Pro-poor analysis of REDD+ activities designed to tackle drivers of deforestation and forest degradation in the Yucatan Peninsula.

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Acronyms

APDT	Public agents of territorial development
CFM	Community-based Forest Management
CICY	Scientific Research Center of Yucatán
CONABIO	National Commission for the Knowledge and Use of Biodiversity (México)
CONAFOR	National Forestry Commission (México)
CPP	Chicle Pilot Plan
DECOFOS	Proyecto de Desarrollo Comunitario Forestal de los Estados del Sur Chiapas, Oaxaca y Campeche, project by CONAFOR.
DICONSA	Public company offering subsidies food and other products in marginal rural areas
ER-PIN	Emission Reductions Program Idea Note
ES	Environmental Services
FAO	Food and Agriculture Organization of the United Nations
FCPF	Forest Carbon Partnership Facility
FIP	Forest Investment Plan
FPP	Forestry Pilot Plan
FSC	Forest Stewardship Council
GDP	Gross Domestic Product
GIS	Geographic Information Systems
GRUMA	Large private food company, important in the production of corn flour
ha	Hectare
IMPEXNAL	Private company
INEGI	National Institute of Geography and Statistics (México)
IPCC	Intergovernmental Panel on Climate Change
IRE	Initiative for Reducing Emissions
LGP	Liquefied Petroleum Gas
LM	Region *La Montaña*, Campeche
MINSA	Large private food company, important in the production of corn flour
MIQRO	Maderas Industrializadas de Quintana Roo
MRV	Monitoring, Reporting and Verification
NAFTA	North American Free Trade Agreement
NGO	Non-Governmental Organizations
NTFP	Non-timber forest products
NUCP	National Union of Chicle Producers
PFA	Permanent Forest Areas
PFSCA	Forest Products of Southeast Mexico and Central America
PROCAMPO	Public subsidy for agricultural production
PROCEDE	Certification Program Ejido Rights and Titling Urban Plots (México)
PROFEPA	Federal Attorney for Environmental Protection (México)
REL	Reference emission level
RPS	Roza-Pica-Siembra
SAGARPA	Secretary of Agriculture, Livestock, Rural Development, Fisheries and Food (México)
SEDESOL	Secretary of Social Development (México)
SEMARNAT	Secretary of Environment and Natural Resources (México)

SPFEQR	Society of ejido forest producers from Quinta Roo (México)
SSC	Social Solidary Cooperatives
tCO_2e	Tonnes of carbon dioxide equivalent
TFD	The Forest Dialogue
UNFCCC	United Nations Framework Convention on Climate Change
U.S.	United States
USD	United States dollar
yr	year
ZM	Mayan Zone

Executive Summary

1 Introduction

1.1 Objective

REDD+ refers to the implementation of activities under the United Nations Framework Convention on Climate Change (UNFCCC) in developing tropical countries to reduce emissions from deforestation and forest degradation and to promote the sustainable management of forests and the enhancement and conservation of forest carbon stocks. REDD+ will provide financing based on performance, to countries reducing their greenhouse gas emissions. A great deal of concern has been raised by civil society as regards REDD+ on questions of equity and whether the benefits of this policy will be ´pro-poor´.

Most public concern regarding pro-poor REDD+ developed around the fear that without formal and clear rights over forest resources, the poor would be evicted from the forests (i.e. denied the uses and non-monetary benefits that they had often informally enjoyed) as soon as carbon emissions reductions and sequestration had an exchangeable monetary value. This thinking later developed into calls for needs-based, pro-poor REDD+ benefit distribution systems. It is clear now that in most countries, including Mexico, the policy will not be considered legitimate and will not be acceptable unless it is able to deliver benefits to the poor(UN-REDD, 2012; Essam, 2011; Enright, McNally and Sikor 2012). Such an approach implies both that(a) REDD+ benefits can flow to poorer rural communities as well as better off ones and that (b) within communities, REDD+ benefits should reach the poorer members as well as better off ones.

The objective of this report is to evaluate the potential for pro-poor REDD+ benefit sharing in Yucatan peninsula considering the prevalent drivers of deforestation and forest degradation the possible alternative to address them, and assessing the impacts of each of these strategies on different local social groups. The evaluation of these impacts is based on a brief description of the livelihoods and living standards of different social groups of rural communities. A pro—poor approach implies that REDD+ benefits flow both to the poorer and the better off groups of the rural areas in the three states of the peninsula.

The document is structured as follows poorer and he background section is presented which includes information on drivers of emissions from deforestation and degradation, REDD+ benefit sharing, poverty and pro-poor approaches, a general historical background on important economic activities developed in the Peninsula related to REDD and on the evolution of the institutional frameworks for land access in Mexico. Then the methodology is presented followed by the findings of this work related to the local drivers of emissions, the identification of different poor and non-poor stakeholders, the identification of potential interventions including their potential for reduced emissions and social niches for implementation; this is followed by the analysis of options for benefit sharing schemes and the design of pro-poor strategies; finally the conclusions are presented. This work uses an in depth review of the literature, information from fieldwork and interview to key informants in the region.

1.2 Background

1.2.1 Drivers of greenhouse gas emissions

Drivers of emissions of deforestation and forest degradation are usually different. Deforestation refers to the complete and permanent change of land use from forest to other land cover. It is generally the result of a deliberate and rational decision by a particular individual or community (usually the owner) to make such a change. Degradation relates to the loss of biomass from a forest which remains forest during a given period, according to the definition adopted by the UNFCCC. This is frequently the result of the uncoordinated activities of multiple actors, on land which is open access or under communal tenure although it may also occur on privately owned land.

Continued degradation over many years may eventually lead to deforestation, but not necessarily, since in many cases the forest stock remains above the threshold definitions for forest (UNFCCC, 2003; Table 1), but contains less biomass than it would in its intact state. Most of the literature focuses on deforestation, there have been very few studies which look at degradation as a separate process, probably because degradation is much more difficult than deforestation to identify using remote sensing techniques (e.g. Skutsch et al. 2011)

Table 1.Parameters for the definition of forest according to COP decisions under UNFCCC (Marrakech Accords, UNFCCC, 2003).

Variable	**Range**
Tree Height	2 to 5 m
Minimum Area	0.05 to 1 ha
Canopy Cover	10 to 30%

It is important to identify both *proximate* and *indirect* drivers of carbon emissions. Direct drivers are human actions and activities with immediate contributions to the loss of carbon stocks – for example, the farmer´s decision to convert a patch of forest to induced grassland, or to horticulture; indirect drivers relate to complex interactions of social economic, political, cultural and technological processes (Geist and Lambin, 2011; Kissinger et al 2012). For example, the availability of government subsidies for irrigation, combined with increased market prices for beef, fruit and vegetables, may underlie the farmer´s decision. Many of the direct drivers of deforestation and forest degradation are responses to different dynamics -the underlying or indirect drivers-, occurring at different geographical scales (i.e. international, national, regional or local level). Drivers differ in space and time and thus need different scales for analysis from local to global scales (Rudel et al 2009; Boucher et al 2011; Geist and Lambin, 2002; De Fries et al 2010; Rademaekers et al 2010; Kissinger et al 2012).

Kissinger et al (2012) identify different direct drivers for deforestation and forest degradation based on a review of global literature and documents submitted by 31 countries to the World´s Bank Forest Carbon Partnership Facility (FCPF) and the UNREDD programme, these are: commercial and subsistence agriculture, mining, infrastructure extension and urban expansion in the case of deforestation; and logging, uncontrolled fires, livestock grazing in forests, fuelwood collection and charcoal production in the case of forest degradation (Hosonuma et al 2012; Kissinger et al 2012). These authors do not specifically mention shifting cultivation, but in as far as this is a form of subsistence agriculture, in most cases it should be included under degradation rather than deforestation. Shifting cultivation typically results in degradation, not deforestation, because it is a cyclical process and after the cultivation phase the forest regenerates naturally. If the whole area used by the farmer over the full cycle is considered to be a management unit, represented by a

mosaic of forest in different conditions, then the average carbon stock over the whole area, including areas under cultivation and areas recuperating, should be taken into account.

