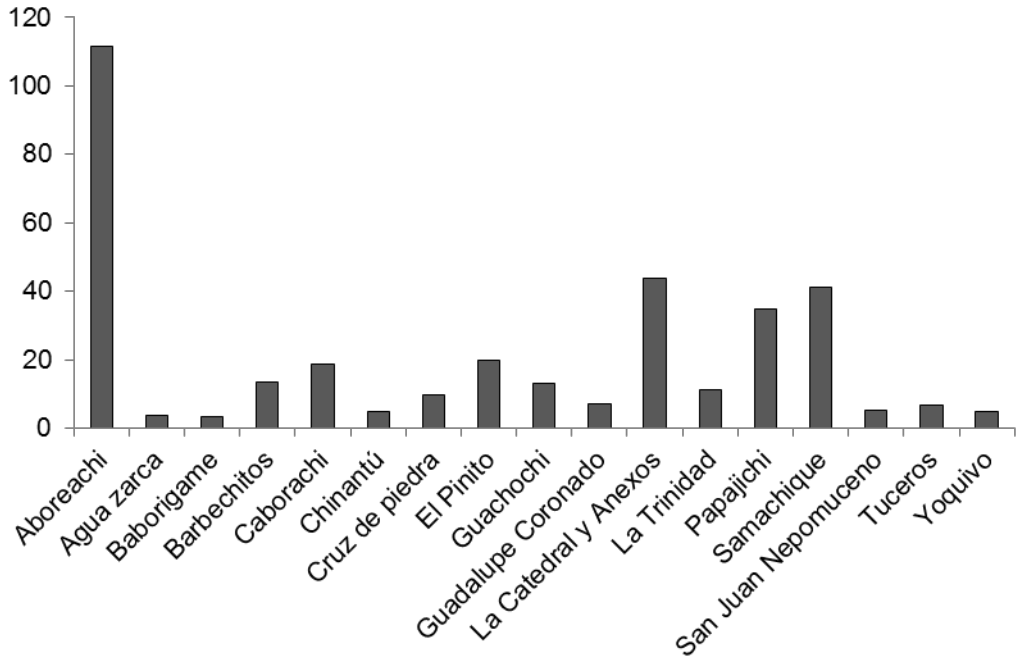
3.4.2 Percentage of Income Generated From Different Production Systems

As has already been mentioned above as a measure of poverty, 14 of the 17 sampled communities mentioned that forestry is the primary source of income. The other important, but more minor source, is cattle. Two of the 17 sampled mentioned cattle as the most important source of income, 5 mentioned it as the second most important source of income, and 5 as the third most important. Government subsidies constitute the bulk of the rest of second and third most common sources of income No other land use source of income is mentioned. Almost all agriculture and livestock grazing is for subsistence and little is sold in markets.

3.4.3 Percentage of community employed by different production systems.

The only source of paid employment in the *ejidos* is forestry. Figure 22 below shows the percentages of total labor force employed throughout the year from the 17 sampled communities. The comisariados were asked about both numbers employed and the number of months for which they were employed. In order to arrive at a standard measure, we made an estimate of the total number of labor days available to the community members in a year. This was then which was divided into the total amount of labor days reported as dedicated to the CFE. The survey with the comisariado of Aboreachi reported more than 100% of the *ejidatarios* as employed throughout the year in the CFE. We did not have a chance to follow up with him to clarify his answer, but based on the other figures, this should be eliminated from any calculations as an unreliable outlier. In the rest of the *ejidos*, the total *ejido* labor force employed as a full-time equivalent is much less than 20%. Nonetheless, this time dedication spread across the entire labor force likely represents a few months income in a very low cash economy

Figure 22: Percentage of community employed in community forest enterprise



The comisariado interviews also suggest that nearly everyone in the communities has corn fields (*milpa*). Livestock raising is also present in all of the *ejidos* and a large percentage of community members have them. Some of the ejidos have very large numbers of livestock (cattle, sheep, and goats). It is useful to note that in the sample 12 of 17 of the communities report having pastures, but only a few of them report that the total number of hectares in pasture is large. This is strong indirect evidence that most of the livestock grazing is in the forest, although in some communities it will also be in semi-arid lands not used for forestry.

No agrarian community reports having any commercial crops, none produce honey, and none product non-timber forest products. Confirmation that most of the emigration is for agricultural labor in northern Mexico is supported by the fact that only two agrarian communities (Guachochi, the municipio capital an La Trinindad in Guadalupe y Calvo, a successful forest community) report that some members receive remittances. Agricultural labor in northern Mexico would not generate enough income to provide remittances

3.4.4 Subsistence Products.

The principal subsistence products are corn and livestock, as detailed above. We unfortunately did not specifically ask about firewood in the survey, but as reported in the Chihuahua IFM section, it is estimated that 30% of the roundwood is in firewood production for domestic use.

3.4.5 Payment for Ecosystem Services

Twelve of the communities in the AATR Chihuahua are currently receiving support for payments for environmental services, 14 of them for hydrological services and 1 for biodiversity services (Guagueyvo). Three of them (Norogachi, El Nopal, and La Trinidad y Anexos) currently have active two contracts for hydrological services, thus Table x below shows 15 different contracts. Table 8 below shows all of the communities currently being supported in the AATR by municipality, the area supported, and the amounts received. The total number of has supported is 34,324. 17 ha and the average number of has supported for the 12 communities is 2,860 ha with a range from 984.69 ha to 4,523.70 ha. This data is also reported in the IFM Chihuahua database.

Table 8: Payments for Environmental Services by Year of Beginning of Contracts in the AATR Chihuahua

	No.	Typology	Agrarian Community	Municipio	Type of Support	Area Supported (ha)	Amount Assigned for 5 years (pesos)
2010	1	3	Ejido La Soledad	Guachochi	Hydrological	2,493.43	$4,762,445.57
	2	4	Ejido La Trinidad y sus Anexos	Guadalupe y Calvo	Hydrological	2,992.63	$5,715,929.03
2011	3	4	Ejido Tetahuichi	Guachochi	Hydrological	984.69	$1,880,757.90
	4	4	Ejido la Trinidad y su Anexos	Guadalupe y Calvo	Hydrological	2,803.43	$5,354,551.30
	5	3	Ejido Alicitos	Guadalupe y Calvo	Hydrological	2,690.73	$5,063,819.32
	6	3	Ejido el Nopal	Guadalupe y Calvo	Hydrological	462.01	$882,439.10
	7	3	Comunidad Humariza	Nonoava	Hydrological	4,523.70	$8,614,889.04
FONDOS	8	3	Ejido Huazarachi	Balleza	Hydrological	3001	$15,005.00
	9	4	Ejido Norogachi	Guachochi	Hydrological	1931.4	$9,657.00
2012	10	3	Ejido Laguna de Los Cano	Guadalupe y Calvo	Hydrological	2022.07	$3,862,153.70
	11	4	Ejido El Tule y Portugal	Guadalupe y Calvo	Hydrological	1331.32	$2,454,554.68
	12	3	Ejido Guagueyvo	Urique	Biodiversity	1966.97	$3,185,114.52
	13	4	Ejido Norogachi	Guachochi	Hydrological	2976.97	$5,670,830.15
	14	4	Ejido Tonachi	Guachochi	Hydrological	2946.78	$5,553,206.91
2013	15	3	EL NOPAL	GUADALUPE Y CALVO	Hydrological	1,197.04	$2,286,346.00

Source: CONAFOR-Chihuahua

The communities have received a total of $55,311, 699.30 pesos ($4,228,723.18 dollars[9]) for an average of 4,609,308 pesos (352,393.57 dollars) per community. Since the contracts are for five years, this implies 921,861 pesos ($70,478.69 dollars) per ejido per year. The numbers sound impressive for very poor communities. However, these are poor communities with relatively large populations. We calculated that the average number of legal community members in 11 of the communities is 240.[10] At the average annual payment mentioned above this implies an average

[9] We used the 2012 average exchange rate for the Mexican pesos to the dollar of 13.08 to make this conversion.
[10] We do not have data on the number of legal community members in one of the communities. Data for calculations taken from IFM database.

payment per community member of US$293.66. Although very modest, this could constitute from 1-2 months of annual cash income. The sample of the comisariados indicates that the PES funds are distributed within the community as daily wages for community members to work on activities such as soil conservation, fire brigades, firebreaks, reforestation, road maintenance, and vehicles to support these activities. Thus, the funds provide much needed paid employment within the community for some percentage of community members.

3.4.5 Type of Wood Products Generated and Marketed.

The type of wood products sold entirely correlates with the CONAFOR typology, which is largely based on industrial vertical integration of the CFE. Thus, Type II communities sell roundwood. Type III communities also sell roundwood, but achieve somewhat higher profits since they carry out the extraction of the roundwood themselves, either to the logging road or directly to a sawmill if they have logging trucks. Type IV communities with sawmills sell principally sawnwood, but may also sell some roundwood. This relationship is confirmed by the interviews with comisariados (see Columns CZ-DU, questions 75-85; AMREDD+ Field Survey-Comisariados database). All Type II and Type III communities in the sample sell 100% roundwood. All Type IV communities except one sell 100% sawnwood. Only one Type IV communities (Papajichi) reports that it sells 10% of its production as roundwood. Four of the Type II or III communities have sawmills inside the community, but they belong to individual community members as private operations. None sell to international markets and none sell pulp.

3.4.6 Timber production systems.

All production is from native forests. As noted elsewhere, the silvicultural system used in the AATR has been exclusively MMOBI, the silvicultural system for irregular forests. Many if not all are now being encouraged if not obliged to begin using MDS for some of their harvest. The most common approach seems to be incorporating around 30% of the volume in MDS.

3.4.7 Status of Land Use Planning

The forest management programs prepared by professional foresters and presented to SEMARNAT are required to contain delineated use zones in the section called *Cuantificación de*

Superficies. Data on *Cuantificacion de Superficies* is found in the fourth tab of the Chihuahua IFM database and is represented in a figure above. This section in the Sierra Norte AATR tends to have a large number of land use classifications, but they are much more basic in the Chihuahua AATR. In all cases they are confined to 4 categories 1) Conservation and Restricted Extraction Area (*Area de Conservación y Aprovechamiento Restringido*), 2) Production Area (*Area de Producción*), 3) Restoration Areas (*Areas de Restauración*), and 4) Other Uses (*Otros Usos*). As a perusal of the database shows, some of the areas of Other Uses are extremely large (e.g the agrarian community of Huazarchi in Ballenas municipio with 79,957 ha). In these cases, the Other Uses lands in addition to agriculture, are usually either enormous stretches of semi-arid scrublands or include some of the canyon areas of the *Barranca de Cobre* complex. As well, as is noted elsewhere, some agricultural parcels are scattered through the forest production areas, although here is some evidence that agricultural parcels are concentrated in a smaller number of stands. The management plans are monitored by community assembles, in the field by the logging boss (*montero*), and by the forest engineer, who will make periodic visits. Monitoring and sanctions can be carried out by the Procuraduria Federal del Medio Ambiente (PROFEPA) and we report on at least one case where sanctions where implemented for overharvesting in a particular year in the Chihuahua narrative. Informal interviews suggest that there are not widespread violations of the management programs. Community land use zoning (*ordenamientos territoriales comunitarios*-OTCs) have been widely implemented in the Sierra Norte of Oaxaca but are basically unknown in the AATR Chihuahua. There are no current plans to implement them.

3.4.8 Presence of a cooperative management institution to facilitate land use decisions and negotiations.

The Assembly, by Article 27 in the Mexican Constitution and agrarian law, is the highest body of decision-making in the community, and includes all legally registered members of the community. The Assembly elects its community leaders in the *Comisariado*[11] (President, Secretary, and Treasurer)

[11] The entire governance body (President, Secretary and Treasurer) is legally the *Comisariado.* Its leader should technically be called the President of the *Comisariado.* However, it is in widespread usage in rural Mexico that the President of the *Comisariado* is referred to as the *Comisariado*, as if that were his title. The elected officials in both bodies are commonly referred to as *los autoridades* (the authorities)

and the Oversight Council (*Consejo de Vigilancia*) for three year periods, although they can be dismissed earlier for non-performance of duties by the Assembly. The community authorities and the Assembly are legal representatives for purposes of presenting management programs to SEMARNAT and for making other land use decisions. All communities' decisions with outside bodies must be approved by the Assembly. However, this does not mean that corruption of community authorities can sometimes bypass community assemblies.

3.4.9 Other information about interaction with non-profit organizations promoting conservation or other societal benefits.

We will note here that all of the communities in the sample receive support from CONAFOR for a wide variety of forests-related activities, including for thinning, elaboration of the management programs, soil conservation, nurseries, reforestation, fire brigades, extraction machinery, and sawmills. It appears that the degree of this support went up sharply in the 2000s, so as mentioned elsewhere it is likely that forest management and forest conditions have improved in the 2000s, but there is likely no clear baseline to actually measure this. As well, five of the 17 in the sample also receive complementary support for some of these activities from the Chihuahua state forestry agency. Finally, only 2 of the 17 report receiving support from a non-government organization (NGO) and in both cases it is Rainforest Alliance.

4. Chihuahua AATR-Improved Forest Management

In this section we focus on the analysis of the significant forest management regimes and harvest practices within the Chihuahua AATR. As in the case of the Oaxaca AATRs, we will make a first approximation of the possible implications for carbon capture and emissions of the management regimes and harvest practices, and make preliminary recommendations for what forms of IFM could enhance carbon capture and reduction of carbon emissions. .

4.1 Introduction

Chihuahua has the second largest volume of production of timber in Mexico, after Durango. There are a total 830 forest extraction permits, with 780 of them for timber extraction. However, of

these 660 are for small private foresters (*pequeña propiedad forestal*) and only 120 are for ejidos and *comunidades* (with only a few *comunidades*). However, in terms of total logging area, 80% of it is in the agrarian communities and only 20% in small private forests.