International markets and commodity prices are important global indirect drivers, especially for countries that base economic growth on exports of primary commodities, timber and agricultural products (Kissinger et al, 2012; Rademaekers et al 2010). At national and local levels there are other indirect drivers such as population growth, demand from domestic markets and problems associated with governance and national policies; indirect drivers exerting the pressure at local level relate to poverty and subsistence activities (Kissinger et al 2012). Population growth and population density relates to demand for agricultural land. On the other hand, expansion of infrastructure facilities improves access to remote forests and may increase extraction of fuelwood (Rademaekers et al 2010). Other underlying drivers are poor governance, corruption, low capacity of public forestry agencies to enforce regulations, land tenure uncertainties, inadequate natural resource planning and monitoring (Rademaekers et al 2010). In the sample studied by Kissinger et al (2012), 93% of the countries surveyed identified weak forest sector governance, weak institutions, conflicting policies and poor enforcement to combat illegal activities as underlying drivers; other common drivers identified are population growth (51%), poverty (48%), insecure tenure (48%) and international market forces (41%) (Kissinger et al 2012).

Since the 80s and 90s agriculture is said to have driven 80% of deforestation worldwide (Gibbs et al 2010, Kaimowitz and Angelsen, 1998; Kissinger et al 2012). In Latin America two thirds of deforested area is due to commercial agriculture; other drivers are mining, infrastructure and urban expansion. Regarding forest degradation, commercial timber extraction and logging accounts for 70% of degradation in Latin America and Subtropical Asia, other drivers of degradation are fuelwood collection, charcoal production and at lesser extent livestock grazing (Kissinger et al 2012). Small scale and illegal mining also have negative effects on primary forests (Swenson et al 2011; Schueler et al 2011). Although poverty might be an important driver at local level, analysis of information from remote sensing in combination with population dynamics, economic trends and agricultural production and exports indicates the impact of smallholders on forest emissions is decreasing (DeFries et al 2010; Kissinger et al 2012). For many countries including Mexico, commercial agriculture is a more important driver than subsistence agriculture (Kissinger et al 2012, Figure 2.2; Boucher et al 2011). It is also important to understand that the direct drivers of deforestation and degradation vary greatly with forest type. Logging may be an important cause in humid tropical forests and in temperate forests (particularly in pine and pine-oak formation) but it hardly occurs in tropical dry forests (*selva baja*, *cerrado* etc), owing to the lack of species which provide useful commercial timber. Shifting cultivation occurs both in humid/semi-humid tropical forests and in tropical dry forests, though usually at a much higher intensity in tropical dry forests where population densities are higher; it occurs on a much smaller scale in temperate forests. The focus of literature on deforestation and degradation is on humid tropical forests and much less is known about tropical dry forests. Dry forests are easier to convert to permanent agriculture as the dry season allows the control of weeds and soils are usually subject to less weathering as compared to vegetation types in wetter climates, so fertility management is easier..

Countries participating in REDD+ can define strategies to deal with local and national drivers but have problems in addressing international drivers on their own. International coordination is required to prevent international leakage (Kissinger et al 2012), and to control demand for products which results in large-scale deforestation (e.g. palm oil, beef, soy). Moreover in many cases the countries themselves have weak forest sector governance and institutions, lack cross-sectoral coordination and are prone to illegal activity (Kissinger et al 2012). Additional drivers of emissions might relate to foreign direct investment (land grabbing) (Schoneveld, 2011; Kissinger et al 2012).

The review by Kissinger et al (2012) indicates the pressures associated with many international drivers are expected to increase (e.g. population trend, global urbanisation, increase of meat based diets, growth of domestic markets and prosperity and factors associated to climate change adaptation) (DeFries et al 2010; Kissinger et al 2012). The global population might stabilise at around 8 to 10 billion around 2050, with larger growth expected in Africa and Asia (Kissinger et al 2012). The demand from international markets has responded historically to that of developed world, however emerging economies are becoming also important consumers (PWC, 2011; Kissinger et al 2012). Thus in the following years increases are expected for agricultural products (70% by 2050), oil seeds and oil palm (23% and 45% respectively), meat (85% by 2050), biofuels (60% and 110% in 10 years for ethanol and biodiesel), vegetal charcoal and minerals (Foresight, 2011; FAO, 2009; OECD/FAO, 2011; Hofstad et al 2009; PWC, 2011). When the prices of fossil fuels are relatively high, other alternatives such as biofuels and hydropower become more attractive. It is expected that an important share of future increases in the production of cereals, sugar cane and vegetable oil will be used to produce biofuels (OECD, FAO 2011; Kissinger et al 2012), if oil prices increase again. Growth is expected in the trade of wood products, however although there are increasing controls for international trade, these only account for over 3.5% of all production; there is limited data on domestic demand, fuelwood production and use and illegal activities (Rademakeres et al 2010; Table 2.1 in Kissinger et al 2012). Nevertheless there is some evidence that timber production is moving to plantations and not to primary forests (FAO, 2010b).

1.2.2 REDD+ benefit sharing schemes

Actions implemented to address the drivers of emissions aim to reduce emissions and increase forest carbon stocks and thus contribute to climate change mitigation. In the context of REDD+ these potential benefits, measured in tonnes equivalent carbon dioxide per year (tCO_2e/year), are the basis for determining the performance of implementation and access to results-based finance to developing countries. As pointed out in the Scoping Paper (Balderas Torres and Skutsch, 2014), at the international level countries can access financial resources in exchange for the carbon performance relative to a national REDD+ baseline (REL or RL). However within each implementing country there can be different and specific arrangements regarding how to distribute the financial benefits generated.

There are always social justice issues related to the distribution of scarce goods and services (e.g. money, education, health services, water access, electricity) (Dieterlen, 2005). Depending on the structure of the local frameworks for REDD+ implementation and socioeconomic and political context, the benefits may be directed to different stakeholders. Moreover, the activities implemented to address the drivers of emissions can by themselves produce different benefits (and costs) in addition to climate change mitigation; this opens the room for the analysis of benefit sharing including an exploration of pro-poor approaches. In this context there are three essential aspects to be considered as regards social justice: first the agents that participate in the distribution of benefits (recipients, agents delivering the benefits); second the types of goods or benefits to be distributed (in cash, in kind, services); and thirdly the principles behind the distribution (Dieterlen, 2005). In this regard, benefit sharing schemes as part of REDD+ need to define eligible activities for implementation; the potential carbon gains that can be obtained; the eligible actors for participation and the reception of benefits; the principles for benefit sharing and the distribution channels and the extent to which cash or in-kind compensation will be used. For a detailed review of issues related to the design of benefit sharing schemes please refer to Balderas Torres and Skutsch (2014) and Skutsch, Balderas Torres and Carrillo, 2015.

1.2.3 Poverty and pro-poor approaches

Poverty can be defined in absolute or relative terms. Poverty can be described in three dimensions: first, as not having enough resources to cover basic objective needs, second, to have less than others members of a group or society, or third, as the feeling or perception of not having enough resources to meet a certain living standard (Hagenaars and de Vos, 1988). Poverty can also be defined as the lack of basic individual capacities to participate willingly in societal life (Sen 1982 and Basu and Lopez Calva, 2003 in Lopez Calva et al 2005), as material scarcity, weak social relationships, insecurity, low self-confidence and powerlessness (World Bank, 2001 in Lopez Calva et al 2005) or as the diminished capacities to access to development opportunities. It is necessary to acknowledge that real opportunities depend on individual and contextual conditions (e.g. health, resources available, pollution, violence) (Dieterlen, 2005). Poverty diminishes the possibilities and liberties to act, choose and interact with the state and participate in markets (Perez Fernandez et al 2005). According to the "Voice of the Poor"[1], a study made among population living in poverty in Mexico, being poor can be understood in a simpler way as 'not having enough to eat' and 'not having an occupation to make a living'; for the poor wellbeing is associated to having the means to satisfy their basic needs (e.g. food, health, minimum services) (Székely 2005).

In 1950, 88.4% of the population in Mexico was poor, in 2002 it was 51.7%, in 2012 it was 45.5% (Hernandez Licona and Razo Martinez, 2005; CONEVAL, 2013). In Mexico poverty is evaluated through alimentary and non-alimentary poverty lines; by February 2015, the alimentary poverty line was $1.94 USD/cap-day while the non-alimentary poverty line was $1.69 USD/cap-day, thus the integrated poverty line was $3.63 USD/cap-day (at an exchange rate of $15 Mexican pesos per USD) (CONEVAL, 2015). According to World Bank Data, in Mexico in 2004, 28 percent of the inhabitants of rural and semi urban areas, were living under extreme poverty and 57% in moderate poverty (WB, 2005); according to the definition of INEGI rural population refers to that living in settlements of less than 2500 inhabitants and semi urban in settlements between 2501 and 15000 inhabitants.