The AATR Chihuahua is located in southeastern Chihuahua in the Western Sierra Madre Region known as the High Sierra Tarahumara. It includes 57 *ejidos* and 2 *comunidades* with logging permits in six *municipios*, as follows: Nonoava (1 ejido and 1 *comunidad*), Balleza (3 ejidos), Batopilas (3 ejidos), Urique (4 ejidos), Guachochi (16 ejidos) and Guadalupe y Calvo (30 ejidos and 1 *comunidad*). The polygon of the AATR Chihuaha is in Figure 23 below

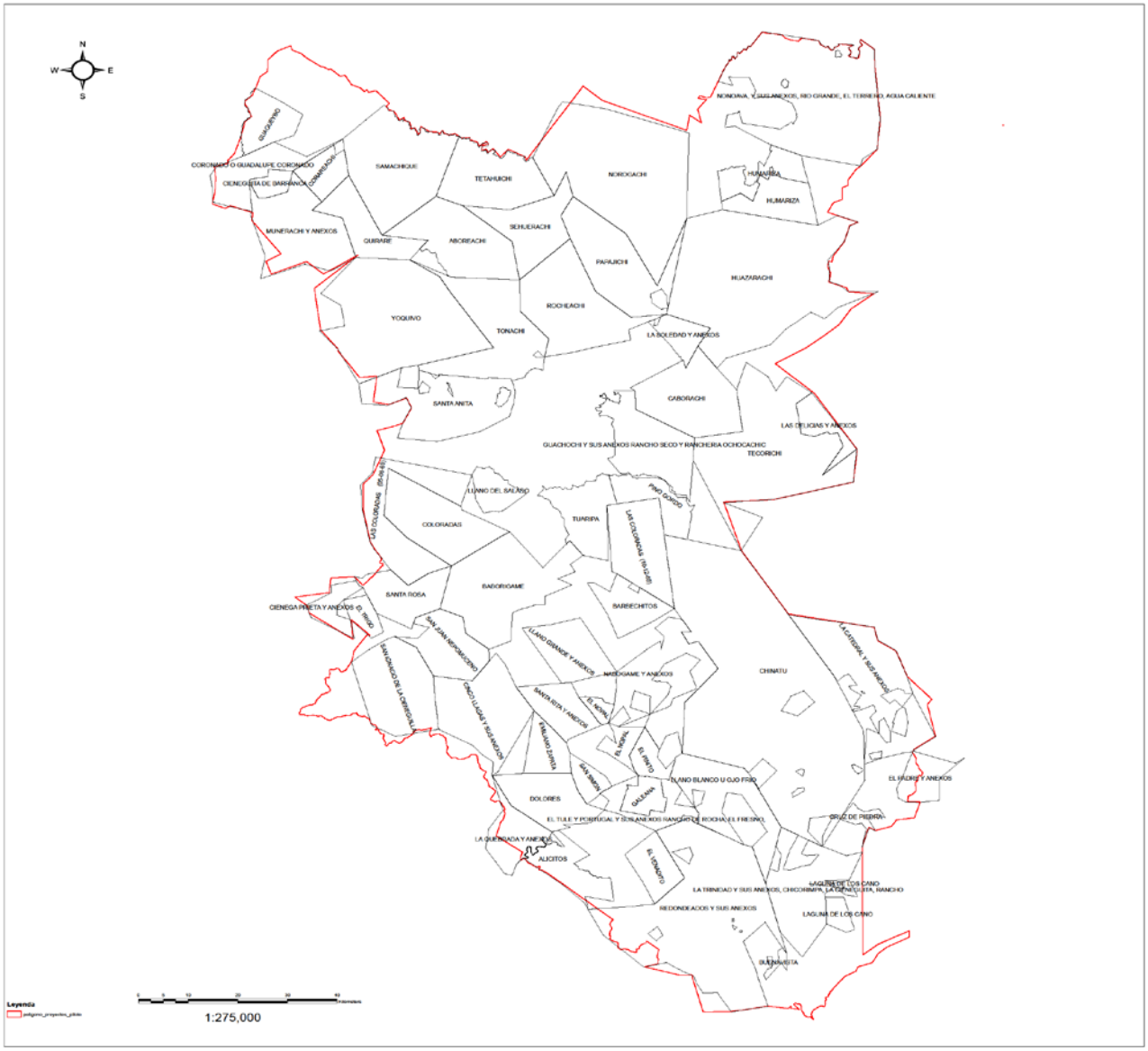


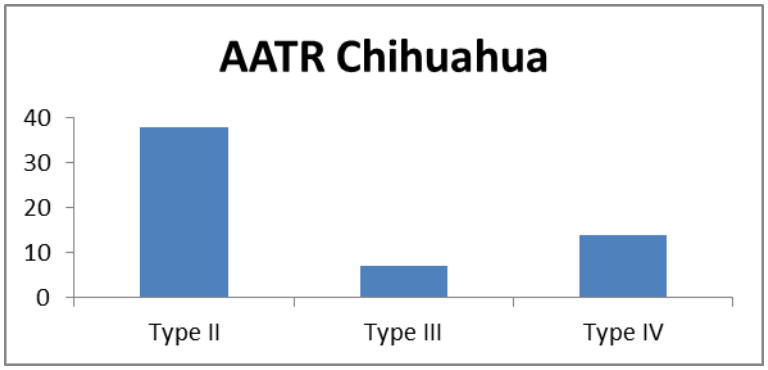
Figure 23: AATR Chihuahua (Source: Rainforest Alliance-Chihuahua)

We initially received from Rainforest Alliance a list of 66 *ejidos* and *comunidades* in the AATR. In the course of the research we discovered that only 59 of these currently have logging permits, distributed in the municipalities as noted above. The 7 *ejidos* in the AATR without logging permits are included at the bottom of the Chihuahua AATR IFM database as *ejidos sin aprovechamiento forestal*".

The total territory of the 59 agrarian communities with logging permits 1,307,939.31 ha. Of this, 629,109.94 ha or 48% is classified as forested. Of the forested surface, 331,503.81 ha are under management programs. This is 52.7% of the forested area and 25.3% of the entire territory under management. Total authorized logging volume in all current authorized plans is 6,301,483.5 M^3 but this includes both 10 and 15 year plans with varying effective periods. It has been suggested that decades of extractive pressure on the forests of Chihuahua have modified their structure, with a tendency towards the domination of smaller diameters (10-30 cm) and the reduction of the density of the biomass (Balderrama et al. 2008).

We will here analyze the AATR by management regime as structured by the typology used by CONAFOR: Type I (communities with commercial forest potential but not currently logging), Type II (communities who use contractors for most extraction processes), Type III (communities who have their own extraction equipment (skidders, winches, and/or trucks) and Type IV (communities with extraction equipment and sawmills). Using this analysis, Figure 24 below shows that Type II's dominate across the AATR, with 38 Type II's , 7 Type III's and 14 Type IV's

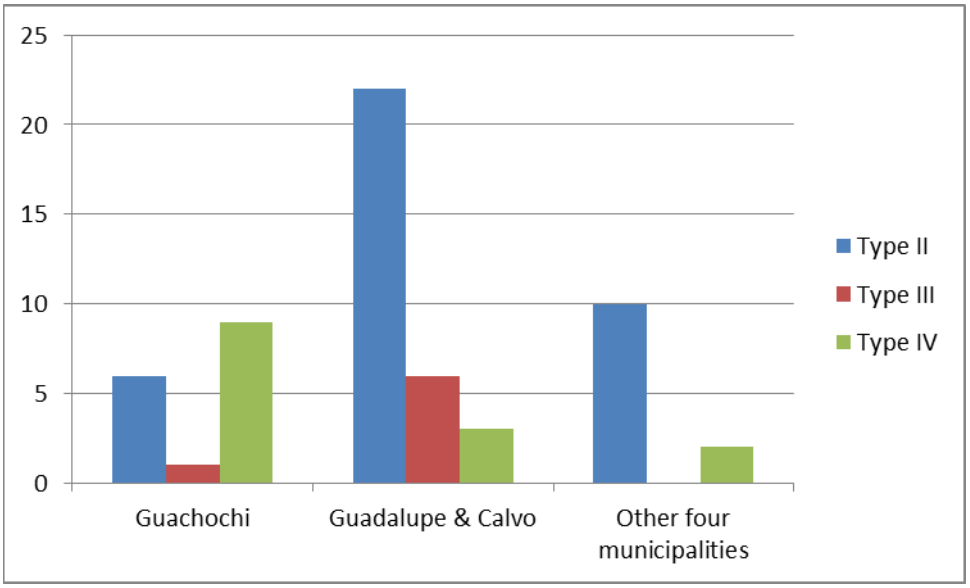
Figure 24: CFEs by Type in Chihuahua AATR



Source: AMREDD+ Chihuahua IFM database

However, further analysis below suggests that there are variations in the degree of organization of forest management across both the typology and the *muncipios*. Figure 25 below thus breaks down the AATR by typology and municipio. This shows that the Type IV better organized communities are concentrated in Guachochi (9 of the 16 or 56%), while the more poorly organized communities that depend upon logging contractors are heavily concentrated in Guadalupe y Calvo (22 of 31 or 71%). The other four *muncipios* are Balleza, Batopilas, Nonoava, and Urique, with a total of 12 CFEs of the total 59).

Figure 25: AATR Chihuahua by Typology and Municipio



The information collected in the AMREDD+ Chihuahua IFM database hows that 81.8% of the total harvested volume is in pine is in pine and 17.5% in oak, with very minor amounts of *tascate (juniperus sp.*) and other broadleafs. The most commonly harvested pine species are *Pinus arizónica*, *Pinus durangensis*, *Pinus engelmanni* and in lesser volume, *P. ayacahuite, leiophylla* and *herrerai*, and the most common oaks species are *Quercus sideroxila* and *Quercus fulva*.

The forests of the AATR are much less productive than those of Oaxaca. The annual increment of pine in the *municipio* of Guachochi is 2.45 m3/ha annually and in Guadalupe y Calvo 1.85

(Ecosistemas y Medio Ambiente Sierra Madre S.C. (2009) whereas in parts of Ixtlán de Juarez the annual increment reaches up to 6.65 m3/ha (Guadalupe Pacheco, personal communication), nearly 3-4 times higher. This is likely due principally to the much lower rainfall in Chihuahua than in Oaxaca (794 mm/years vs. 1,500-2000 mm/year in Sierra Norte), and much colder average winter temperatures in Chihuahua. Visual observation of the forests in the Sierra Tarahumara also suggests that they are much more open and lower density than those in Oaxaca.

The Sierra Tarahumara does not generally have a good reputation for good forest management. Nonetheless, there are a few *ejidos* that, while they are not well-known nationally, nonetheless deserve to be mentioned in the first ranks of Mexico CFEs. Of particular note here is the *ejido* of La Trinidad in the otherwise very troubled *municipio* of Guadalupe y Calvo, which has been FSC-certified since 2002 and Tatawichi in Guachochi, a 100% Rarámuri community that won a National Forest Merit Prize from CONAFOR several years ago for success in reorganizing their CFE since 2005.

A forest measurement issue of great concern in the AATR Chihuahua is related to the use of the use of the Doyle Rule (*pie Doyle*). The Doyle rule substantially underestimates the volume of trees, particularly in the smaller diameter classes. Its use as a heritage of earlier decades, and it is said to be the only state in Mexico where it is still in common use. The alternative is scaling (*cubicación*). Scaling was introduced in many other states of Mexico by the 1980s and is a more accurate measurement of the volume in the fallen tree. One forester estimated that income to the communities could be doubled with the use of scaling, but this would have to be independently verified.

4.2 Applicable federal, state and local laws or regulatory frameworks relevant to forest management

Forest management in Chihuahua is subject to the same three levels of the federal regulatory framework for extraction of timber as was reviewed in the introduction. Briefly, these are:

- The General Law of Sustainable Forest Development (*LGDFS-Ley General de Desarrollo Forestal Sustentable*; 2003, modified in 2008 and 2013),
- The regulations (*Reglamento)* of the LGDFS, composed of 178 articles in 44 pages, from 2005 (hereafter *Reglamento*) and
- The *Norma Official Mexicana* (NOM) 152-SEMARNAT-2006 (hereafter NOM-152) "that establishes the guidelines, criteria and specifications of the contents of the forest management programs or the exploitation of timber forest resources in forests, rainforests, and arid zone vegetation", approved in 2008 and composed of 24 pages of detailed instructions.

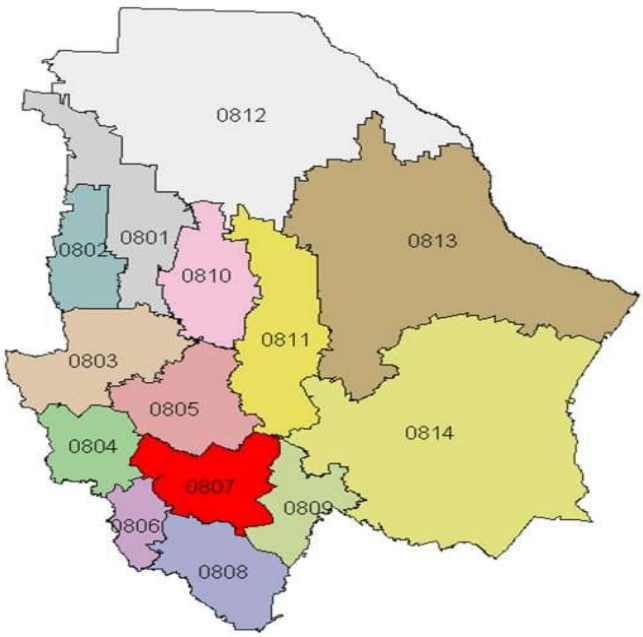
Thus, the review of the regulatory apparatus for Mexico in the introduction is also valid for Chihuahua. However, as we shall see, the implementation of the regulations may be more uneven in the AATR Chihuahua than in Sierra Norte. In Chihuahua there is another level of governance which is formally present in the Sierra Norte of Oaxaca, but which does not have the same operational presence as in Chihuahua. This is the *Unidad de Manejo Forestal* (Forest Management Unit-UMAFOR). In Chihuahua there are 15 UMAFORs, each one headed by a Regional Association of Silviculturists, who are in turn organized into the Union of Forest Producers of Chihuahua. The legal basis for the UMAFORs is found in several articles of the LGDFS. They are envisioned as the base of the administrative pyramid for forest administration in Mexico. They are defined as "Territories whose physical, environmental, and social conditions have some similarity for purposes of zoning, sustainable forest management and forest conservation" (Article 7 of the LGDFS). They are charged with the following activities among others

- The integration of forest-level silvicultural information;
- The updating of cartographic materials,
- Carrying out regional or subregional studies that support forest management.
- Carrying out common practices for the conservation and restoration of associated resources.

- Complementary efforts in the tasks of prevention, detection, control and fighting of fires, forest plagues, as well as illegal logging and in given cases restoration and damages occasioned by these agents.
- The production of plants to support reforestation activities for production purposes.
- Protection, conservation, and restoration at the level of the forest unit.
- The development of an annual work program for the UMAFOR
- The presentation of periodic progress reports for the execution of the regional program,
- The equitable distribution among its members of the costs or additional expenses of management.

The two UMAFORS that cover the Chihuahua AATR are the UMAFOR of Guachochi and the UMAFOR of Guadalupe y Calvo. The location of these two UMAFORS is found in Figure 26 below.

Figure 26: UMAFORs in the State of Chihuahua



The UMAFORs are governed by the Regional Association of Silviculturists, which includes all agrarian communities and private individual foresters in the UMAFOR. It is administered by a forest engineer, with a forest technician for every 3-4 ejidos. They do not develop the forest management programs, these are done by individual contracted foresters and their teams, so it is an additional source of both funds channeled from government agencies and technical assistance. The UMAFORs also develop comprehensive studies of the forest management status of the area under their responsibility (Chávez Rodriguez, 2009; Ecosistemas y Medio Ambiente Sierra Madre, S.C., 2009)

4.2.1 UMAFOR Guachochi

The 2009 Regional Forest Study for the Guachochi UMAFOR made some of the following observations that are relevant for this study

> "Forest protection activities in the region are acceptable, but do not have the required efficiency required for sustainable forest management, above all the detection and fighting of forest fires.
>
> Pests and other forest diseases in the managed forests of the UMAFOR do not show critical levels that require urgent and specific attention…normally their detection and control are atended as part of the normal management activities. Nevertheless, we do not have a complete regional diagnosis of the situation.
>
> There exists illegal logging in the region, apparently at a small-scale and in some cases concentrated in specific areas, with little local capacity to monitor the illegal activities.
>
> The gathering of firewood for local use is not regulated and it is estimated that it constitutes 30% of the roundwood production.
>
> Although 85% of the area is forested, only 24% (175,000 ha aprox.) of this is under management for timber. Of the rest, approximately 85,000 ha are in recovery or yet to be incorporated into pine production and another 140,000 ha are feasible to be incorporated into oak production.
>
> There are no authorized permits for non-timber forest products.

> Although there exist regional forest biometric studies in 2000, these were never validated and do not cover the total área of the UMAFOR."(our translation) (Ecosistemas y Medio Ambiente Sierra Madre, S.C. 2009)

These comments for Guachochi suggests that fire control could be improved, that forest pests are present by significantly under control, that illegal logging is also present but not widespread, and that there is substantial potential for expanding production, particularly into oak. We were present for a meeting of the UMAFOR Guachochi in December, 2013 so could observe some of the issues covered. There were around 50 people present, although it was not clear how many ejidos and small private property owners were represented. The UMAFOR reported on a new effort at certification, and reviewed specific activities in combatting forest fires, biometric evaluations, forest roads, nurseries, maintenance of reforestation and reforestation, soil conservation and forest pests. Although the programs were not extensive, mostly small scale, it did appear that it provided another significant source of support and governance of forest management activities.

4.2.2 UMAFOR for Guadalupe y Calvo

Guadalupe y Calvo has more rugged terrain than Guachochi, and the forests are considered to be of better quality. However, due to the violence in the region it receives less regular technical support. It is also notable that the regional study for Guadalupe y Calvo (Chávez Rodrigues, 2009) had an entire section entitled "Identification of the principal environmental impacts". A separate section with this title was not present in the UMAFOR Guachochi report. It is not clear that this indicates an actual higher level of environmental impact in Guadalupe y Calvo, but it is suggestive of it.

The environmental impacts noted in the Guadalupe y Calvo report were (our translation and edited from the original):

- **Felling and Skidding** affect the regeneration and neighboring trees, as well as the herbaceous vegetation and the soil, altering as well habitat for wildlife in the logging area……In the case of skidding with winches principally, sufficient care is not taken. The skidding of the trunks takes the risk of being carried out in the direction of the slope, and can become a drainage canal that surely promotes the (erosion) of particles when it rains.

Recommendation. This impact can be fought by obliging the training of the loggers in the techniques of directional felling and skidding in trails previously traced to prevent damage that induced erosion and damage to the neighboring trees.

- **Change in the density with logging**, this is propitious for the development of intolerant species…..provoking alterations in the floristic composition and eventually fragmentation of the stands.

  Recommendation. This impact can be prevented through permanent training of the technical personnel and obliging those who conduct the logging be persons with sufficient qualifications in silvicultural criteria relative to the temperament of the species…

- **Construction and maintenance of Roads.** Poor logging road maintenance causes the carrying of particles for drainage of rainwater in terrain without vegetation, on the roads, on the margins and banks of the storage areas…..depending on the equipment and procedure used the type of impact on vegetation and soil will vary.

  Recommendation. Depending on the type of road and complementary works, the observance of measures for the drainage system (and design of the roads) (la forma, revestimiento y peralte de la carpeta de rodamiento) as well as the routine of maintenance and abandonment according to the season of use should be obliged.

- **The inadequate disposal of slash** the felled trees, branches, leaves and possibly bark (when debarking is done in the forest) are threats to promote the growth of forest fires…….

  Recommendation. - It should be obliged to chop the branches to a size that permits their rapid incorporation into the organic matter and only in very open forests they should be placed in contours to (stop soil erosion).

- **Inadequate carrying out of logging** with respect to the species that are logged, the equilibrium of the original composition can be influenced if a particular species is logged….or of certain dimension, this can alter the process of succession and dominance……..leading to the deterioration of the genetic stock.

> **Recommendation.** The objectives of each intervention should be clear, particularly if managing irregular forests with selection, where the final and intermediate cuts are practiced in the same place. Thus, close communication is required between the author (of the management program) and the conductor of the program, with training and qualifications previously, to share goals and criteria for planning and execution. (Chávez Rodrigues, 2009).

These are some very specific observations about environmental impacts of extraction in Guadalupe y Calvo, pointing to problems with skidding, changes in forest density, logging road maintenance, inadequate disposal of slash, and problems with logging and species composition. We came upon this language after conducting fieldwork, so did not have the opportunity to interview foresters who work in the *municipio* about it. However, it should be noted that this *municipio* has a very high percentage of Type II operations (twice as many, with 22 of 31 or 71%, compared to 6 of/16 or 37% in Guachochi). In Type II operations the logging is mostly carried out by contractors, with varying degrees of supervision from the community. The deduction could be made from the above that there are a lot of problems with the environmental impacts of the contractors. The last recommendation above suggests that foresters would like to be able to work more closely in training these contractors in order to reduce impacts. This could also be a possible area of intervention for an IFM project, focused on helping communities move from a Type II organization to Type III, with greater direct participation in the logging process. However, the security situation and remoteness represent substantial challenges.

In addition to the support provided by the UMAFORs, municipal governments in Chihuahua may have their own forest administration office. In Guachochi the municipal government administers the Temporary Employment Program (PET) which pays community members to perform forest maintenance activities so they have to coordinate with the UMAFOR and state and federal governments

Finally, in addition to the role of the UMAFOR in regulating and monitoring forest management in Chihuahua, there are also multiple efforts from government, multilaterial organizations and NGOs to improve forest management in Chihuahua and elsewhere in northern Mexico. For example,

CONAFOR, PNUD, GEF, and Rainforest Alliance recently published the *Manual de mejoras practicas de manejo forestal para la conservacion de la biodiversidad en ecosistemas templados de la región norte de México (Manual for best practices in forest management for biodiversity Conservation in the temperate ecosystems of northern Mexico (*Vargas Laretta, 2013*).* Nearly all of the practices recommended by the manual for biodiversity conservation in logging would also serve to reduce impact with respect to carbon emissions. These include careful planning of the logging process, marking of trees, directional felling, reduce impact on watercourses, close and restore skid trails at the end of the logging season, minimize the number, width and length of forest roads and plan their placement for the upper parts of watersheds, control erosion, leaving chopped slash and arranging it Iin rows and similar practices. A recommendation that could conflict with improved carbon capture is the recommendation to maintain openings in the forest. As noted elsewhere, openings in the forest for agriculture are scattered throughout production areas. These are only recommendations in a manual and it is not known how widely it has been distributed or used, but it does indicate the level of attention to improving forest management in the region.

Two final regulatory issues that emerged in interviews and in a review of management programs have to do with the anchoring of the winches and the control of agricultural clearings in the forest.

The field observations reported on more fully below, suggest that the anchoring of the winches to trees without protection (tires) occurs with some frequency. Another phenomenon that does not occur in Oaxaca forests, with their widespread land use zoning and concentration of activities, is that agricultural clearings may be scattered throughout the forest (Figure 27 below). One forester said that is commonly placed in the conditions for authorized logging that no trees a particular distance from the forest opening can be marked for cutting. This is done to avoid using this mechanism to enlarge the forest clearing. In forests where there a lot of agricultural openings, this can reduce volumes. There are reports of farmers girdling trees at the edges of forests in order to expand agriculture. In the interviews with comisariados we asked if there was a problem with community members attempting to enlarge clearings in the forest, and 5 of 17 reported that it was. It may be that this problem is confined to a relatively few stands in any given forest. For example, in a review

of the management plan for the ejido Aboreachi, that had a staggering amount of detail for each one of 2, 205 *unidades de manejo* or stands, it noted that only 16 of them had from 1-20% of the area of the stand in agriculture.

Figure 27: Agricultural clearing in the forest-Ejido Aboreachi

4.2.3 Certification

The first *ejido* to to be certified in Chihuahua was Ejido La Trinidad in Guadalupe y Calvo in 2002. It was re-certified in 2009, and is now in the process of being certified for a third period. A second one, El Tule y Portugal, also in Guadalupe y Calvo, was not certified until 2009. However, there is currently a new push from CONAFOR in collaboration with Rainforest Alliance to expand the number of certified *ejidos* in Chihuahua. At the meeting of the UMAFOR Guachochi where I was present they gave a presentation on certification, and the comisariado of ejido Caoborachi commented that it was

not that difficult but that the hardest part was getting the workers to use the required safety equipment like boots, hardhats, earplugs etc.

In Table 9 below, the current status of certification efforts in the AATR in Chihuahua are detailed. These efforts, as mentioned, are being carried out by Rainforest Alliance with financial support from CONAFOR. It shows that six communities in Guachochi are currently in the process of being certified, with the two already noted in Guadalupe y Calvo.

Table 9: Status of FSC certification in the AATR Chihuahua

UMAFOR	Ejido	Status
Guachochi		
	Sehuerachi	In Process
	Tecorichi	In Process
	Caborachi	In Process
	Santa Anita	In Process
	Yoquivo	In Process
	Samachique	In Process
Guadalupe y Calvo		
	La Trinidad	In Process of Re-certification
	EL Tule y Portugal	Certified

4.3 Management Programs

In general, the formal process of planning, approving and executing the timber harvests is the same in Chihuahua as in Oaxaca. A review of several representative management programs and interviews with foresters highlights the very substantial investment of time and effort in development of the management plans for submission to SEMARNAT. One forester reported that it takes 6 months to gather the data and produce the management plan, three months of which is spent on gathering data in the forest for the inventories. It involves a field team of 21 people taking measurements in the forest, all of whom are from the community. This includes 10 *brigadistas* each one with an

assistant, and the director of the teams (*jefe de campo*). There are then 5 people in the office of the forest engineer capturing the data and writing the report.

The management plans presented to SEMARNAT thus contain staggering amounts of detail on the forest[12]. In one non-random sample of only around half of the appendices to the management plan for the ejido Aboreachi, there were a total of 130 pages of data on "Dasometric Characteristics of groups of species; 54 pages of data on "General Characteristics by Diameter Category and Species in the Harvestable Management Units"; 15 pages of data on "Determination of the Treatment Method for the Harvestable Management Units"; 15 pages of data on "Calculation of Increments of the Harvestable Management Units"; 22 pages of data on "List of the Calculation of the Possibilities and Intensity of Management of Pine and Oak"; 22 pages of data on "List of the Calculation of the Possibilities and Intensity of the Management of Other Conifers, Broadleafs and Dead Pine"; and 24 pages of data on "Annual Logging Plan for the Possibilities of Harvestable Pine and Oak". This listing is taken from only 7 of 24 appendices, so this is truly "big forest data".

The narrative section of the management plan, including large numbers of summary tables, is 183 pages. There are multiple sections where reduction of damage to the forest from logging is covered, most of which would also reduce carbon emissions. For example, Section 14 is entitled "Commitments to Reforestation and Measures for Conservation and Protection of Wildlife and Plants" and the first section is cited in its entirely below

> "FLORA
>
> One of the goals to take into account in the logging proposed in the management program is continual protection to the soil to avoid erosion. As a measure to achieve that, it is proposed the segregation of areas with propensity to erosion, as well as those stands that contain

[12] In Oaxaca, we were not able to get copies of the entire management plans to be able to review them at leisure, only look at them and take notes in offices. Neither SEMARNAT nor the individual foresters were ever willing to give us digital copies of the management plans. However, SEMARNAT Chihuahua allowed us to make digital copies of 4 representative management plans (and would have let us copy more) so we were able to review more extensively the magnitude of the data in the plans.

streams or springs in their interior. In addition, to protect the flora, scenic beauty and wildlife the following measures will be taken:

a) Directional felling: This consists of attempting, to the degree possible, direct the felling of the tree towards place where it produces the least possible damage to the residual vegetation.

b) Skid trails: These are done with purpose of mitigating as much as possible the compaction and exposure of the soil for the skidding of the logs. After carrying out the extraction activities, measures should be taken to avoid that they become foci of erosion. (Our translation*)(Programa de Manejo, Ejido Aboreachi)*

Section 16. "Description and Programming of the Preventitive and Mitigation Measures of Environmental Impacts" also has great detail on preventing and mitigating environmental impacts. In the introduction, it is noted that the measures respond to the Normas *Técnicas Ecológicas* NTE-CRN-001-012/92 and the Mexican official norms NOM-060/061-ECOL-1994 published in the Diario *Oficial de la Federación* April 9, 1992 and May 13, 1994, respectively, the Forest Law and the General Law of Ecological Equilibrium and Environmental Protection. A subsection "C." identifies 22 possible negative impacts from logging including "soil erosion" and "residual damage to trees". A section D. "Preventive measures and Mitigation of Environmental Impacts" goes into much greater detail than the corresponding sections in the Oaxaca management plans. This section has no fewer than *106* separate measures that will reportedly be taken. I have selected at random five of these measures below, directed mostly at wildlife conservation, but which also has implications for reduction of carbon emissions, and directional felling.

D12. Establish areas of nesting, feeding and refuge for wildlife according to the structure and composition of the vegetation.

D13. In logging areas, leave standing trees identified as having birds' nests, small mammals and reptiles, for the development of xilófagos insects integrated to trophic processes,

D14. In commercial logging, directional felling will be applied, to minimize damage to the residual vegetation and the understory.

D15. Leave standing at least 5 trees per hectare, preferably in groups, to guarantee the nesting of birds, mammals and reptiles.

D16. Branches and waste will be chopped to accelerate their decomposition and incorporation to the soil. (our translation) (*Programa de Manejo, Ejido Aboreachi*)

Many more examples could be given to illustrate the very substantial degree of careful planning, a significant part of it directed towards controlling damage to the forests, that is contained in the management programs.

However, there is also evidence from the programs reviewed that errors are made and that federal enforcement of laws does occur. For example, the management program for the *ejido* Yoquivo shows there was a "Second Modification" to the Management Program in June, 2011 to take into account that the ejido had apparently logged more than its authorized volume that year. This excess logging was detected or reported to PROFEPA (Procuraduría Federal de Protección al Ambiente) and the logging permit was suspended until this Second Modification was carried out. It discounted the unauthorized volume and with that, the logging permit was reinstated. This suggests that the regulatory framework does have at least some teeth and that some infractions are documented, monitored, and sanctions imposed by PROFEPA.

The *dictamenes tecnicos* that authorize the implementation of the management plan tend to have less additional detail than those in Oaxaca (possibly because the management programs in Chihuahua tend to have more detail than those in Oaxaca) and basically just restate the requirement of a 20 meter buffer around streams and water bodies and that all other environmental precautions in the regulations and management program should be followed. Field inspections are made by SEMARNAT and also documented in the files. For example, in March, 2011 a SEMARNAT inspector visited the forests of the ejido Caborachi and went into some detail on the post-logging state of the forest concluding that the ejido had "……..arranged the slash against the curve, along the slope and around some arroyos. It is concluded that the treatment that has been given to the forest is correct". It went on to note that the ejido has established a plantation of pine in a 6 ha clearing that had previously been dedicated to agriculture.