Table 2 presents the population of the three states of the peninsula by income level. Figures show that around 20% of the population lives roughly below the poverty line, however it can be seen that a substantial share of the population is at risk of becoming poor if they experience a reduction in their income (from 35 to 50%). Overall, Yucatan is the poorest state of the three, however in comparison with other states of the country, the poor population of Yucatan has access to an ample base of natural resources which enables them to cover subsistence needs.

Table 2. Poor population by income level in the states of the Yucatan Peninsula (From, De la Fuente et al 2015)

Income level	Yucatan	Campeche	Quintana Roo
< 4 US/cap-day	18.2 %	23.0 %	17.4 %
4-10 US cap-day	49.4 %	39.7 %	34.0 %
10-50 US cap-day	30.0 %	34.9 %	42.4 %
> 50 US cap-day	2.1 %	2.4 %	6.2 %
Rank /32 States*	21	15	8

* Rank 1 is Nuevo Leon, the state with lower proportion of its population under $USD 4/cap-day.

[1]"The Voice of the Poor" is a study which was undertaken in Mexico in 2003 (SEDESOL, 2003). As part of this study 3000 members of poor populations of urban and rural areas were interviewed to understand how the poor perceive themselves and the causes and possible solutions to poverty (Székely, 2005; Suárez, 2005). This is a valuable study that is used here to help to define strategies to alleviate poverty consistent with the perceptions and realities of the poor.

There is a high incidence of rural poverty, in particular extreme poverty, in the so called marginal areas, and a strong correspondence between poor communities and municipalities identified in the poverty map and marginality as defined by the CONAPO, and marginality index used by SEDESOL. *Extreme rural poverty* is hence prevalent in marginal areas. From a historical perspective marginal areas are traditional "zonas de refugio" (shelter zones) of indigenous populations. This is the case for example in the indigenous zones in Yucatan, and Quintana Roo, where the municipalities of higher marginalization index have large Maya populations. In Campeche, the historic process differs, and the municipality with highest marginality is Calakmul, which was a destination during the resettlement policy in the late 1970's.In order to address this issue, each federal government during the last decades has created a specifically targeted program to promote productive development and promote investments in marginal areas (e.g. Proyecto de Desarrollo de Zonas Marginales, Microrregiones, Sin Hambre).

CONEVAL is the institution in charge of the measurement and monitoring of poverty in the country. The poor population is grouped into those in extreme and those in moderate poverty, additionally the vulnerable population is evaluated in terms of income level and the level of social deprivation related to different factors (i.e. illiteracy and educational lag; lack of access to social security; lack of basic services in house; lack of access to health services; lack of quality spaces in house; and poor access to food) (CONEVAL, 2013).Table 3 below presents the monthly per capita monetary poverty lines associated with each of the groups described in the rural and urban contexts; the income levels are lower in rural areas and provide a reference to evaluate the impact that different initiatives can have for poverty alleviation if they target these groups.

Table 3. Monthly per capita income levels for different population groups in urban and rural areas (in Mexican Pesos) (from CONEVAL, 2013).

	Rural	**Urban**	**Number of Social Deprivation Factors (All)**
Population in Poverty			
Extreme Poverty	455	685	3.7
Moderate Poverty	946	1,452	2.0
Poor Population	775	1,332	2.4
Vulnerable Population			
By Social Deprivation Factors	2,869	5,126	1.8
By Income	1,070	1,628	
Non-Poor Non-Vulnerable	5,303	6,480	

The number of social deprivation factors can also be correlated with different income levels (Table 4 from CONEVAL, 2013); if interventions are planned to reduce the level of deprivation, the value of the investment can be related to the difference in income. Considering the changes in the number of deprivation factors, the average gain is around $147 pesos for each factor that is reduced. In Figure 1 it can be seen that there is a good fit in the correlation between the number of social deprivation factors with income and with the pervasiveness of poverty within each group. This implies that by looking into the characteristics of the households and individual to study their deprivation level, it is possible to derive estimates of their income. The level of pervasiveness includes the population below the alimentary and non-alimentary poverty lines.

Table 4. Correspondence between number of social deprivation factors, poverty and income (from CONEVAL, 2013).

Number of Social Deprivation Factors	Poverty Pervasiveness	Average Monthly Income
0	0.3	1601
1	0.377	1368
2	0.427	1212
3	0.477	1048
4	0.524	907
5	0.571	804
6	0.6	717
Total	0.427	1210

Figure 1.Correlation between the number of Social Deprivation Factors with income and poverty pervasiveness (based on CONEVAL, 2013).

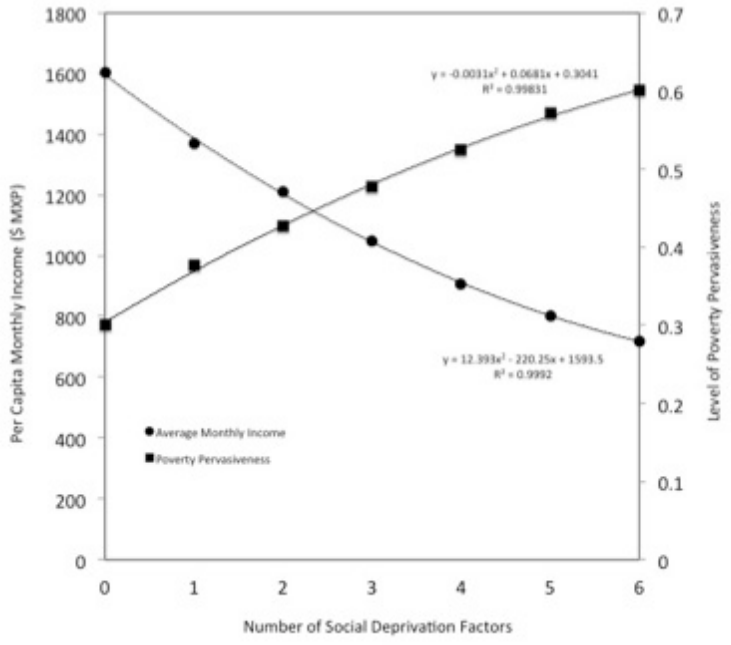


Table 5 presents the percentage of the population of each state in the Yucatan Peninsula according to their poverty and vulnerability type in 2012 (CONEVAL, 2013). Overall 79.2% of the population of the peninsula lives in poor or vulnerable conditions, with a higher percentage of the population of Yucatan; nevertheless there is slightly more people living in extreme poverty in Campeche.

Table 5. Poor population in the states of the Yucatan Peninsula in 2012 according to their specific condition (from CONEVAL, 2013).

	Poor Population			Vulnerable Population		Poor and Vulnerable
	Extreme	Moderate	Total	Social Deprivation	Income	
Campeche	10.4%	34.2%	44.6%	28.6%	5.6%	78.8%
Quintana Roo	8.4%	30.4%	38.8%	30.4%	6.2%	75.4%
Yucatan	9.8%	39.0%	48.8%	27.0%	6.3%	82.1%

Table 6 shows the changes in the size of the groups facing different social deprivation factors from 2010 to 2012 for the states of the Peninsula (CONEVAL, 2013). In general small improvements are

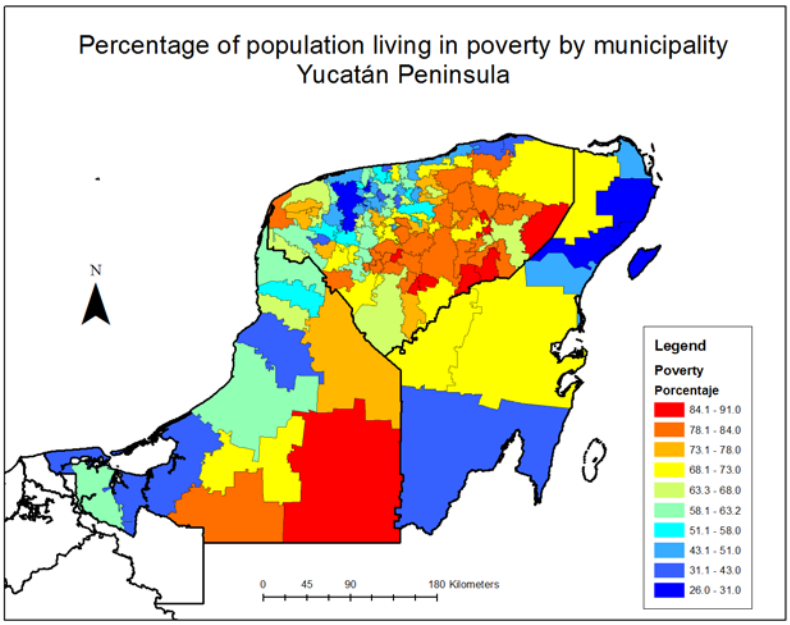
reported for all factors for Campeche and Quintana Roo with the exception of Social Security access, this is not the case in Yucatan; this situation may be related to changes in unemployment levels. However, in Yucatan there were negative changes as regards the presence of basic services in the houses, the quality of houses, and the level of alimentary deprivation. This may be an indication of population growth were young couples are starting to build their patrimony; this demographic growth might be also consistent with a higher pressure on land which in the case of poor production may be associated with higher alimentary deprivation levels. However it is necessary to undertake further studies to establish these links.