Actions as simple as reforesting 5 ha with native pines require authorization from SEMARNAT as evidenced in the file of the ejido Samachique.

4.3.1 Silvicultural Practices.

Until the last year, the only silvicultural system used in Chihuahua was the uneven-aged system, the *Método Mexicano de Ordenacion de Bosques Irregulars* (*MMOBI) (*See introduction for more description of MMOBI). Until 2012-2013, the Método de Desarrollo Silvícola (MDS) had never taken root in Chihuahua, although it was developed beginning in the 1970s in neighboring Durango. As a SEMARNAT forester explained "It's because of the culture, the tradition of the producers, they haven't seen other options," An anecdote that is told about earlier efforts at MDS is that when foresters returned months later to a large opening left by a liberation cut they discovered one of the community members had planted potatoes there. Thus, there are frequent references to the dangers of land use change from MDS in Chihuahua, a concern that was not heard in Oaxaca. However, as part of the current initiative to increase production, SEMARNAT, in collaboration with CONAFOR is now requiring MDS to be applied in at least part of the forest. Despite the concerns about land use change, one interviewed forester said that he had already given presentations to the community assembly on MDS and that the management plan for 2014 was being modified to include it. It will be combined with MMOBI (as is also commonly done in the Sierra Norte AATR), with around 70% of the volume being harvested with MMOBI and 30% with MDS. MDS will be applied where slopes are no greater than 20% and where there are large quantities of smaller dimension timber. A second forester interviewed also noted that in his ejido the split between 70% MMOBI and 30% MDS is being planned. This forester, like others interviewed, also said that it is time to practice MDS in Chihuahua and his ejido due to the large volume of small diameter timber. Both CONAFOR and the Chihuahua state government have decided to not promote SICODESI, so it is not practiced in Chihuahua.

Due to the low productivity of the forest, turns of the 90-100 years are the norm in Chihuahua. In fact, of the 59 agrarian communities in the Chihuahua IFM database, the average turn is exactly 90 years, with some as high as 120 years, whereas in Oaxaca it is usually 50 years.

4.3.2 Extending Rotations as a Means of Carbon Capture

A more extensive discussion of extending rotations as a means of carbon capture is found in the report on IFM in Oaxaca. Although we have not yet conducted the analysis, it appears that higher percentages of the authorized volume are harvested in Chihuahua than in Oaxaca. This could create some opportunities for capturing carbon through extending rotations. A study that modeled carbon capture in three ejidos in the municipio of Boycona, outside the AATR but with similar conditions, found relatively high intensities of cutting and a decline in biomass. In one ejido in particular the modeling found that the greatest positive effects in carbón capture were related to the reduction in the intensity of extraction and the lengthening of the cutting and maturation cycles. It was found that an increase in the rotation period from 10-12.5 years represented 42% of additionality over 5 years (Balderrama et al. 2008)

4.4 Timber extraction methods (felling, skidding, and hauling)

4.4.1 Felling

Training in directional felling begin Chihuahua in the mid-1970s, when responsibility for logging was assumed by *Productos Forestales de la Tarahumara* (PROFOTARAH) a parastatal that was created to bring order to what had been a disorganized, destructive and exploitative pattern of logging by private enterprises up until the early 1970s. From this period, all of the chainsaw operators were from the community and began to receive training in directional felling. A forester who worked for PROFOTARAH in the mid-1980s reported that there were small private forest owners who were fined for not practicing directional felling, that it was not common but it happened.

The 2002 report on certification for Ejido La Trinidad, although now dated, suggests problems with directional felling. It was reported that “The logging personnel carry out felling, but with some deficiencies….they don t use *cunas* to aid in directional felling. The extracting of the logs to the road is done with teams of oxen and winches dragging the logs over the soil. This system causes insignificant damage to the soil. Nevertheless, the impact on the residual mass during the felling of the trees is significant” (Smartwood/CCMSS, 2002).

The sample of 17 interviews with forest engineers found widespread agreement that currently directional felling is practiced and that there are relatively few problems with it. Some representative comments follow (see AMREDD+ Field Survey-Forest Engineers database for Chihuahua for all comments).

> "It is attempted to not damage the residual trees and where the forest is very closed damage as little as possible"
>
> "The felling is carried out by the contractors, avoiding damage to the residual trees, it's done with chainsaws, And they know how to direct the fall of the pine."
>
> "Before beginning the extraction, we gave a course on directional felling, also focusing on the height of the stump (to leave it as low as possible. Now there is more caution".
>
> "Courses have been given in directional felling by the UMAFOR; In 2007 people came from Brazil and Chile to train them, also to not leave banderillas and for chainsaw maintenance."
>
> "If the logging boss sees a chainsaw operator fell a tree that is not marked, they punish him, they take away his opportunity to work for 1-2 months. They have always done felling well. There have also been training courses by CONAFOR".
>
> The logger fells the trees in the natural direction, trying to minimize damage to the residual
>
> Stand."

This sample suggests that directional felling is widely practiced and there are currently few problems with it (although one of the comments suggests more recent problems that were corrected). The forester for the ejido Caborachi noted that the ejido has had training in directional felling in recent years and that it is practiced and that there is "no significant damage" from felling. Directional felling is also significantly helped by the very low density of these forests making it easier to avoid damage. The implications of the low density forests for low felling damage is confirmed by Brown (2005), who carried out a study of the impact of logging on the carbon balance of the temperate pine forests in *ejido* Chochachi, to the north of the AATR Chihuahua. She found that only 0.69 trees were

incidentally felled per felled tree with a mean DBH of 9.6 cm and that" the biomass of incidentally killed trees represents just 3% of the total biomass left to decompose" (Brown, 2005) with the rest being from the stump and the top of the crown. She concludes that "An open forest combined with relatively short trees ensures that few trees are incidentally damaged during felling". She also found that the damage values in Chihuahua were far below those registered in studies in Malaysia, Belize, and the Congo. However, the smaller sample of 5 field observations (more on that below) found that 2 of the 5 or 40% had some problems with directional felling. Since the forest engineers are only occasionally in the field during the actual logging, this suggests that their perception may be overly optimistic and that there are more problems than they report. As well, the comments above from the UMAFOR Guadalupe y Calvo suggested more widespread problems with directional felling in that *municipio*. Felling low on the trunk, close to the ground, was also standard practice since the 1970s/1980s, to avoid forest pests. Field observations and other sources all suggest that this is currently widely practices

4.4.2 Skidding.

Damage in skid trails in not thought to be significant and one forester noted that there is usually abundant regeneration in the disturbed soil of the skid trails, and that they have 15 years to recover before being logged again. When cable winches are used, the required practice is that when the winch is anchored with chains, it either has to be to a tree that is marked for cutting, or the tree should be protected with tires. However, as will be noted below, this is not always practiced and we recorded instances of damaged to unmarked (for harvesting) trees that were used as anchors without protection (See Figure 28 below). When asked about possibly greater damage created by rented winches, one forester commented that that was possible, but that the *ejidos* made sure to contract with operators who were careful and that they are supervised by the *montero* (logging boss).

Figure 28: Damage to tree trunk from anchoring winch without protection in ejido Cruz de Piedra

In the interviews with the sample of 17 forest engineers they were also asked about damage in the skidding process, and a few representative comments were (for ejidos with problems the name is included, for possible follow-up):

> “Trees trimmed (despuntados), branches knocked off (desramados), or partial damage to bark. The ejido has little natural regeneration, there is grazing in the logging areas. (Agua Zarca)
>
> “In the skidding they use skid trails, they are done in all different directions, so the soil is vulnerable to erosion. They do damage to the regeneration and scrape adult trees”. (Baborigame).
>
> “Impact the the soil and the wildlife temporarlly flee, it’s not much, they damage branches, trunks, and regeneration”.
>
> “People from Rainforest came to train and now they understand better, now the damage is minimal”.

The skid trails do not seem to present many problems in designing them, and they are reported as being only 1-3 meters wide and up to 500-600 meters long (see Figure 28).

Figure 29: Light to Moderate Damage from Skidding in the Ejido Cruz de Piedra. Skid Trail itself shows minimal damage.

The two *ejidos* above (Agua Zarca and Baborigame) who were noted to have problems with skidding are both Type II, further suggesting that problems with logging impact may be concentrated in these *ejido*s.

4.4.3 The Use of Animal Traction

The most notable aspect of skidding in the Chihuahua AATR is the widespread, but unquantified, use of animal traction. The combination of using winches and animal traction appears to be particularly common, with winches used on steeper slopes and animal traction on gentler slopes. Horses are usually used but also oxen. Oxen are stronger and more productive, since they can haul larger trees on steeper slopes, but they are also more difficult to manage. It is reported that the use of oxen is more present in Guadalupe y Calvo. Despite being in a mountainous region, the southern sierra of

Chihuahua is also characterized by extensive mesas and gentle slopes in many areas. In driving from Parral to Guachochi it is notable that there seems to be steady rise in slope, but no steep climbs as with Sierra Norte. As a result of this, the historical use of animal traction has persisted, since there are substantial areas where mechanical traction is not necessary.

It is apparently nowhere documented what communities use animal traction and the percentage of the volume which is managed. One forester interviewed, when asked how many of the communities use animal traction responded "all of them", although are data suggests this may be something of an exaggeration.

The use of animal traction is not recorded in the management programs, but in the sample of 17, 6 use only winches, 10 use both winches and animal traction (of varying percentages of the volume) and only one (Agua Zarca) reports using only animal traction. Of those who use animal traction, the volume extracted volume varies form 10%-98%, although most are grouped in the 35-60% range. All of those interviewed agreed that animal traction caused less damage to the forest. Four of the 12 that use animal traction said that the tendency was to increase their use.

As has been noted, "these methods of extraction are more "ecological" because they cause little damage to the residual mass and in many cases are more efficient and economic, to the degree that they are still in use (our translation)" (Vargas Laretta, 2013:7). It is estimated that the costs of using animal traction are around half that of using the truck-mounted winch, 350 pesos pesos per thousand board feet *pie doyle* for animal traction versus 650 pesos for the winch. Animal traction is also used to load the logging trunks, using ramps. Here, one forester noted that animal traction is more productive, and that animals can load three trucks in the time that a winch can load two. The trucks are slower because they have to do more maneuvering. As well, the teams of animals are owned and maintained by individual members of the community, so the *ejido* does not have the cost of maintenance, and it generates an additional flow of income for the *ejidatarios* that have the teams. The horses also only have to be fed once a day.

Figure 30: Animal traction in the ejido Caobrachi. Note also the openness of the forest and the small diameter of the trees, as well as the flatness of the terrain.

The ejido of Aboreachi is a particularly interesting case. Around ten years ago Aboreachi began making a transition from using winches to animal traction, a process which is now well advanced. They had 3 truck-mounted winches but now have only one, having sold one and the other is discarded on the sawmill property. There were discrepancies on exactly how much of the harvest is currently done with the winch. In separate interviews, the forester said only 2% while the comisariado said 25%. Nonetheless, it has been greatly reduced from the earlier situation where 100% was skidded with the winch. Interviews in the ejido of Caborachi reported that 60% of the harvest is done with animal traction and the photo above shows animal traction in this ejido.

The use of animal traction is an important element in low carbon emissions forestry in the region. In addition to the light to imperceptible damage from the skidding process, they burn no fossil fuels either in their operation or in their "manufacture". As we will note further in the conclusions, better documentation of the carbon and economic advantages of animal traction, its current degree of use, and a study of the topographic and other circumstances in which it is most viable, could be significant information in documenting its current contributions, and future potential, in the reduction of carbon emissions from logging

4.4.4 Hauling

As in Oaxaca, since nearly all of the forests in Chihuahua have been harvested for decades, it is uncommon that new forest roads are constructed. Sixteen of the 17 forest engineers reported erosion in the roads, although 12 of the 16 that responded said it was light, with the remainder describing it as moderate. Observations suggest there is little opportunity to reduce emissions impacts from narrowing forest roads or that haul roads are unnecessarily wide. Seven of the 17 sample said they do not own their own extraction equipment.

4.4.5 Post-Harvest Treatments

Since the PROFOTARAH period in the 1970s, chopping and dispersing the slash was the standard practice, and it is required by SEMARNAT regulations. However, as part of the initiative to promote MDS and to control the greater erosion that it may occasion, SEMARNAT is now for the first time requiring leaving the chopped slash in contours (*acordonamiento de material muerto*), as opposed to dispersing it, to control erosion and reduce the risk of forest fires.

Figure 31: *Acordonamiento de material muerto*, a new practice in the AATR Chihuahua. This example is from a pre-commercial thinning (*pre-aclareo*) as part of a first-time implementation of MDS in ejido Aboreachi

Since 2005 CONAFOR has given support and training in constructing countour lines with the slash instead of dispersing to encourage soil conservation. The practice is said to be increasingly common today, although there can sometimes be problems with how it is done. For example, if the slash is not chopped fine enough, water can just flow under it and cause erosion.

As noted earlier, in addition to the interviews with forest technicians, we carried out direct observations of the impact of logging practices in 5 ejidos. The observations on skid trail damage (with both animal traction and winches), directional felling, post-harvest treatments in the skid trails and in the logging area in general, and the height of the stumps left by logging are reviewed in Table II below.

Table 10: Observations in the Logging Areas of 5 ejidos

Ejido	Skid Trail Damage-Animal Traction	Skid Trail Damage-Winch	Directional Felling	Post-Harvest Treatment -Skid	Post Harvest Treatments-Logging Area	Stump Height

				Trails		
Agua Zarca	Imperceptible	NA	No damage observed-low density forest	Not necessary	Chop and Disperse slash-also used as firewood by nearby homes	Less than 25 cm-what is recommended
Cruz de Piedra	NA	"Moderate" 14 young trees felled, 2 adult trees leaning, 9 adult trees with stripped bark, 7 trees damaged-used as anchors for winch without protection.	No damage observed-low density forest	Not necessary-skid trail itself not visible after one year	Chop and disperse slash-also used as firewood by nearby homes	Less than 25 cm-what is recommended
Guachochi	NA	"Ligero", 1 adult pine felled, 5 young pines felled, 2 adult pines with damage –used as anchors without protection-No damage to bark observed (low density forest)	No damage observed-low density forest	Only light soil damage	Chop and disperse slash-also used as firewood by nearby homes	Less than 25 cm-what is recommended
Samachique	"Light" 2 young pines felled. They avoided passing through an	"Moderate" 9 young pines uprooted, 6 young pines with damage to the bark. Winch anchored to	"Moderate" Directional felling not used-2 adult pines topped, 1 adult pine felled, 1	Only light soil damage	Chop and disperse slash-also	Less than 25 cm-what is recommended

	area of regeneration.	oaks, which show little damage, or to trees marked for felling.	adult pine broken, 3 adult pines stripped of branches.		used as firewood by nearby homes	
Yoquivo	NA	"Moderate" 7 adult pines leaning, Abundant Young trees uprooted; 8 adult pines with bark damage; 4 pines damaged-used as anchors for winch without. Damage in trunk loading área.	"moderate" 4 adult pines, 2 adult pines and one adult oak felled, 4 adult pines stripped of bark, 14 young pines felled.	Only light soil damage	Chop and disperse slash	Less than 25 cm-what is recommended

Of the five logging operations observed, only one used exclusively animal traction, 3 used exclusively winches, and one used both. For the two using animal traction, for one the damage was classified as imperceptible and for the other "light". In the four that use winches, damage was classified as "moderate", underlining the important role that animal traction can play in keeping carbon emissions from the logging process low. With respect to directional felling, two of the five showed damage from the poor application of directional felling. The Chihuahua IFM database shows universal use of directional felling since it is required in the regulations. The interviews with the 17 foresters showed that all also reported that directional felling was practiced. Only one forester (for Agua Zarca) reported significant damage from the poor application of directional felling. However, the field

observations suggest that continuing problems with directional felling may be more widespread than is being reported, with two of the five (both Type IV communities in Guachochi) having problems. The observations found no significant problems in damage in the skid trails, in the post-harvest treatment of chopping and dispersing the slash (as noted, with arranging the slash in contours now becoming more common), and in the height of the stump left by logging.

We will here directly quote some general comments about harvesting impacts made by Ing. Ivan Grijalva Martínez, who did all of the field observations (accompanied in one of them by David Bray). An edited version of his comments follows

Damage to the residual forest mass during the extraction by winch**.**

- It can be said that the damage is considerable, if we add up all of the skid trails in all the ejidos and communities with permits, independently of the capacity for regeneration of the forest.
- It can be reduced emphasizing that it is the obligation of the logging permits holders to carry out extraction with the necessary care to avoid damage.
- The field workers (chainsaw operators, cable operators, operator of the winch) dont follow recommendation to cause less damage to save time, to make their work easier, for lack of training and lack of supervisión, or out of bad habits to extract a little more volume when they cut down commercial trees not marked by the forester.
- When those in charge of extraction are the ejidatarios themselves, one supposes that they will cause the least damage posible, as owners of the resource. In spite of that they do damage that could be avoided (ejidos Samachique y Yoquivo). If those in charge are contractors or buyers one suppose that they will do it with even less care causing greater damage, since they are not from the ejido (Ejido Cruz de Piedra).
- These details (directional felling, anchoring the winch on marked trees or in other cases protecting them with tires or oak branches, locating skid trails en areas where it provokes less damage) were previously cited in the text of the logging autorización as conditions, it creasted

a greater sense of obligation to fulfill it. Currently, it mentions general aspects of the norms without details.

- With respect to the previous point, in a meeting with Ing. Heredia, the subdelegate of SEMARNAT, he mentioned that in the authorizations for land use change they are going to detail as much as possible the commitments and measures of mitigation of negative impacts, to facilitate inspections by PROFEPA. I asked him if that measure would not be extended to the logging authorizations, and he indicated that they would not be (so apparently they don't see a problem).

- The winch operators are people with no technical traning, they learned from the experience of several or many years. But technical training is necessary.

- In several ejidos that work only with winches, they see the option of using animal traction. It would be useful to promote with them the use of animal traction.

- The engineers responsable for the management programs consider as the priority the elaboration of the management program, carrying out the marking, doing the paperwork for transportation, presenting the anual report, and leave as a lesser priority the review of the logging áreas. In some cases they will verify the correct execution of the cleaning of the forest or the chopping and dispersión of the slash, but they do not enter into details to check damage to the residual stands and to the soil (Some were not sure of the width or length of the skid trails).

Erosion in roads

- Erosion in the roads is a reality. The responsable engineer does not get into the rehabilitation and maintenance of roads, it is carried out by the ejidatarios themselves or in a few cases by the buyer. Training is also necessary for the field workers who work in this capacity

Marketing

- Normally and by tradition the forest engineers dont get involved in the marketing. I noticed that in some of the medium and large ejidos they don't have contracts, and they suffer delayed payments or lose the product entirely when they are not paid.

  With reference to the two paragraphs above, it should be noted that the payments to the forest engineers dont include these activities, but it can be suggested that CONAFOR provide training in these aspects.

  In several cases there is an Alliance between the buyer of the Wood and the forest engineer, the first pays for the technical services completely and more reliably tan the ejido, so the forest engineer favors the buyer in marking the trees.

  Other comments

  Some of the people interviewed tend to minimize the problem of damage to the forest during logging, road erosion, and ilegal clearings in the forest, or they intentionally don't mention it. The reality in the field suggests something else. (email communication from Ing. Ivan Grijalva Martínez, 5/3/14)

As Ing. Grijalva notes, the interviews with forest engineers suggested that damage to the forest was under control, but his personal field observations suggest more widespread problems, particularly in two of the five observations. This suggests that there could be a need for closer studies of the degree of damage from logging and opportunities for reduction of emissions from IFM practices.

4.4.6 Illegal logging and illegal crops

There are widespread reports of illegal logging in the AATR but it is not clear how serious a problem it is. Several of the forester interviewed said that illegal logging was not a problem in their ejido. One forester noted that his ejido had a brigade accredited with PROFEPA (the environmental attorney general) and that they are paid through the Programa de Empleo Temporal (PET-a government work program).

It is also not clear how widespread agricultural clearings for illegal crops such as poppy and marijuana are. In our field observations, we did encounter one example, in an ejido which shall remain anonymous (see Figure 32 below), of new agricultural clearings which local experts said were clearly for drug cultivation.

Figure 32: Agricultural Clearing for Illegal Drugs

4.5 Forest Measurements, Management Units, Harvest Schedules and Timber Harvest Data.

As noted elsewhere, the NOM-152 requires highly detailed forest measurements for timber harvests, and the forest management program provide staggering amounts of data, requiring teams of up to 21 people three months in the field. However, growth rates are calculated using regional averages rather than growth rates specific to the managed stand, although CONAFOR and SEMARNAT currently have a program to get more detailed and local growth information. As also noted earlier, the inventory methods required in the NOM-152 are highly detailed and can be found in section 5.2.7 (pp. 8-10).

Shapefiles for the logging areas of the communities in Chihuhua are not available since most contain a very large number of irregular shaped polygons. We have taken pictures of the maps of these logging areas for all of the agrarian communities, and they have been submitted with this report. Data on harvest schedules (cutting cycles, turns) are found in the AMREDD+ Chihuahua IFMdatabase.

As noted above, the turns in the AATR average 90 years. Authorized and actual timber harvest data for 2003-2013 is found in the IFM Chihuahua database also.

With respect to harvest intensity CONAFOR has current plans to increase production nationally by 94% and are currently reviewing management plans for 1.2 million ha in Chihuahua. As noted above, many of the ejidos are now planning to harvest around 30% of the volume using MDS, although our data does not show how much the total volume is increasing due to this. A review of the authorized volumes in the Chihuahua IFM database shows only a few cases where the authorized volumes have gone up substantially from 2012 to 2013, so these impacts are not yet being seen. Foresters report, and CONAFOR is apparently reacting to the fact, that there are a substantial number of dense small-diameter stands which can be effectively harvested using MDS. They are also developing markets and processing facilities for products such as medium-density fiberboard that can use the small diameter timber. As discussed in the introduction, the impact this kind of practice can have on carbon capture may depend on a wide variety of variables, and it is not clear whether any one silvicultural practice is superior to another in carbon capture terms. The harvesting of significant quantities of small-diameter timber that goes into a long-term forest products pool may not cause significant carbon emissions, and the well-managed cleared openings should result in the rapid capture of carbon in natural regeneration or planted trees.

4.6 Preliminary recommendations potential IFM activities with greatest potential for reducing or removing GHG emissions in Chihuahua

The setting of the AATR in the Sierra Tarahumara of Chihuahua is substantially more challenging and complicated than the AATR of Sierra Norte in Oaxaca for four reasons. 1) It is spread over a much larger and more remote area, with difficult logistics, communications, and security situations in the entire region, but particularly in the *municipio* of Guadalupe y Calvo. 2) The ejidos tend to have larger, poorer populations than in Sierra Norte, and as a result there is no reinvestment in the forest in most of the ejidos, with all profits being distributed to the community members. 3) There are also much larger percentages and absolute numbers of Type II communities, where the logging is carried

out by contractors, particularly in the municipality of Guadalupe y Calvo, 4) An additional social issue is that many ejidos have populations of both mestizos of primarily Spanish descent and the indigenous Rarámuri people. In these situations, the Rarámuri community members are frequently marginalized from employment and decision-making in the community forest enterprise. Although a serious social justice issue, and one that has cause serious tensions in some communities, it is not clear that this issue has any impact on harvest practices.

This combination of the first three factors above and the evidence collected for this reports suggests that there are more issues with logging impacts and carbon emissions in the Sierra Tarahumara than in Sierra Norte. It appears that poor logging practices in general are particularly present in the Type II logging communities in Guadalupe y Calvo. However, issues in directional felling in particular may also be present in a larger percentage of ejidos than is reported, including some Type IV communities, as is noted in his comments by Ing. Grijalva.

The widespread use of animal traction in Chihuahua is an interesting example of a very low-carbon traditional skidding practices that could be highlighted for its ecological value and further encouraged. A more careful comparison of the magnitude of carbon emissions in the use of truck-mounted winches, both in damage to the forest and in their operations, and animal traction could be useful in highlighting the carbon advantages of the latter. Given that animal traction cannot be used in steeper slopes, it is not clear to what degree the practice can be expanded. However, the experience of the community of Aboreachi is instructive, in that they were able to greatly expand their use of animal traction over the last 7-8 years on their own initiative. We do not know the exact topography of the ejido, but this suggests there may be other ejidos where the use of animal traction and a reduction of carbon emissions could be achieved.

Despite these deficiencies and opportunities, it also needs to be emphasized the logging in Chihuahua operates under the same regulatory framework as logging in Mexico, and that it has the additional modest technical support that comes from the operation of the UMAFORs. Thus, to a substantial but somewhat lesser degree than Sierra Norte, it also meets to the definition of reduced impact logging

as "intensively planned and carefully controlled timber harvesting conducted by trained workers in ways that minimize the deleterious impacts of logging" (Putz et al. 2008:1428).

Ongoing training in directional felling in particular, and possibly skid trail design, are available in Chihuahua, provided by CONAFOR and the State Government both directly and channeled through the UMAFORs. Rainforest Alliance is also currently working on improving forest management practices with four pilot communities in Guadalupe y Calvo: Chinatú, La Trinidad, el Nopal, and Catedral. Two of these are Type IV communities and two are Type III. They are thus not working with any of the Type II communities, where most of the problems appear to be concentrated, and where the problems are likely linked to poor practices by logging contractors.

In addition to the uncertain possibilities for reducing carbon emissions from the harvesting processes, it should also be noted that at least one study has found limited possibilities for carbon capture from afforestation and reforestation activities due to limited amounts of land available for these activities. In addition, a tendency towards reduction of diameter size and biomass in the harvested forests suggests limited possibilities for carbon capture through current silvicultural practices and rotations periods (Balderrama et al. 2008).

To summarize, in Table 11 below we make our preliminary recommendations with respect to what IFM activities may be relevant for Chihuahua. We find modestly more possible opportunities for IFM in Chihuahua than in Sierra Norte of Oaxaca, although seriously tempered both by the security situation and the challenge of working with the contractors who conduct the logging operations in the Type II communities. There may be more opportunities in Type IV communities, particularly in the municipio of Guachochi.

Table 11: Preliminary Recommendations on Potential for IFM activities in the AATR Chihuahua for reducing or removing GHG emissions (IFM activities adapted from Griscom and Cortez (2013) and Griscom et al. (2014)

Potential IFM Activities	Status in AATR Chihuahua	Recommendation
Better Harvesting		
1.Road and Skid Planning	Comprehensive road and skid trail planning required in regulatory framework. Skid trail width regulated. Post-harvest treatments of skid trails required. Regulations appear to be mostly observed. Sample suggests that in only one ejido (Baborigame) are their significant issues in skid trail planning. Higher logging impacts in general in Type II communities in Guadalupe y Calvo and possibly in Type IV communities in Guachochi	Target further studies and possible project on reduction of harvest impacts with Type II communities and logging contractors in Guadalupe y Calvo. Train communities to move from Type II to Type III with greater control over harvesting.
2. Directional Felling	Regulations say that felling must take into account environmental impact. Directional felling reported to be widely observed, but there may be the need for additional training. An issue not covered but present in Sierra	Possible opportunities to reduce damage from lack of directional felling in Type IV communities in Guachochi.

	Tarahumara is damage from anchoring winches to trees.	
3. Improved Cutting of Log Sections	Not regulated. Cutting low on stump widely practiced in AATR Chihuahua	Unclear opportunity for improvement in carbon emissions
4. Cutting Vines	Not relevant	Not relevant
5. Low-Impact Logging Equipment	Regulations say extraction should be carried out with "minimal damage to ecosystem". Use of monocable winches, considered relatively low impact is standard in AATR Chihuahua. Widespread use of animal traction, usually in combination with winches, unusual and low carbon emission practice. No bulldozers	Possible opportunity for further study to compare carbon emission from winches and animal traction. Highlight and promote animal traction as a major contribution to low-carbon emission forestry wherever feasible. Could reduce observed damages in Type IV communities.
6. Reducing the felling	Apparently not an issue in	Little opportunity for improvement to reduce carbon

of defective trees	AATR Chihuahua.	emissions
7. Reducing collateral trees felled	Evidence that this is an issue in some ejidos. But problem may not be widespread.	Larger sample of field observations required. Could be part of carbon emissions study
8. Properly identifying commercial species before cutting	Data-intensive inventories carried out. Trees marked by species before logging with a "hammer" with a code that identifies the forester. Felling unmarked trees reported to be an issue in some ejidos in earlier period, but not currently.	Little to no opportunity for improvement to reduce carbon emissions
Haul Road Corridor Width	Not considered an issue in AATR Chihuahua. However, road erosion is more of an issue	Little to no opportunity for improvement to reduce carbon emissions
Logyard Area	Logyards not used in temperate forests, loading done on secondary forest roads	No opportunity for improvement to reduce carbon emissions
Protection		

11.Riparian buffer zones	Regulations required strips of varying width around permanent and temporary water courses. Appears to be widely observed.	No opportunity for improvement to reduce carbon emissions
12. Agricultural Clearing Buffer Zones*	Agricultural clearings in some forest areas. Some tendencies by farmers to expand areas by girdling trees. Efforts to regulate not clear.	Some opportunity to reduce carbon emissions but difficult since it touches on food security in an area that has experienced food insecurity due to drought.
13.High Conservation Value Forests	Regulations require protection of environmentally sensitive forests. HCV forests have apparently not been well-identified in AATR Chihuahua	Unclear opportunity for improvement to reduce carbon emissions .
14.Steep Slopes	Logging does take place on steep slopes, steeper than called for by regulations. Mitigated by new requirement to leave chopped slash in contours, increasingly practiced	Little to no opportunity for improvement to reduce carbon emissions

15. Corridors	Not mentioned in regulations. Not explicitly taken into account in management programs. Corridors not well-identified in AATR Chihuahuaa. Most logging takes place in forests with contiguous masses of unlogged forests.	Unclear opportunity for improvement to reduce carbon.
Growth		
15, Silvicultural Practices to ensure the regeneration and growth of native trees species and long-term timber production, income and employment	Due to inter-generational values, communities concerned with long-term production, income, and employment. Regulations backed by community norms and culture but mitigated by extreme poverty. Introduction of MDS should accelerate carbon capture by native species. On study found possibilities for increased carbon capture through decreasing intensity of cut and lengthening cutting cycles.	Possible opportunity in reducing intensity of logging and extending rotations, but more intensive silvicultural studies required.