Table 6.Evolution of the groups with different social deprivation factors from 2010 to 2012 in the three states of the Yucatan Peninsula (from CONEVAL, 2013)

	Edudational Lag		**Health Services**		**Social Security**		**Quality and Space in House**		**Basic Services in House**		**Alimentary Deprivation**	
	2010	2012	2010	2012	2010	2012	2010	2012	2010	2012	2010	2012
Campeche	24.1%	19.2%	19.2%	12.2%	60.0%	61.0%	22.1%	17.7%	36.5%	33.0%	31.2%	18.7%
Quintana Roo	18.3%	17.6%	24.3%	21.2%	53.9%	54.9%	21.7%	19.7%	15.2%	14.5%	21.8%	18.6%
Yucatan	24.7%	23.4%	20.7%	15.7%	56.9%	58.8%	19.5%	20.6%	37.4%	42.7%	21.4%	25.1%

The map presented in Figure 2 shows the share of the population living in poverty per municipality for the three states (CONABIO, 2010); this means the population that is lacking at least one social need and whose income is insufficient to cross the poverty lines. It shows that poverty prevails more strongly in the central part of Yucatan and in the south of Campeche. Municipalities with lower figures are those where main urban areas are located (Cd. Del Carmen and Campeche in Campeche, Mérida in Yucatán, and Cancún and Chetumal in Quintana Roo).

Figure 2.Percentage of population living in poverty by municipality in the Yucatan Peninsula (CONABIO, 2010).

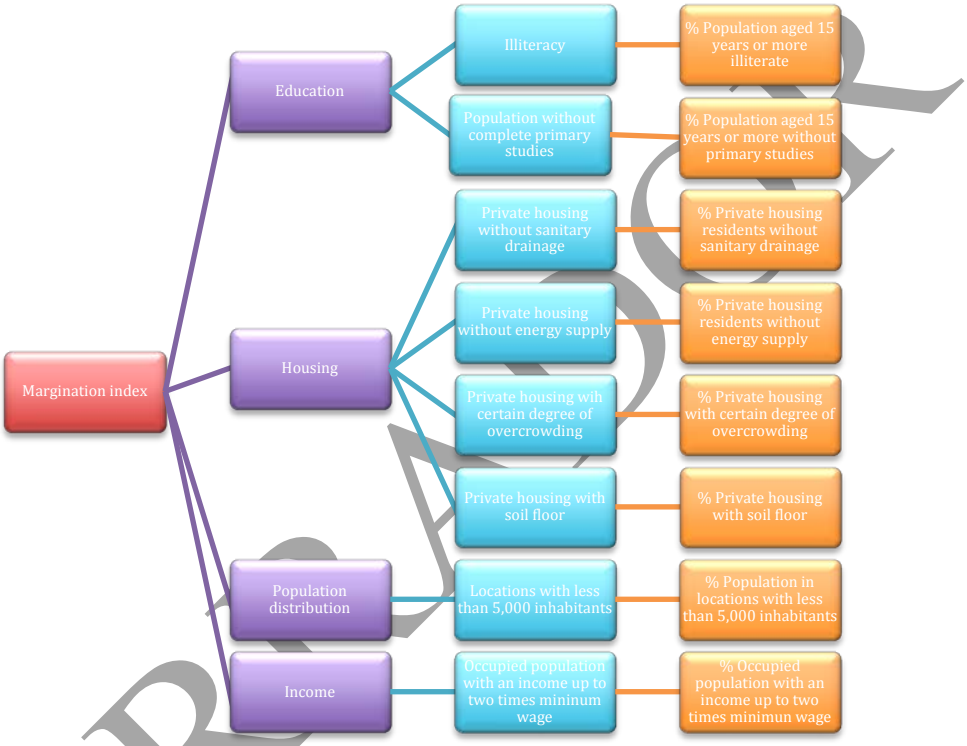


1.2.3.1 Measuring poverty

The measurement of poverty can be done through direct, objective or subjective approaches. The direct determination of poverty considers the measurement of unsatisfied basic needs, for instance: overcrowding when more then 3 persons cohabit a bedroom; lack of own house; lack of sanitary services; when at least one child under 6-12 years old is not going to school; or when the head of a

household of size of four or more, does not have at least three years of elementary school (Lopez Calva et al 2005).In Mexico there is a marginalisation index following this approach. In the construction of the marginalisation index, nine forms of exclusion, reflecting gaps in four dimensions, are taken in consideration. For each of these dimensions an indicator consolidates the intensity: population without education; services in the residences; income level; and residency in small and isolated areas. The higher the indicators the lower the opportunities to access development options (CONAPO, 2013) (Figure 3).

Figure 3. Criteria and factors used to integrate the marginalisation index, from (CONAPO, 2013).



One problem with the direct determination of poverty relates to the definition of "basic needs". The second approach can consider the measurement of variables such as income or expenditure. In relation to objective approaches, Carter and Barrett (2006) describe four different ways to evaluate and understand poverty. The first approach is the definition of static income/expenditure lines to establish poverty levels from single point estimates at household levels. However in order to identify chronic or temporary poverty a second approach is necessary, which includes the temporal dimension to obtain a dynamic income/expenditure poverty line. The third approach is the asset-based poverty line that helps to understand structural poverty and analyse poverty transitions. The asset poverty line refers to the aggregated level of different productive assets that would produce sufficient income to equal the poverty line. Finally the fourth approach to analyse poverty dynamics focuses on the identification of the pathways to walk out of poverty or on the prevalence of poverty traps through the dynamic analysis of changes in the assets and income of poor households (Carter and Barrett, 2006).

1.2.3.2 Causes of poverty

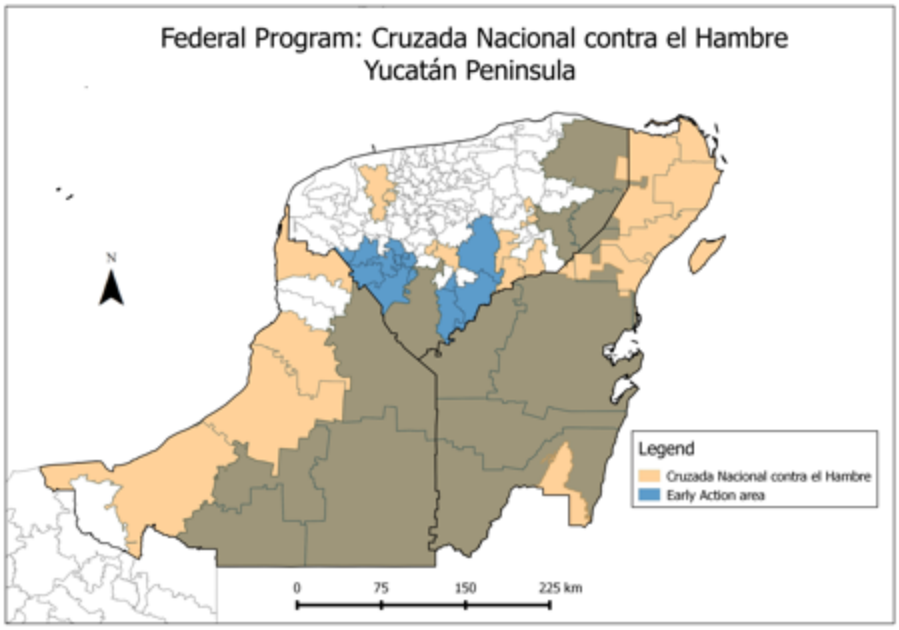
Causes of poverty may be structural, resulting from the lack of access to basic services such as schooling, health services, water and sanitation, which in turn are usually related to relative