- Item # 12 added for AATR Chihuahua, not present in corresponding table for Sierra Norte AATR

The preliminary conclusion that this study comes to, and the hypothesis for further study, is that there may be some opportunities for IFM activities to reduce or remove GHG emissions in the Chihuahua AATR in three areas:

1) Supporting Type II communities in Guadalupe y Calvo through intensive training to either a) empower them to more closely monitor and supervise the work of contractors in their ejidos, which could bring added value in more efficient logging or b) both training and helping them acquire extraction equipment and move from Type II to Type III, also implying greater community control and capacity in logging processes.
2) Expand training in directional felling in a selection of communities in the AATR, including Type IV communities in Guachochi.
3) Analyzing the opportunities presented by current practices of using animal traction, both horse and oxen, as a low carbon forestry strategy. A survey should be conducted on current magnitude of use of animal traction across the AATR. Carefully designed field studies in a sample of cases to evaluate both the reduction of carbon emissions and the cost savings in comparison with mechanical skidding should then be carried out. Depending on the outcome of these studies, a programs of supporting and expanding animal traction as an innovative "back to the future" low carbon forestry strategy could be carried out.

5. General Conclusions of the Field Survey and IFM Components in the AATRs Oaxaca and Chihuahua.

In this study we have evaluated the management regimes present in Mexican community forestry in Áreas de Acción Temprana REDD+ in Oaxaca and Chihuahua and the potential for reduction of carbon emissions through improved silvicultural and harvesting practices. We have seen that the three levels of the Mexican regulatory framework for forest management and timber harvesting largely corresponds to principles of IFM or RIL-C as laid in multiple publications. The permitting procedures require extensive evidence of planning and careful implementation of the entire logging process. The

magnitude of the Mexican community forestry sector (~2000 CFEs) has also required an official classification of the universe on the basis of vertical industrial integration from communities that sell "on the stump", to those who own some extraction equipment, to those who have sawmills and other advanced processing facilities. These levels of vertical industrial integration or management regimes appear to have some influence on harvesting practices. Mexican silviculture is characterized by one principal uneven-aged method (The Mexican Method for Ordering Irregular Forests-MMOBI) and several variants of an even-aged system (the Silvicultural Development Method). Studies suggest that whether or not an uneven-aged or even-aged system is superior in terms of carbon capture depends greatly on specific practices, the time horizon considered, and the fate of the wood products, so one is not inherently superior to the other. Extending rotations may be an option in either system for increasing carbon capture.

The Sierra Norte has a trajectory of over 30 years of increasingly mature CFEs with some of the leading examples in Mexico, and a predominance of completely vertically integrated Type IV communities, and now including an entrepreneurial alliance between 3 communities that has a national chain of furniture stores. In general, the CFEs in the Sierra Norte AATR appear to be well-organized, have diversified economic bases in the community (including remittances, water bottling, ecotourism, and access to urban occupations in the city of Oaxaca in some cases) and without major social conflicts. Conflicts over boundaries exist, although in only one case do they seriously impact logging, and in another case of boundary conflict, the communities recently agreed to joint logging to address an outbreak of pine bark beetles, Over 70% or higher of the AATR is in forest cover, evenly divided between forests managed for timber and forests under mostly informal community conservation, and studies show no ongoing deforestation in the pine-oak forests and high forest cover and no ongoing deforestation in montane tropical and cloud forests in the AATR. TYPOLOGY AND SILVICULTURAL ACTICES. The approved forest management programs require land use zoning across the entire community territory and the community assembly approves this process. SILVICULTURE. SEMARNAT practices for authorizations in Oaxaca include extensive requirements pertaining to various aspects of these practices. There appears to be virtually no incidence of entire trees being felled as collateral damage, with typical damage being light to moderate and retracted to

scraping of trunks and damage to branches. Skidding is carried out with monocables mounted on trucks and skid trails generally appear to be more than allowed for regulations and to be relatively low impact. Manual skidding is used on some uphill slopes and other harvest practices are also reasonably good, There is evidence that harvest practices in the Sierra Norte AATR have improved in the last decade and there appears to be little opportunity to achieve significant further reductions in carbon emissions through improved practices. Opportunities for improvement would appear to be concentrated in the few Type II communities in the Sierra Norte.

The Chihuahua AATR presents much different conditions. Forest communities in the southern Sierra Tarahumara, site of the AATR, have on average much larger territories, larger, poorer and more ethnically diverse populations and much less productive forests, due to lower rainfall, colder winters and possibly historical overharvesting. Most communities are ejidos, but almost all have varying percentages of indigenous peoples who are members. Five of the 17 communities sampled have boundary conflicts, but none appear to affect timber harvesting. FSC certification is historically underdeveloped, with only two communities having been certified in the 2000s, but six more are in the process of being certified. The Chihuahua communities are very poor, and the poverty impacts forest management, since no profits are invested in the forest, and there is widespread grazing of livestock in the forest. There is a substantial dependence on forestry as virtually the only source of cash income in most of the ejidos, with 14 of 17 in the sample reporting as the primary source of income. Subsistence agriculture and livestock raising are practiced by most community members. Until 2012-2013 the uneven-aged MMOBI was the only silvicultural system practiced but in that year a Conafor-Semarnat program has begun requiring the use of MDS. As in Oaxaca, the forest management programs require land use zoning in the entire territory, and the community assembly approves the management programs and their elected leadership represents them in interactions with government agencies.

In the entire AATR, Type II roundwood production communities predominate, with 38 Type IIs, 7 Type IIIs and 14 Type IVs. However, the Type IV communities are concentrated in Guachochi (9 of 17) while the less-organized Type II communities are concentrated in Guadalupe y Calvo (22 of 31). The

UMAFOR Guadalupe y Calvo reports problems with felling, skidding, changes in forest density, construction and maintenance of roads, inadequate disposal of slash and inadequate carrying out of logging, with these problems likely concentrated in the numerous Type II communities. A review of forest management plans suggest very high amounts of detail in planning and a transition to greater use of MDS is taking place. Interviewed foresters suggested few problems with felling, skidding and hauling but direct forest observations found more issues problems in 2 of the 5 communities surveyed. Issues observed including poor use of directional felling, anchoring winches to unprotected trees resulting in damage, and other poor logging practices, both in Type IV communities in Guachochi. An unusual skidding practice in Chihuahua is the still widespread, but unquantified use of animal traction (known locally as *troncos*), principally by horses but in some cases by oxen. In the sample of 17, 10 use both motorized winches and *troncos* and one used exclusively *troncos*. *Troncos* are cheaper than mechanized skidding, generate more employment and have less impact on the forest. Leaving slash in contours is a relatively new practice in the AATR, but is now being more widely introduced as an element in MDS.

With this background, our final recommendations are:

- In the Sierra Norte AATR, there appear to be few opportunities for improved forest management that could substantially reduce carbon emissions. Silvicultural and harvest practices are generally well-managed. While room for improvement certainly exists, it appears to be unlikely to be sufficient to warrant further investment. What opportunities exist may be in the few Type II communities.
- In the Sierra Norte AATR, extending rotations could be a practice that could result in reduction of carbon emissions from logging in general. Currently, only about 70% of the authorized volume is harvested over the last ten years across the AATR. This is due to conservation decisions, disorganization, untimely arrival of logging permits, and the advent of the rainy season, and we did not ascertain the exact proportion of reasons. The degree to which the current 70% is a baseline depends on the exact reason for not harvesting, but it also suggests that further reductions could be feasible if the price of carbon competed with the price of

timber. However, mechanisms would have to be in place to assure that the reduction in harvest does not reduce employment in the community, since this is a primary goal of the CFEs.

- In the Chihuahua AATR, there may be opportunities to reduce emissions from harvest practices through supporting Type II communities, particularly in Guadalupe y Calvo, to either a) more closely supervise and participate in some aspects of logging carried out by contracts or b) acquire extraction equipment and training that would allow them to exert greater control over the harvest process and make the transition from Type II to Type III.
- In the Chihuahua AATR, carry out a more extensive study of carbon impacts of harvesting and expand training in directional felling, skidding, and other harvest practices to Type IV communities in Guachochi.
- In the Chihuahua AATR, possibly the most interesting and promising avenue to reduce carbon emissions from a range of harvest practices, from the use of equipment to direct harvest impacts, is the use of animal traction as an important element in the future of low carbon forestry in the region. It is suggested that a more extensive study of why and where communities currently use animal traction, its harvest impacts, costs, and reductions of emissions from technological substitution (animal traction for gasoline-powered winches). .

In sum, we find forest management practices in the studied Mexican AATRs to not have the serious harvesting impacts found in Indonesia. The Mexican regulatory process is quite rigorous, some would say overregulated, but nonetheless provides a firm foundation for already-improved forest management. As with any regulatory framework, adherence to the rules is variable, but decades of experience in forest management in all of the communities, combined with community governance and self-interest as well as periods of technical assistance and training, suggest that implementation of silvicultural and harvest practices are generally in alignment with the regulatory process.

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Appendix I: Study Universe and Samples for Oaxaca AATRS (Mixteca and Sierra Norte) and Chihuahua AATRs

The first table below shows the entire universe of communities with logging permits in the Mixteca is shown below. Administratively, Santa Cruz Itundujia is actually in the "Costa" Region, but it is here included because they are Mixtec peoples and for some government and NGO programs are considered to be in the Mixteca. However, as noted in the text, only two of these communities, Santiago Yosundua and Santa Catarina Cuanana (highlighted in yellow), are actually in the Mixteca AATR. Santiago Yosundua is not currently exercising its management plan for conservation reasons, leaving only Santa Catarina Cuanana, which has only been logging one year. For that reason, we do not include in the Mixteca AATR in the analysis in the text. However, information on all of the active logging permit communities is in the AMREDD+ Mixteca-Sierra Norte IFM database.

Appendix II: Table I Communities with Logging Permits in the Mixteca. Communities highlighted in yellow are in the Mixteca AATR				
	AÑO EMITIDO	PREDIO	MUNICIPIO	STATUS OF MANAGEMENT PLAN
1	2012	SANTA CRUZ ITUNDUJIA	Santa Cruz Itundujia	Currently exercising management plan
2	2006	SAN ESTEBAN ATATLAHUCA	San Esteban Atatlahuca	Currently exercising management plan
3	2009	SAN MIGUEL EL GRANDE	San Miguel el Grande	Has only exercised one year (2011-2012) of management plan begun in 2008
4	2011	SANTIAGO YOSUNDUA	Santiago Yosundua	Not exercising management program for conservation reasons
5	2006	SAN ANDRES NUXINO	San Andres Nuxino	Currently exercising management plan
6	2011	SAN JUAN TAMAZOLA	San Juan Tamazola	Not exercising management program due to internal conflicts
7	2011	SAN PEDRO MARTIR YUCUXACO	San Pedro Martir Yucuxaco	Not exercising management program due to internal conflicts
8	2011	MIER Y TERAN	San Esteban Atatlahuca	Exercise one year (2011-2012) wont harvest again
9	2012	SANTA CATARINA CUANANA	Santiago Yosundua	Currently exercising management plan. In first year 2012-2013.
10	2012	SAN MIGUEL ACHIUTLA	San Miguel Achiutla	Not exercising management program for conservation reasons

11	2006	SANTIAGO NUNDICHE	Santiago Nundiche	Not exercising management program for conservation reasons

C.

Table II (Appendix I) below shows the universe of communities with logging permits in the Sierra Norte AATR. One additional community, San Isidro Lagunas, does not appear on the list since it has not exercised its permits since its granting in 2006 due to internal conflicts.

Appendix I-Table II-Communities in the Sierra Norte AATR with Logging Permits

ID del Predio	AÑO EMITIDO	PREDIO	MUNICIPIO	STATUS OF MANAGEMENT PLAN
1	2003	CAPULALPAM DE MENDEZ	CAPULALPAM DE MENDEZ	Currently Exercising Mangement Plan
2	2006	IXTLAN DE JUAREZ	IXTLAN DE JUAREZ	Currently Exercising Mangement Plan
3	1999	PUEBLOS MANCOMUNADOS	STA. CATARINA LACHATAO, STA. MARIA YAVESIA Y SANTIAGO AMATLAN	Currently Exercising Mangement Plan
4	2012	SAN FRANCISCO LA REFORMA	SAN PEDRO YOLOX	Currently Exercising Mangement Plan
5	2009	SAN JUAN LUVINA	SAN PABLO MACUILTIANGUIS	Currently Exercising Mangement Plan
6	2004	SAN MIGUEL ALOAPAM	SAN MIGUEL ALOAPAM	Currently Exercising Mangement Plan

7	2007	SAN PABLO MACUILTIANGUIS	SAN PABLO MACUILTIANGUIS	Currently Exercising Mangement Plan
8	2007	SANTA MARIA JALTIANGUIS	SANTA MARIA JALTIANGUIS	Currently Exercising Mangement Plan
9	2004	SANTIAGO COMALTEPEC	SANTIAGO COMALTEPEC	Currently Exercising Mangement Plan
10	2006	SANTIAGO XIACUI	SANTIAGO XIACUI	Currently Exercising Mangement Plan
11	2011	SAN JUAN TABAA	SAN JUAN TABAA	Currently Exercising Mangement Plan
12	2013	SAN JUAN EVANGELISTA ANALCO	SAN JUAN EVANGELISTA ANALCO	Currently Exercising Mangement Plan
13	2008	SAN ANDRES YATUNI	SANTIAGO XIACUI	Currently Exercising Mangement Plan
14	2000	SAN JUAN TEPANZACOALCO	SAN PEDRO YANERI	Currently Exercising Mangement Plan
15	2003	LA TRINIDAD IXTLAN	SANTIAGO XIACUI	Currently Exercising Mangement Plan
16	2005	SAN JUAN BAUTISTA ATEPEC	SAN JUAN BAUTISTA ATEPEC	Currently Exercising Mangement Plan
17	2005	SAN MARTIN BUENAVISTA	SAN PEDRO YOLOX	Currently Exercising Mangement Plan

18	2009	SANTA CATARINA IXTEPEJI	SANTA CATARINA IXTEPEJI	Currently Exercising Mangement Plan
19	2005	ZONA 1 SAN ISIDRO EL CARRIZAL	SAN PEDRO YOLOX	Currently Exercising Management Plan

Table III below shows the sampled communities in the Sierra Norte AATR. 15 of nineteen communities were sampled for the community leader survey, 8 of 19 for the forest engineer survey, and 8 of 19 for the forest observations survey.

Appendix I-Table III-Samples in the Sierra Norte AATR

ID del Predio	Comunidad	Community Leader Survey	Forest Engineer Survey	Direct Observations
1	CAPULALPAM DE MENDEZ	X		
2	IXTLAN DE JUAREZ	X	X	X
3	PUEBLOS MANCOMUNADOS			
4	SAN FRANCISCO LA REFORMA			
5	SAN JUAN LUVINA			
6	SAN MIGUEL ALOAPAM	X		
7	SAN PABLO MACUILTIANGUIS	X		
8	SANTA MARIA JALTIANGUIS	X	X	X
9	SANTIAGO COMALTEPEC	X		
10	SANTIAGO XIACUI	X		
11	SAN JUAN TABAA	X		X
12	SAN JUAN EVANGELISTA ANALCO	X	X	X
13	SAN ANDRES YATUNI	X	X	X
14	SAN JUAN TEPANZACOALCO		X	
15	LA TRINIDAD IXTLAN	X	X	X

16	SAN JUAN BAUTISTA ATEPEC	X		
17	SAN MARTIN BUENAVISTA	X	X	X
18	SANTA CATARINA IXTEPEJI	X		
19	ZONA 1 SAN ISIDRO EL CARRIZAL	X	X	X

Table IV below shows the study universe for the Chihuahua AATR.

Appendix II-Table IV Study Universe for Chihuahua

ID del Predio	Nombre del Predio	Municipio	Status
1	HUAZARACHI	BALLEZA	Management Plan Active
2	LAS DELICIAS Y ANEXOS	BALLEZA	Management Plan Active
3	TECORICHI	BALLEZA	Management Plan Active
4	MUNERACHI Y ANEXOS	BATOPILAS	Management Plan Active
5	QUIRARE	BATOPILAS	Management Plan Active
6	YOQUIVO	BATOPILAS	Management Plan Active
7	ABOREACHI	GUACHOCHI	Management Plan Active
8	AGUA ZARCA	GUACHOCHI	Management Plan Active
9	CABORACHI	GUACHOCHI	Management Plan Active
10	CIENEGUITA DE SINFOROSA	GUACHOCHI	Management Plan Active
11	GUACHOCHI Y SUS ANEXOS RANCHO SECO Y RANCHERIA OCHOCACHIC	GUACHOCHI	Management Plan Active
12	LA SOLEDAD Y ANEXOS	GUACHOCHI	Management Plan Active
13	NOROGACHI	GUACHOCHI	Management Plan Active
14	OTOVACHI	GUACHOCHI	Management Plan Active
15	PAPAJICHI	GUACHOCHI	Management Plan Active

16	ROCHEACHI	GUACHOCHI	Management Plan Active
17	SAMACHIQUE	GUACHOCHI	Management Plan Active
18	SANTA ANITA	GUACHOCHI	Management Plan Active
19	SEHUERACHI	GUACHOCHI	Management Plan Active
20	TETAHUICHI	GUACHOCHI	Management Plan Active
21	TONACHI	GUACHOCHI	Management Plan Active
22	TUCEROS	GUACHOCHI	Management Plan Active
23	ALICITOS	GUADALUPE Y CALVO	Management Plan Active
24	BABORIGAME	GUADALUPE Y CALVO	Management Plan Active
25	BARBECHITOS	GUADALUPE Y CALVO	Management Plan Active
26	BUENAVISTA	GUADALUPE Y CALVO	Management Plan Active
27	CIENEGA PRIETA Y ANEXOS	GUADALUPE Y CALVO	Management Plan Active
28	CINCO LLAGAS Y SUS ANEXOS	GUADALUPE Y CALVO	Management Plan Active
29	COLORADA DE LOS CHAVEZ	GUADALUPE Y CALVO	Management Plan Active
30	CRUZ DE PIEDRA	GUADALUPE Y CALVO	Management Plan Active
31	CHINATU	GUADALUPE Y CALVO	Management Plan Active
32	DOLORES	GUADALUPE Y CALVO	Management Plan Active
33	EL NOPAL	GUADALUPE Y CALVO	Management Plan Active
34	EL NOPAL	GUADALUPE Y CALVO	Management Plan Active
35	EL PINITO	GUADALUPE Y CALVO	Management Plan Active
36	EL TRIGO	GUADALUPE Y CALVO	Management Plan Active
37	EL TULE Y PORTUGAL Y SUS ANEXOS RANCHO DE ROCHA, EL FRESNO,	GUADALUPE Y CALVO	Management Plan Active

38	EL VENADITO	GUADALUPE Y CALVO	Management Plan Active
39	GALEANA	GUADALUPE Y CALVO	Management Plan Active
40	LA CATEDRAL Y SUS ANEXOS	GUADALUPE Y CALVO	Management Plan Active
41	LA TRINIDAD Y SUS ANEXOS, CHICORIMPA, LA CIENEGUITA, RANCHO	GUADALUPE Y CALVO	Management Plan Active
42	LAGUNA DE LOS CANO	GUADALUPE Y CALVO	Management Plan Active
43	LLANO BLANCO U OJO FRIO	GUADALUPE Y CALVO	Management Plan Active
44	LLANO DEL SALADO	GUADALUPE Y CALVO	Management Plan Active
45	LLANO GRANDE Y ANEXOS	GUADALUPE Y CALVO	Management Plan Active
46	NABOGAME Y ANEXOS	GUADALUPE Y CALVO	Management Plan Active
47	PINO GORDO	GUADALUPE Y CALVO	Management Plan Active
48	REDONDEADOS Y SUS ANEXOS	GUADALUPE Y CALVO	Management Plan Active
49	SAN IGNACIO DE LA CIENEGUILLA	GUADALUPE Y CALVO	Management Plan Active
50	SAN JUAN NEPOMUCENO	GUADALUPE Y CALVO	Management Plan Active
51	SAN SIMON	GUADALUPE Y CALVO	Management Plan Active
52	SANTA ROSA	GUADALUPE Y CALVO	Management Plan Active
53	SANTA RITA Y ANEXOS	GUADALUPE Y CALVO	Management Plan Active
54	HUMARIZA	NONOAVA	Management Plan Active
55	HUMARIZA	NONOAVA	Management Plan Active
56	CIENEGUITA DE BARRANCA	URIQUE	Management Plan Active
57	CORAREACHI	URIQUE	Management Plan Active
58	CORONADO O GUADALUPE CORONADO	URIQUE	Management Plan Active
59	GUAGUEYBO	URIQUE	Management Plan

			Active

Table V below shows the sampled communities for the Chihuahua AATR. Seventeen of 59 communities were sampled both for community leaders and forest engineers, while 5 direct observations were made in the forest.

Appendix I-Table V-Communities Sampled in the Chihuahua AATR				
ID del Predio	Comunidad	Community Leader Survey	Forest Engineer Survey	Direct Observations
6	YOQUIVO	X	X	X
7	ABOREACHI	X	X	
8	AGUA ZARCA	X	X	X
9	CABORACHI	X	X	
11	GUACHOCHI Y SUS ANEXOS RANCHO SECO Y RANCHERIA OCHOCACHIC	X	X	X
15	PAPAJICHI	X	X	
17	SAMACHIQUE	X	X	X
22	TUCEROS	X	X	
24	BABORIGAME	X	X	
25	BARBECHITOS	X	X	
30	CRUZ DE PIEDRA	X	X	X
31	CHINATU	X	X	
35	EL PINITO	X	X	
40	LA CATEDRAL Y SUS ANEXOS	X	X	
41	LA TRINIDAD Y SUS ANEXOS, CHICORIMPA, LA CIENEGUITA, RANCHO	X	X	
50	SAN JUAN NEPOMUCENO	X	X	
58	CORONADO O GUADALUPE CORONADO	X	X	

Appendix II-Surveys Used in the Research

As noted in the text, five data capture instruments were used in the research. The first two data capture instruments, for collecting information from the logging permit files and for data from government databases, were created in excel spreadsheets to facilitate capture. These spreadsheets are available in the supplementary documentation submitted with this report. The three additional surveys, for interviews with community authorities (*comisariados*), forest engineers, and direct observations in the forest are found below.

Proyecto: "Diagnóstico comunidades forestales dentro de la AATR Chihuahua"
The Nature Conservancy/Rainforest Alliance
(David Bray/ Elvira Durán/Ivan Grijalva)

ENTREVISTA CON COMISARIADOS

Gracias por la oportunidad de concedernos esta entrevista. La entrevista tiene el propósito de recoger datos básicos sobre su comunidad y los bosques que aquí se aprovechan. La idea es obtener una visión de cómo podría ser posible una modificación de esas prácticas para aumentar los acervos de carbono forestal o, en su caso, reducir las emisiones de las prácticas silvícolas. El proyecto está apoyado por la ONG The Nature Conservancy, quien es financiado por la Agencia para el Desarrollo Internacional del gobierno de los Estados Unidos (USAID), y que a su vez trabaja en colaboración con la Comisión Nacional Forestal (CONAFOR). Se busca integrar un diagnóstico que ayude para eventualmente implementar el programa del llamado REDD+ (reducción de emisiones por deforestación y degradación), el cual podría operar como un programa de pago servicios ambientales por captura de carbono. Su colaboración es voluntaria, por tanto no tiene que responder a todas las preguntas, pero si está de acuerdo en responder se agradece su apoyo. Con la idea de poder hacer los apuntes de lo que nos diga, de manera más precisa, le pregunto si me permite grabar la entrevista?

Fecha: _____ Entrevistador:

_____

I. DATOS GENERALES

1. Nombre del Comisariado: _____ Teléfono: _____
Correo: _____

2. Nombre del Núcleo Agrario (Ejido/Comunidad): _____

5. Existen conflictos sobre linderos: Sí____ No____ 6. Número de lugares del predio con conflictos:
_____

Conflicto 1:

7. Nombre del paraje: _____ 8. Área en disputa (ha): _____ 9. Es de Vocación Forestal? Sí____ No____

10. Describir brevemente el problema:
_____
_____
_____
_____

Conflicto 2:

11. Nombre del paraje: _____ 12. Área en disputa (ha): _____ 13. Es de Vocación Forestal? Sí____ No____

14. Describir brevemente el problema:
_____
____
_____
_____

Conflicto 3:

15. Nombre del paraje: _____ 16. Área en disputa (ha): _____ 17. Es de Vocación Forestal? Sí____ No____

18. Describir brevemente el problema:
_____
____
_____
_____

II. DATOS SOCIALES

19. Cuantos comuneros/ejidatorios hay en el padrón (#)?_____ 20. Pertenece a alguna etnia: Sí____ No____

21. Cuál? _____ 22. Qué % de habitantes son hablantes de la lengua indígena: _____

23. Cuantos comuneros/ejidatarios son residentes en la comunidad (#): _____

24. Cuantos comuneros/ejidatarios viven fuera (#): _____ 25. Calcular %: _____26. Viven fuera de manera pemanentement? Si___No____

27. Cuantos hijos de comuneros (y otros posesionarios) hay?_____ 28. Cuantos hijos(as) de comuneros viven fuera (#): _____

29. La migración de los comuneros es mayormente a (indicar ciudad, estado o país): _____

30. En los últimos 3 años, hay gente que está llegando a vivir a la comunidad? Sí____ No____

31. Si es de manera temporal a qué se dedica? _____ 32. Si es de manera permanente a qué se dedica? _____

III. USO DE SUELO

33. El bosque bajo manejo es parcelado? Si_____No_____. 34. El bosque no manejado es parcelado? Si_____No_____

35. Hay Agricultura comercial: Sí____ No____ 36. En que superficie (ha): _____ 37. Tipo(s) de agricultura comercial: _____

37ª. ¿Hay problemas con la expansión de los claros para agricultura? La gente están cinchando los arboles para ampliar los
claros?_____
_____
_____

38. Hay pastizales: Sí____ No____ 39. En que superficie (ha): _____ 40. Indicar tipo de ganado hay en la comunidad: _____

41. Cuantas cabezas de ganado hay en la comunidad: _____

42. Aprovechan productos no-maderables **con permiso**? Sí____ No____ 43. En qué superficie (ha): _____

44. Qué tipo de productos no-maderables se están aprovechando: _____

45. Aprovechan productos no-maderables **de manera informal**? Sí____ No____ 46. En qué superficie (ha):

_____

47. Qué tipo de productos no-maderables se están aprovechando informalmente:
_____

IV.DATOS ECONÓMICOS

Fuentes principales de ingresos en la comunidad (*Posiblemente van a decir "agricultura", pero hay que enfatizar que se trata de ingresos monetarios, y también pedirles sobre la importancia de programas del gobierno (oportunidades, procampo, etc))*:

50.¿Cuál es la fuente de ingreso **más importante**?_____ 51. ¿Cuál es **la segunda** fuente de ingresos más importante?_____

52. ¿Cuál es **la tercera** fuente de ingresos más importante en los hogares?_____

53. ¿Cuántos comuneros/ejidatarios trabajan en la empresa forestal? _____

53ª Por Cuantos meses al año?_____

54. ¿Cuantos ciudadanos o avecindados trabajan en la empresa forestal de la comunidad? _____

55. ¿Cuántas personas de otras comunidades trabajan en la empresa forestal? _____

56. ¿Cuántos comuneros/ejidatarios tienen milpa?_____ 57. ¿Cuantos comuneros tienen cultivos comerciales? _____

58. ¿Cuantos comuneros tienen abejas/colmenas?_____ 59. ¿Cuantos comuneros/ejidatarios se dedican a trabajar los productos no maderables? _____

60. ¿Cuantos comuneros/ejidatarios tienen ganado?_____ 61. ¿Cuantos comuneros reciben remesas o envíos de dinero? _____

62. ¿Existen utilidades anuales por la venta de madera? Sí___ No___ 63. Su hay utilidades, estas se distribuyen por: Reparto (%)_____/ Fondo comunal %_____/ Otros fines %_____

V.PAGO DE SERVICIOS AMBIENTALES Y OTROS APOYOS

64. ¿El núcleo agrario ha tiene un contrato de servicios ambientales con CONAFOR?
Si_____No_____

65. De ser sí, qué tipo de pago recibe?: Hidrológicos_____ Biodiversidad_____
Carbono_____Agroforestal_____

66. ¿Cómo se utilizan los recursos económicos de los servicios ambientales en la comunidad?
_____

_____
_____

67. El núcleo agrario recibe otros apoyos de CONAFOR? Sí ___ No____ 68. Si la respuesta es sí, indicar cuáles? _____

69. El núcleo agrario recibe apoyos de alguna ONG para aspectos forestales o de conservación? Sí ___ No____

70. Si la respuesta es afirmativa, indicar nombre de la ONG: _____ 71. Explicar brevemente que tipo de apoyo que da a la comunidad:_____
_____
_____
_____
_____

72. El núcleo agrario recibe apoyos de otras dependencias de gobierno para aspectos forestales o de conservación? Sí ___ No____