isolation and the cost of providing these services. Poverty in rural areas is also linked to regional resource endowment, and lack of access to the productive resources that would allow adding value to natural resources and increasing household income (e.g. technology, inputs, credit, insurance, markets, information, training). In Mexico poverty is also related to a very uneven wealth distribution. In this context IFAD (2014) states there are three important factors that determine rural poverty in Mexico, these are: geographical location particularly proximity to urban centers, as in these areas there are more opportunities for income diversification (i.e. poverty increases in those areas where settlements are dispersed and far from cities); ethnic background, since it is clear that most of the poor population in rural communities is indigenous; and gender, since women in general have fewer opportunities to migrate and have more restricted access to productive resources (CONAPO, 2006). Rural poverty is also linked to the difficulty of increasing productivity of rural labour. The persistence of poverty in Mexico, as in most contemporary middle-income countries with highly dualistic economies, is related to the inability to move the labour force engaged in "refuge" occupations with low productivity into high-productivity employment. This applies to both urban informal and rural marginal labourers. Highly productive employment, capable of offering returns to labour above the poverty line, would be the only way to increase income and lead to sustained poverty reduction, though the power relationships within the Mexican economy restrict wages even in high productivity jobs. Even if the economic system was able to offer high-productivity employment to rural workers, moving them out of low-productivity rural jobs would require schooling and capacity building to which they do not have access.

There are different factors associated with poverty: individual factors (lack of skills, effort or savings); social or external context (lack of education, low wages); and fatalistic views (bad luck, divine designs) (Feagin, 1972 in Palomar, 2005). In order to understand the reasons that the poor population in Mexico find to explain their condition, the study cited above, the *Voice of the Poor*, asked for the reasons why they considered they were poor. While studies and economic theory pinpoint to factors such as education, low productivity, obsolete technologies, lack of infrastructure and poor market-access as important causes of poverty nearly half of the sample in the *Voice of the Poor* answered poverty was a matter of bad luck or destiny (i.e. there will always be poor and rich; because it is God´s will; bad luck; there are no institutions helping the poor) (Székely 2005). If the objective is to incorporate pro-poor approaches into REDD+, or any other development strategies, these views need to be taken into account. The majority of the poor consider they are poor due to external reasons and find it difficult to improve their conditions within their own lifetime (Palomar, 2005). There is an age divide in this since the young associate poverty more with individual factors (e.g. not enough hard work), while the elder tend to focus on fatalistic reasons, particularly in rural areas (Palomar, 2005). Results of the study indicate that the lower the income, the higher the perception that poverty is a due to fate. At higher levels of income, the perception of the importance of personal effort as a strategy to get out of poverty increases (Szekely 2005b).In Mexico there are certain social groups that are particularly passive and expect the government to satisfy their needs in exchange for political allegiance (e.g. needs related to education, health, employment, land) (Palomar, 2005). Interestingly the government is perceived by the poor as the main cause of poverty and social problems (Dieterlen, 2005). This indicates that despite the loyalty to certain political parties and groups, the expectations of the poor have not been satisfied. Finally, the study of the causes of poverty indicates that beliefs such as victimization correlate with perceptions of low self-esteem and symptoms of depression (Smith, 1985 cited in Palomar 2005); moreover, poorer groups tend to have a lower feeling of control of their lives (Palomar, 2005). It has also been documented that social subsidies and charities are sometimes associated with lower self-esteem and depression (Perez Fernandez et al 2005). It is therefore open to debate whether this type of intervention can undermine the potential of poor to develop by the creation of poverty traps. This kind of discussion is of course highly charged from a political standpoint and opinions on it usually reflect the worldview of the observer rather than any objective analysis. The current debate about the program

´Cruzada contra el Hambre´ is a case related to this point. Figure 4 below shows that in general the definition of the EAA for REDD+ in the Yucatan Peninsula coincides with the areas covered by the Cruzada Nacional Contra el Hambre; only a few municipalities in the southern part of Yucatan are not included in the Cruzada. It is true that there is a large part of the territory covered by the Cruzada that is not included in the Early Action Area.

Figure 4. Correspondence between the coverage of the Cruzada Nacional contra el Hambre and the Early Action Area for REDD+.



1.2.4 Regional and historical background

The Yucatan Peninsula in the southeastern part of Mexico is politically divided into three states (Yucatan, Campeche and Quintana Roo). It is covered by several types of tropical forest, according to the rainfall distribution, tree height and the proportion of trees that shed their leaves during the dry season varies, giving rise to different types of topical forest. In this document we classify as *selva* i.e. high –*alta*-, medium –*mediana*- and low –*baja*- on the basis of the height of trees. Figure and Table 7 below present the main types of vegetation according to the 1:250:000 land cover map of INEGI (2015).

Figure 5. Mainland cover classes and vegetation types in the Yucatan Peninsula (based on INEGI serie V, INEGI, 2015a).

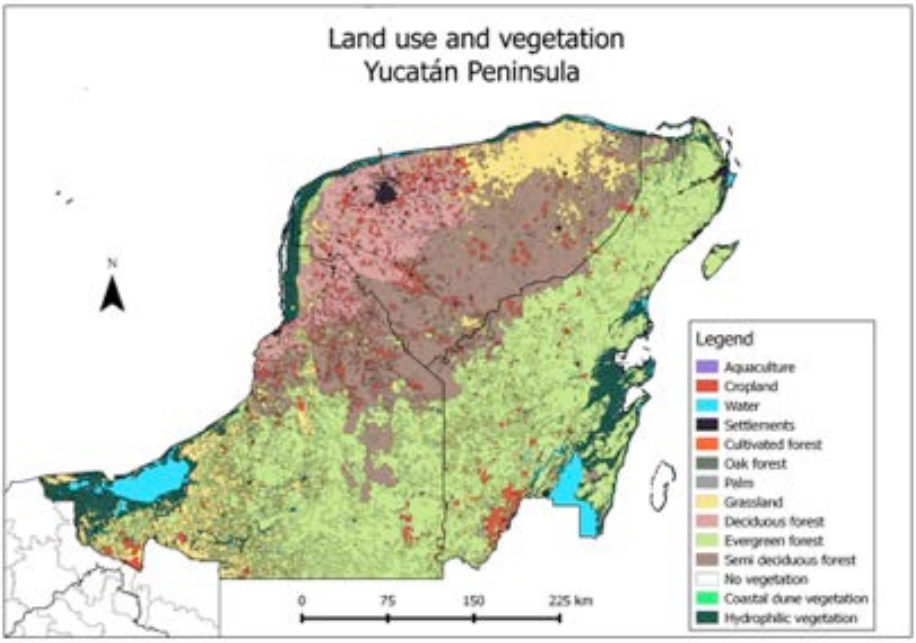


Table 7. Main vegetation types and land cover in the Yucatan Peninsula, based in INEGI (2015)[2].

Vegetation Type	Area	Percentage %
Agriculture	735,938	5.2%
Pastureland	1,971,683	14.0%
Selva Baja	533,759	3.8%
Selva Mediana	1,362,101	9.7%
Selva Alta	64,803	0.5%
Selva Baja (secondary)	951,583	6.7%
Selva Mediana (secondary)	7,137,125	50.7%
Selva Alta (secondary)	57,407	0.4%
Hydrophilic Vegetation	996,652	7.1%
Settlements	151,203	1.1%
Other	106,291	0.7%
Total	14,068,545	100%

In Yucatan state and the north of Campeche, most of the forest is secondary or successional forest known as acahual, identified as deciduous and semi deciduous tropical forests. In this part *selva mediana* and *selva baja* predominate as a part of a cycle of shifting cultivation system, known as *milpa*. This is an agricultural production system based on maize, squash and beans among other products, in which fertility management is based on a swidden system. This has been the traditional form of agriculture in the Yucatan Peninsula since pre-hispanic times, and it is believed it provided sufficient food to sustain a population even larger to that living in Yucatan in the 1980s (i.e. about a million) (Garza and Kurjak, 1980; Teran and Rasmussen, 2009), though the view that prehispanic Maya relied on milpa has also been challenged (Puleston, 1978). Nevertheless, still today, milpa is the main agricultural production system practiced by traditional rural communities, in particular in the shallow and stony soils of the north of Yucatan. Where soils are better formed, deeper and with

[2]Classification of land uses: Agricultural lands include rainfed and irrigated areas; pastureland includes natural and planted; Selva baja includes, deciduous, semi-decidous, perennial, sub-perennial and thorny; Selva mediana includes deciduos, semi-decidous and sub-perennial; Selva alta includes perennial and sub-perennial; secondary areas include herbaceus, shrubs and arboeral dominated areas corresponding to each group of selvas.

higher fertility; permanent mechanized agriculture systems are being implemented by both *ejidos*[3] and private properties. In the south of the Peninsula in the Quintana Roo and Campeche states, there are considerable areas of *selva alta* and *selva mediana* where timber production has been a major factor in natural resource management (evergreen forests).As already said geography and thus resource endowment to ascertain extent determine poverty, as the profitability and riskiness of agriculture and forestry are vary in different areas. In this sense the state of Yucatan has lower potential than Campeche and Quintana Roo. However, in the past, Yucatan was the scene of one of the most successful plantation economies, which made it the economic center of the Peninsula.