73. Si la respuesta es afirmativa, indicar nombre de la dependencia: _____

74. Indicar brevemente que tipo de apoyo da esa dependencia a la comunidad:
_____

VI. EMPRESA FORESTAL

75. La comunidad vende madera? Sí ___ No____ 76. Si la respuesta es sí, indicar como se vende:

a) A pide de árbol (*tipo II de CONAFOR*) b) A pie de camino(*tipo III de CONAFOR*) c)Aserrada (*tipo IV de CONAFOR*)

77. La comunidad tiene aserradero: Sí ___ No____ 78. El aserradero pertenece a la comunidad? Sí ___ No____

79. El aserradero está dentro del núcleo agrario? Sí ___ No____ 80. Hay otros aserradero dentro del núcleo agrario? Sí ___ No____

81. ¿Qué porcentaje se vende %_____ 82. ¿Qué porcentaje vende de madera en rollo? %____

83. ¿Qué parte se vende aserrada Sí ___ No___ %_____

84. ¿Madera para pulpa u otros fines? 85. ¿A quién se vende la madera? _____

86. Hay alguna venta a nivel internacional? Sí ___ No____ 87. Si la respuesta es sí, describir brevemente: _____

VIa. Extraccion_

A. ¿El ejido usa troncos (animales) en la extracción? Si_____No_____

B. ¿Si es si, cuantos troncos se utilizan en el arrime? _____

C. ¿Que porcentaje del volumen esta sacado con troncos?_____

D. ¿Cuantas gruas se utilizen en el arrime? _____

E. ¿ Se ha disminuido el uso de gruas en los últimos años a favor de los troncos? En que porcentaje?_____Comentarios_____
_____
_____
_____
_____

D. ¿Que ventajas tengan los troncos sobre las gruas?
_____
_____
_____
_____
_____

88. ¿Ha habido infracciones de PROFEPA a la comunidad Sí ___ No____ 90. Si la respuesta es sí, describir brevemente:
_____
_____

91. El núcleo agrario tiene ordenamiento territorial comunitario (OTC)? Sí ___ No____

92. ¿De no existir un OTC ahora, su elaboración ya está en proceso? Sí ___ No____ 93. ¿De no existir, piensan realizar un OTC? Sí ___ No____

VII. ORGANIZACIÓN/ESTRUCTURA DE LA EMPRESA FORESTAL

94. Si el bosque este parcelado, como se organiza el aprovechamiento?
Describir_____
_____
_____

95. Hay grupos de trabajo en el ejido (O sea, el aprovechamiento ya no es comunal)?
Si_____No_____ De ser si, como se organiza el aprovechamiento?
Describir_____
_____
_____

96. Tomando en cuenta la respuesta arriba, quien administra la empresa forestal de la comunidad?:

a) El Comisariado b) Un Comité elegido en Asamblea c) Un gerente profesional d) Alguna combinación de lo anterior (describir)

97. Describa brevemente como está organizada la Empresa Forestal si no esta cubierto arriba:
_____
_____
_____

VIII SOBRE EL VIVERO y Manejo de Incendios

98. ¿Tienen vivero? Sí ___ No____ 99. Si la respuesta es sí, podría indicar el promedio de producción anual de planta en el vivero?_____

100. ¿De dónde obtienen la semilla para el vivero? Compran / Colectan

101. Describa las estrategias utilizadas para evitar e impedir la expansión de incendios forestales?
_____
_____

102. ¿Se ha capacitado a comuneros/ejidatarios para el manejo del fuego? Sí ___ No___ 102. En caso afirmativo, quien les ha capacitado? _____

XI. PROBLEMAS Y RETOS PARA APROVECHAMIENTO DEL BOSQUE

103. En su opinión, ¿Cuáles son los obstáculos que ha enfrentado la comunidad para aprovechar y vender la madera? _____
_____
_____

104. ¿Cómo los han ido superando?
_____
_____
_____
_____

105. En su opinión, ¿Existe algún tipo de presión para reducir la superficie de bosque por otro uso del suelo dentro del predio? Sí ___ No___
106. Indicar cuál?
_____
_____

107. ¿Existen conflictos dentro de la comunidad relacionados con el aprovechamiento forestal? Sí ___ No___

108. Si la respuesta es sí, considera que los conflictos son: grave_____ no muy grave_____ no es grave o relevante _____

109. ¿Podría explicar en qué consisten esos conflictos?
_____
_____
_____

¡¡¡¡GRACIAS!!!!

Proyecto de Carbono Forestal-The Nature Conservancy/Rainforest Alliance

(David Bray/ Elvira Durán/Ing. Ivan Grijalva)

ENTREVISTA CON EL PRESTADOR DE SERVICIOS TÉCNICOS

Gracias por la oportunidad de concedernos esta entrevista. La entrevista tiene el propósito de recoger datos básicos sobre el programa de manejo silvícola en la comunidad a su cargo como prestador de servicios técnicos. La idea es obtener una visión de cómo podría ser posible una modificación de esas prácticas para aumentar los acervos de carbono forestal o, en su caso, reducir las emisiones de las prácticas silvícolas. El proyecto está apoyado por la ONG The Nature Conservancy, quien es financiado por la Agencia para el Desarrollo Internacional del gobierno de los Estados Unidos (USAID), y que a su vez trabaja en colaboración con la Comision Nacional Forestal (CONAFOR). Se busca integrar un diagnóstico que ayude para eventualmente implementar el programa del llamado REDD+ (reducción de emisiones por deforestación y degradación), el cual podría operar como un programa de pago servicios ambientales por captura de carbono. Su colaboración es voluntaria, por tanto no tiene que responder a todas las preguntas, pero si está de acuerdo en responder se agradece su apoyo. Con la idea de poder hacer los apuntes de lo que nos diga, de manera más precisa, le pregunto si me permite grabar la entrevista?

Fecha: _____ Comunidad/Ejido: _____

DATOS DE REFERENCIA DEL PRESTADOR DE SERVICIOS TECNICOS

Nombre del Prestador: _____
Dirección: _____
_____
Correo electrónico: _____ Tel:_____

1. ¿Desde cuándo Ud. ha sido prestador de servicios técnicos de la comunidad/ejido?
   _____

1b. Confirmar tipología conafor (I, II, III, IV) y especificar equipo que tienen._____
_____
_____

PREGUNTAS SOBRE EL MANEJO FORESTAL

(Se desea documentar los procesos de planeación, aprobación y ejecución del aprovechamiento de madera)

2. ¿Me podría describir como eran las condiciones del bosque al inicio del ciclo de corta?

3. ¿Me podrías describir como se hizo el inventario?

4. ¿Cómo se determinó el método silvícola a emplear (indicar si éste va a ser para bosques regulares o irregulares, y porqué)?

4ª. ¿Si el método silvícola es de selección (MMOBI) se practica el entresaca?

5. ¿En el caso de este ejido, cómo se determinó o definió el área que conforma los diferentes rodales/unidades mínimas de manejo del plan de manejo?

6. ¿Qué características deben tener los árboles que van a ser marcado?

7. ¿Cómo se marcaron los arboles a extraerse?

8. ¿Cómo es la orografía en la comunidad?

9. ¿Cómo influye la orografía en el establecimiento de rodales?

10. ¿Cómo influye la orografía en las estrategias de extracción de los troncos?

11. ¿Quien supervisa el aprovechamiento de madera en el ejido?

12. En caso de ser el ejido, favor de describir cómo se organiza la gente para hacer la supervisión?

13. Se practica el derribo direccional? Si_____No_____Podría describir el proceso de derribo en el ejido?

14. ¿Típicamente, o a veces, hay daño colateral con el derribo de árboles durante el proceso de extracción? SI_____No_____Qué tipo de daño se nota)?

15. ¿Cómo se diseñan las carriles de arrime (como se decide donde se ponen)?

16. ¿Qué tan anchas y largas son las carriles de arrime?

17. ¿Qué equipo se usa para extraer los rollos del lugar del derribo?

18.a ¿El ejido usa animales de tracción (troncos)? Si_____No_____ De ser si, donde se usa y porque?

18 b. ¿Se puede decir que porcentaje del volumen esta sacado con troncos?

18c. ¿Se nota menos daño al bosque con el uso de la tracción animal?

18d. ¿ Existe en el ejido una tendencia de dejar el uso de gruas en favor de los troncos?

19. Si el ejido no cuenta con equipo, entonces indique quién es el dueño del equipo?

20. ¿Describa cómo se diseñan los caminos secundarios?

20ª. ¿ Existe erosion en caminos? Si_____No_____

20b. ¿ De existir erosion en los caminos, se califica como ligero_____Mediano_____Fuerte_____?

21. ¿Cuáles son los disturbios naturales típicos en los bosques de esta ejido?

22. En general, Ud. Cree que el proceso de extracción en el ejido hace danos importantes al bosque? Si_____No_____Si es si, describir los danos.

23. ¿En qué porcentaje de las áreas intervenidas realizan reforestaciones y en qué porcentaje son regeneración natural?

24. Para Ud, cual es el reto más grande que se enfrenta en la elaboración del programa de manejo en este ejido?

25. Ud. Podría comentar si existe tala ilegal en el ejido y como se hace?

26. Preguntar que de no encontrar volúmenes ejercidos por los últimos 10 años en los expedientes en SEMARNAT si podamos volver a pedir esos datos?

CONFIRMAR DATOS DEL COMISARIADO

Nombre del Comisariado: _____
Dirección: _____
_____
Correo electrónico: _____ Tel:_____

DATOS DEL TÉCNICO FORESTAL Del EJIDO

Nombre del Técnico Forestal: _____
Dirección: _____
_____
Correo electrónico: _____ Tel:_____

PROYECTO
Comunidades Forestales y Mejoramiento del Manejo Forestal en México
(TNC-MREDD+; AATR Chihuahua

Formato para observaciones dentro del bosque.

Comunidad_____

Entrevistador_____

Fecha_____

¿Quienes se acompañaron y respondieron durante la visita al bosqueó y respondió durante la visita?

_____

_____

_____

Nota: se debe intentar hacer las observaciones en el rodal mas reciente posible. De preferencia **2012-2013**, pero otro recién si no es posible visitar lo mas reciente

1. Distancias aproximadas desde la comunidad a las áreas de aprovechamiento forestal.

2. Daños observados en el sitio por el derribo de árboles.

a) Ninguno b) bajo c) medio d) alto

Nota (Describir los daños observados)

3. Características del carril de arrime.
(Datos de pendiente, topografía del terreno, entre otros)

4. ¿Qué impactos se generan por los carriles de arrime?

5. ¿Qué tratamientos posteriores se aplican sobre los carriles de arrime para disminuir los impactos generados?

6.a Se aplica curvas de nivel después del aprovechamiento?

6. ¿Qué equipo se utiliza para la extracción de la madera?

7. ¿En qué porcentaje de las áreas intervenidas realizan reforestaciones y en qué porcentaje son regeneración natural?

8. Observaciones generales dentro del área visitada donde se realizó el aprovechamiento. Observaciones del impacto de la técnica silvícola utilizado.

9. Visitar rodal de 2010 o un año cercano. Hacer la observación si la regeneración es a) buena b) regular c) no muy buena.

Appendix III: Guide to the Databases

The associated databases presented with this narrative report are in two spreadsheets, one for the Oaxaca AATRs (AMREDD+ Bray-Duran Oaxaca AATR database) and one for the Chihuahua AATR (AAMREDD+Bray-Duran Chihuahua AATR database). Each of the spreadsheets is organized into a series of tabs on different subjects. The structure of the databases and their characteristics are presented in the table below. There are 8 tabs in each database: 1) *Resumen General del Predio (General Summary of the Agrarian Community; 2. Resumen General del PMFA (General Summary of the Programa de Manejo Forestal Autorizado; 3.Volumen Autor vs Aprovecha (Authorized Volume vs Logged Volume); 4.Cuantificacion de Superficies (Quantification of Community Territory); 5. Forest Engineer Interviews; 6.Comisariado Interviews; 7.Forest Observations; 8.Government Data (from census and other official government sources).* The number of cases, simple size if not entire universe, and the nature of the data (quantitative or qualitative). There is a unique agrarian community identification number which is the same across all tabs for each state. For Oaxaca, there is data for the Mixteca AATR only for the first four tabs for the 6 communities in the entire Mixteca. As noted in the Methods and Database section of the report, there is only forest management community in the Mixteca AATR which has been logging for only one year, so we did not compile information for the last 4 tabs.

Table: Structure of the Oaxaca and AATR databases

Tabs	*AMREDD+ Bray-Duran Oaxaca AATR database*			*AMREDD+ Bray-Duran Chihuahua AATR database*		
	Number of Cases	*Entire universe or sample*	*Nature of Data*	*Number of Cases*	*Entire universe or sample*	*Nature of Data*
1. Resumen General del Predio (General Summary of the	Mixteca (6); Sierra Norte	Entire Universe	Quantitative	59	Entire Universe	Quantitative

Agrarian Community	(19)					
2. Resumen General del PMFA (General Summary of the Programa de Manejo Forestal Autorizado	Mixteca (6); Sierra Norte (19)	Entire Universe	Quantitative (almost all numbers	59	Entire Universe	Quantitative (almost all numbers
3.Volumen Autor vs Aprovecha (Authorized Volume vs Logged Volume)	Mixteca (6); Sierra Norte (19)	Entire Universe	Quantitative (almost all numbers	59	Entire Universe	Quantitative (almost all numbers
4.Cuantificacion de Superficies (Quantification of Community Territory)	Mixteca (6); Sierra Norte (19)	Entire Universe	Quantitative (almost all numbers	59	Entire Universe	Quantitative (almost all numbers
5. Forest Engineer Interviews	Sierra Norte only (8)	Sample	Mostly Qualitative	17	Sample	Mostly Qualitative
6.Comisariado Interviews	Sierra Norte only (15)	Sample	Quantitative and Qualitative	17	Sample	Quantitative and Qualitative
7.Forest Observations	Sierra Norte (8)	Sample	Mostly Qualitative	5	Sample	Mostly Qualitative
8.Government Data (from census and other official government sources)	Sierra Norte (19)	Entire Universe	Quantitative	59	Entire Universe	Quantitative

There is a third spreadsheet “Description of Variables” which describes the variables or column headings used in the databases. These variables are largely the same across all tabs in the two state AATR databases. Where there are variations, they are shaded in the “Description of Variables” spreadsheet.

The comisariado interview tab and the government data tab in several instances present conflicting data on the same question, particularly territory of the agrarian community, number of comuneros, and percentage of the population that speaks an indigenous language. The exact number of comuneros is commonly in flux due to deaths and informal recognition at the level of the comunidad. The comisariado is likely expressing the community’s current understanding of the numbers. However, in our analyses, we use the official figures due to uncertainty about the variable accuracy of comisariados. With the official figures there is at least a single source. There are also frequently inconsistencies in the responses of the comisariados. The accuracy of comisariado responses is also raised by the response to questions about territorial conflicts with other communities. In the survey, all responded that there are no conflicts. However, we know from official sources and personal knowledge that conflicts do exist, and we have placed the ones for which we have verification in the corresponding section in the narrative report.

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