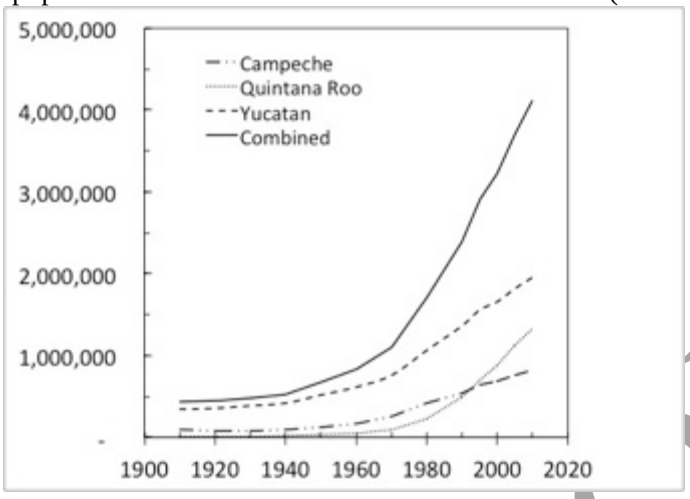
Population dynamics have responded to different socioeconomic and political phenomena. There is evidence that the Peninsula has been populated for more than 15 centuries when the first Mayan settlements were established. Some authors affirm the Maya practiced the *milpa* system which not only provided the subsistence means for the farmers, but it was able to produce surpluses for trading and sustain a complex society (Teran and Rasmussen, 2009); it is probable that an important proportion of labor for it came from slaves and servants (Ojeda Lopez, 2009).The population of the Peninsula has grown rapidly in the last forty years. From 1910 to 2010 the population increased ten-fold and since the 1970s it went from one to four million inhabitants (Table 8) (INEGI, 2010a). The figures show no signs of stabilising, thus it is expected it will continue to grow (Figure 6). Yucatan is the most densely populated state with 49.48 persons/km^2, followed by Quintana Roo with 29.65/km^2 and Campeche with 14.3/km^2, these figures are lower than national average of 57.3/km^2 (a 2010a).

Table 8. Historical population of the Yucatan Peninsula (totals and annual growth rates) (based on INEGI, 2010a).

Year	Campeche		Quintana Roo		Yucatan		Combined	
1910	86,661		9,109		339,613		435,383	
1921	76,419	-1.07%	10,966	1.85%	358,221	0.50%	445,606	0.21%
1930	84,630	1.19%	10,620	-0.35%	386,096	0.86%	481,346	0.89%
1940	90,460	0.69%	18,752	7.66%	418,210	0.83%	527,422	0.96%
1950	122,098	3.50%	26,967	4.38%	516,899	2.36%	665,964	2.63%
1960	168,218	3.78%	50,169	8.60%	614,049	1.88%	832,436	2.50%
1970	251,556	4.95%	88,150	7.57%	758,355	2.35%	1,098,061	3.19%
1980	420,553	6.72%	225,985	15.64%	1,063,733	4.03%	1,710,271	5.58%
1990	535,185	2.73%	493,277	11.83%	1,362,940	2.81%	2,391,402	3.98%
1995	642,516	4.01%	703,536	8.52%	1,556,622	2.84%	2,902,674	4.28%
2000	690,689	1.50%	874,963	4.87%	1,658,210	1.31%	3,223,862	2.21%
2005	754,730	1.85%	1,135,309	5.95%	1,818,948	1.94%	3,708,987	3.01%
2010	822,441	1.79%	1,325,578	3.35%	1,955,577	1.50%	4,103,596	2.13%

[3]Land property regime in Mexico including areas for communal and individual use.

Figure 6. Historical population of the Yucatan Peninsula 1990 to 2010 (based on INEGI, 2010a).



Economic activities since colonial times have focused on extraction and exports of natural resources, first to Europe, blood wood tree (palo de tinte) and timber, later since the mid 19th century there was an economic boom in Yucatan associated with the production of henequen, and later economic growth occurred in Campeche and Quintana Roo associated with extraction of chicle (chewing gum), which was exported to the U.S. The most recent processes driving the economy of the region, and increasing substantially the regional population, were firstly a national settlement policy, with the promotion of land clearing for agricultural development projects to ease political tension over land tenure crisis in other parts of the country.

Since 1974 the economy of Quintana Roo has grown based on tourism development. The growth of this sector has drained available labor and led to failure of the development of agricultural activities in most zones of Quintana Roo. Then, the discovery and development of oil extraction in the coast of Campeche in the early 1980s and recently, tourism development in the coast of Quintana Roo have increased the waves of immigration to the Peninsula. Around 1986 working primary activity areas were those under production before 1974, when tourism development started. These areas are: the Rio Hondo basin where sugarcane developed around a sugar mill and forest activities. The forest sector received an impulse during 1954 when an industrial forest unit was created by decree (DOF 04/05/1954) giving exclusive rights over 462,984 ha of forests to a private company MIQRO for a period of 29 years. This area included the current forest ejidos of Quintana Roo. When in 1983 the concession ended, the Plan Piloto Forestal was created with state funds and a German technical cooperation agreement.

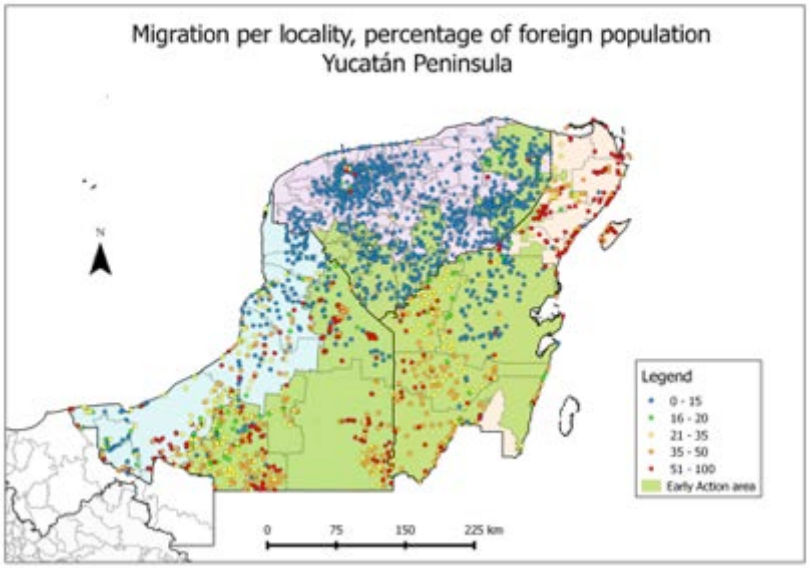
Since at least the beginning of the 20th century, immigrants included labourers to work in the henequen, chewing-gum, oil and tourism sectors (mostly within the peninsula, from other regions of Mexico, but also foreigners, e.g. Lebanese fleeing from the war or Koreans arriving to work in henequen haciendas). Immigrants to re-populate the territory and develop agricultural activities include producers from different regions of the country, groups such as the Mennonites, and around 25,000 political refugees from Guatemala during the civil war of the 1980's (Aguayo Quezada and O'Dogherty, 1986). The relocation dynamics can be seen in the emigration immigration data as presented in Figure, where it can be seen that Yucatan is a *net* source of emigrants (144,414 in 2010) and Quintana Roo is by far the largest target for newcomers in the Peninsula (641,828) (INEGI, 2010a). At national level the percentage of domestic migration in 2010 was 17.6%, this is the population residing in a state different from the one in which they were born (Romo Viramontes et al, 2013). Figure 7 shows that in Yucatan the level of domestic migration of the population that still resides in the state is in general lower than the national average whereas there is a large number

of immigrants in the Riviera Maya and the central and southern parts of Quintana Roo and Campeche.

Table 9.Figures of immigration and emigration in the states of the Yucatan Peninsula (From INEGI, 2010a)

	Emigrant Population				Immigrant Population			
State	**2000**		**2010**		**2000**		**2010**	
Campeche	89,223	23%	109,734	24%	156,158	21%	180,252	17%
Quintana Roo	34,139	9%	55,003	12%	485,255	64%	696,831	67%
Yucatán	271,734	69%	300,624	65%	113,140	15%	156,210	15%
Total	395,096		465,361		754,553		1,033,293	

Figure 7.Immigration by locality, percentage of foreign population in population centres in the Yucatan Peninsula. (INEGI, 2010a)



The following sections describe briefly the main changes related to the political history of the Peninsula and the associated changes in the institutional framework associated with land access and forest management in Mexico. These topics provide a basic contextual background for the analysis of the drivers of emissions and potential implementation of REDD+.

1.2.4.1 Political and social background of the Yucatan Peninsula

During the colonial period, the Peninsula formed a unique political unit named Yucatan, which included the current territory of Belize and the Petén in Guatemala. After Mexico´s war of independence, Yucatan proclaimed its own independence briefly during two short periods but re-joined the country definitively in 1848 in exchange for support in fighting the rebel Mayans during the Caste War. During this war, which started in 1848, Mayans rebelled when the Spanish origin population broke their land use agreements with the indigenous chiefs, as a result of trade liberalization brought by the Cadiz Constitution in Spain.

It is revealing that among the conditions included in the proposed Tuzcacab peace treaty of 1848, the Mayans requested to be allowed to continue with their shifting cultivation practices in the *montes* of Yucatan without having to pay a fee for it, as well as the cancellation of debts and

autonomy to form their own local government, among other matters (Diaz Soto, 2002).Later as henequen plantations developed, the indigenous traditional lands in the north west of the Peninsula became part of the haciendas, reinforcing war and Mayans took shelter in the tropical forests in the south. The city now known as Felipe Carrillo Puerto was the Mayan stronghold (Chan Santa Cruz); economic growth of the time associated with henequen did not reach this region (Ramayo Lanz, 2014). Although the peace treaty was signed in 1855 there were still conflicts for fifty more years; the rebels received military weapons from the English from Belize in exchange for timber and other forest products. This situation was diplomatically settled by Mexico and England in 1893, but local conflicts only ended in 1917 after president Venustiano Carranza recognized the authority of one of the Mayan leaders (Francisco May) and granted him a large forest concession and a pension (Ramayo Lanz, 2014).

In 1862 the state of Campeche was separated from Yucatan. After Merida, Campeche was the second city in the region, the first being Ciudad del Carmen, which was the first point of maritime trade. The most recent state is Quintana Roo which was created as an independent and sovereign state only in 1974. In 1902 Quintana Roo was separated from Yucatan to become a federal territory; it was administered by the federal government which kept control over valuable products (e.g. mahogany, cedar and chewing gum) and the tariffs associated with maritime trade. However, despite the large revenues raised, the federal government did not reinvested in the territory which was a marginal areas with poor communications (Ramayo Lanz, 2014). For instance, paved roads from Chetumal to Campeche and from Chetumal to Peto in the central part of Yucatan were only built in the 1970s.

The public administration of Quintana Roo in its early years was characterized by political turmoil driven by national and regional interests. Examples of this are the fact that the territory was temporarily restored to Yucatan from 1913 to 1915, and further divided between Yucatan and Campeche from 1931 until 1935; from 1902 to 1940 there were 25 governors in Quintana Roo appointed from Mexico City, and between 1915 and 1927 none of them lasted more than one year in office (Ramayo Lanz, 2014). There are still controversies related to the exact boundaries of the three states involving an area nearly equivalent to 5% the area of the Peninsula. These boundaries are still in dispute in the national Supreme Court. This provides an idea of the difficulties that may be faced in attempts to set up common grounds for the management of natural resources and development of the region.

1.2.4.2 Ejido and land tenure

In the Yucatan Peninsula, as in Mexico in general, two land tenure systems exist, the *ejidal* system under which the inhabitants have rights over land use, sometimes in a communal basis, but cannot use it as a guarantee for loans nor sell it; and private property. The land tenure regime in any zone is dependent on the local history of land settlements, and the power relations. When the Spaniards conquered the Peninsula some of the original population was displaced, as Spaniards took over the land, opening areas for pasture and moving some of the original *milpa* to less productive areas. When plantation agriculture became profitable, a private property regime, created the “haciendas”. Since the early 1920's *ejidos* were created, in a trend of agrarian reform. The creation of *ejidos* restricted the areas in which members of communities and families could move to carry out their itinerant practices, increasing the pressure in those parts of the territory that were allocated to *ejidos*.

Some researchers indicate that historically shifting cultivation was the prevalent primary activity in the Peninsula (Teran and Rasmussen, 2009; Roys 1957 in Torres Mazuera, 2014a); giving rise to a customary land use allocation system that survived to some extent in parts of the Yucatan Peninsula

until the late 1960s. On the land allocated, shifting cultivation in Yucatan was performed under a open-access regime were family units chose areas for their *milpas* and founded "family courses" based on customary rules (*rumbos familiares*)(Torres Mazuera, 2014a). However, land property regimes changed substantially after the 1920 and 1930's, first as a result of the agrarian reform, when the population was settled as *ejidos*; also later in the 1970, when *ejidos* were created in underpopulated areas; and finally at the end of the 20th century, when the constitution was changed to allow the privatization of *ejido* land. Box 1 presents a brief description of the conditions for land access in *ejidos*.

Box 1. Organisation and land access in *ejidos*

In the Yucatan Peninsula, most communities take the form of *ejidos*. The highest authority in the *ejido* is the general assembly where members with certificates either to individual parcels, or to the use of the common use ejido land is an *ejidatario*, and has the right to vote in the Assembly. A member of the *ejido* with formal rights to land is called an *ejidatario*, *posesionario* (those in possession of a plot but not a legally recognized *ejidatario*, i.e. they do not have voting rights or rights to a share of the common resources*); avecindados* are residents officially recognized by the *ejido* assembly and registered by federal authorities, but who have no rights to land (although they may rent from others or work as laborers). More marginal groups, such as immigrants, may not be even officially acknowledged as *avecindados*. By no means all adults nor all heads of families living in an *ejido* are *ejidatarios*, as in principle these rights can only be inherited by one descendant. Thus after one or two generations there may be a large group of residents, who have no formal access to land and who are not necessarily *avecindados* in the legal way. It is possible that these landless groups are granted access to land by renting or allowing them to use land for *milpa* but this depends on land availability and the degree of organization of the *ejido*.

Ejidos were formed as part of the agrarian reform from the early 20th century, first to distribute to local people lands which had been latifundia and later, from the 1960s onwards, as a strategy to disperse the population. In this process large latifundia were nationalized and handed out to peasant communities, and a second form of land tenure arose when the legal rights to the ancestral land of indigenous communities were recognized. The land reform process started after the Mexican Revolution, and continued with various policy orientations up to the last quarter of the 20th century. In this latter period (1967-1992) it was mainly a bare land settlement policy. *Ejidos* were initially allotted a communal area and areas for the demarcation into individual plots. There are still some legal disputes around the boundaries of ejidos and ownership of properties. Table 10 presents the amounts of land distributed by presidential period from 1900 to 1992; overall 61% of the territory of the peninsula was granted to ejidos and communities in the past century (INEGI, 2010b).

Table 10. Land entitled to ejidos by presidential period in the Yucatan Peninsula (ha) (1900-1992) (INEGI 2010b).

Period	Campeche	Quintana Roo	Yucatan
1900-2014		2,635	697
1915-1934	270,044	14,793	734,000
1935-1940	1,472,103	433,614	520,900
1941-1945	20,555	1,075,288	358,769
1946-1952	7,980		68,984
1953-1958	62,664	10,382	46,532
1959-1964	266,432	171,844	74,899
1965-1970	513,083	301,429	461,345
1971-1976	144,136	246,386	47,816
1977-1982	268,594	305,790	73,852
1983-1988	326,536	216,568	42,180
1989-1992	3,508	29,505	1,290
Total (ha)	**3,355,635**	**2,808,234**	**2,431,264**
Extension State (ha)	**5,792,400**	**4,236,100**	**3,961,400**
Percentage (%)	**58%**	**66%**	**61%**

In 1992, in order to give legal certainty to investments and facilitate access to credit in rural areas, the constitution was modified to allow the disincorporation of specific plots of land from the *ejido* regime and privatize it (Torres Mazuera, 2014b); this was one of the many neoliberal policies implemented in the 1980s and 1990s. Following the reform, the PROCEDE program was created to demarcate the limits of the parcels in the *ejidos*, regularize them, provide certificates to land (communal or individual), identify all the members of the agrarian communities including the *avecindados* and *posesionarios*, and create internal codes of rules in the *ejidos* (Torres Mazuera, 2014b). The reform was inspired by the philosophy that clear property rights and an established market for land were essential for rural economic development (Torres Mazuera, 2014b). In addition to the different initial endowments, land concentration and inequality had been growing even before the 1992 reform by practices that were not officially allowed but were tolerated, such as sale of land certificates and the fragmented inheritance of parcels (Warman, 2003), and this process accelerated after the 1992 reform. Agriculture by contract and extra-legal land lease also existed at this time. Another historical process contributing to the asymmetric distribution of resources in Yucatan in particular was the economic parcelisation of *ejidos*. From the 1970s there were programmes to promote rural productive cooperatives that were used to make an economic parcelisation of *ejidos*. However in some cases dominant members of the cooperatives took control over the plots of land assigned, keeping the most productive lands for their individual use. This temporary situation was made permanent after the certification of PROCEDE (e.g. in Mani, Huntochac, Tzucacab, Yucatan) (Torres Mazuera, 2014b; Torres Mazuera, forthcoming).

The constitutional reform allowed that once an area was privatized and became *freehold* (*dominio pleno*) any further decisions and transactions made did not need to be made by or validated by the *ejido* assembly. The privatization process of lands has to follow the procedure defined by law, however this is not always done in practice and transactions may have little legal certainty; they may be contested and land can enter into dispute (Torres Mazuera, 2014c; Torres Mazuera, forthcoming). Many of the objectives of PROCEDE were not accomplished since only 1.4% of parcels were under freehold in 2006, moreover only 4.5% of total credit targeted the primary sector and in general there have been no new joint ventures between ejidatarios and external investors (SRA, 2006; Rello and Saavedra, 2007; and WB 2001, in Torres Mazuera, 2014b). Perhaps the most relevant outcome of the program was the regularization of the land market which enables ejidatarios to sell their land, usually their most productive asset. When land is sold new owners usually start new productive activities causing deforestation to take possession of land and recover the investment made (i.e. commercial agriculture, urbanization, pastureland). This has had very important consequences in the Peninsula especially in Campeche where there have been sales of agricultural land by *ejidos* to private individuals, companies and communities such as the Mennonites.

The importance of inequality of initial allocation of land in the Yucatan Peninsula to *ejidos* in terms of forest resources is outlined in Skutsch and Balderas Torres 2015. While some *ejidos* in the Zona Maya have 50,000 ha of *selva alta*/*mediana* shared between perhaps 100 ejidatarios, others have only 5000. The numbers of ejidatarios is also very variable. The explanation for why the distribution of land was carried out in this way is found in the policy objectives that justified the creation of an ejido, which is stated in the creation decree and linked to the agrarian policy prevalent at the time and place the ejido was formed. For instance in the late 1930s during the presidency of Cardenas ten large chewing-gum based *ejidos* (*chicleros*) were created allocating around 420 ha of forest per *ejidatario* (this was estimated as optimal for the harvesting of chicle); later, agriculturally based ejidos were created to receive immigrant farmers around the *ejidos chicleros* with an endowment of 20 ha per *ejidatario* (Bray and Klepeis, 2005). It is clear that inequality in forest distribution is not limited to the Yucatan but is found all over Mexico, Skutsch et al 2014). This has a major effect on the viability of forest enterprises (economies of scale), and

also on the potential for sustainable management and participation in REDD+ activities. It is clear that from the initial design of ejidos, a livelihood strategy was in the mind of the federal government: the allotment in the ejidos chicleros would allow the ejidatrios to perform these forest-based productive activities while the vocation of the other ejidos were agricultural practices.

There are certain differences among the three states that form the Peninsula that need to be mentioned. The first factor is the indigenous population of the Yucatan Peninsula. According to the 2010 census data, among the ten Mexican states with highest proportion of indigenous households, Yucatan is first (with 51.4%),Quintana Roo fourth (with 32.7%), and Campeche fifth (with 21.3%). Though it is necessary to mention that in Quintana Roo and Campeche, as in Yucatan, the most important indigenous group is the Maya, recent migration from other parts the country brought indigenous populations of other ethnic origins, who do not speak Maya and thus may find extra difficulties in economic integration as their ethnicity is not accepted locally.

The second factor is access to land. The Mexican agrarian reform had two quite different stages; the first a true agrarian reform that tried with some success to modify land ownership by granting land taken from large private estates to landless peasants. In Yucatan, social conflicts caused by the 1929 crisis started the distribution in 1934 of henequen haciendas to the workers. This was followed some years latter by huge grants in Yucatan and the forest ejidos in Campeche, involved in chewing gum collection from 1935 to 1940, and some years later (1940-45) the same thing happened in Quintana Roo (see Table 10). Later after 1960, land granted was mainly a bare land colonization policy, that gave out national land to landless peasants of central and northern Mexico in the tropical low lands, to ease social tensions following the agricultural crisis of the 1960´ss, when prices of export crops fell (particularly cotton).This did influence the land use policy in the Peninsula of Yucatan as it opened the way to large rural development projects that in the end failed to create a productive economy.

Ejidos can provide land rights and recognize new *posesionarios* or *avecindados* and *ejidatarios* but this is an improbable, costly and slow process, and does not happen very often (Torres Mazuera, 2014b; forthcoming). Even before the 1992 reform, *ejidatarios* could ask the federal government for the extension of their *ejido*, but the process took more than ten years and was subject to political interests (Warman, 2003). Apart from other matters, many *ejidatarios* are reluctant to increase their numbers because this implies a small share of the resources for all.

An unexpected outcome of PROCEDE was that ejidos have become more unwilling to include non-ejidatarios as regards land-access. The reasons for this include: the concern that larger families with be favoured if new land allotments are to be made on a per capita basis; the interest of current ejidatarios in keeping their power in relation to other local social groups (non-ejidatarios often function as labourers for ejidatarios); and the often unjustified reason that there is no more land available (Torres Mazuera, forthcoming). However there are also occasional cases where *ejido* committees include a large number of new *ejidatarios* as a mechanism to gain control of the *ejido* assembly. Table below presents the number of individuals with rights to communal parcels according to the ejidal censuses of 2001 and 2007 (INEGI, 2007); data shows the limited access women have to communal areas (under 7%, although in absolute terms figures increased by about 49% in the period); it also shows the pace at which new formal rights are granted in comparison with population growth. Considering the population growth in 1980-1990, the size of the cohort that might have reached adulthood during the period 2001-2007, the growth in the number of persons with access to formal land rights is far smaller –about ten fold for the combined figures-; although this is partly due to the fact that most of the newcomers landed in urban and touristic areas. Nevertheless the figures for Campeche and Yucatan do clearly show the gap between population growth and formal access to land rights.

Table 11.Number of individuals with formal rights to communal areas by gender (2001 and 2007) (from INEGI, 2007).

	2001			2007			Yearly Change 2001-2007	Yearly State Level Population Growth (1980-1990)
	Women	Men	Total	Women	Men	Total		
Campeche	3,101	42,360	45,461	4,616	41,951	46,567	0.41%	2.73%
Quintana Roo	3,132	32,040	35,172	3,981	32,126	36,107	0.44%	11.83%
Yucatan	4,196	121,819	126,015	5,754	123,111	128,865	0.38%	2.81%
Total	10,429 (5.0%)	196,219 (95.0%)	206,648	14,351 (6.8%)	197,188 (93.2%)	211,539	0.39%	3.98%

1.2.4.3 Legal framework for forest management

The legal framework for forest management and timber production in Mexico has evolved over the years and only recently included criteria for sustainable management. In the second half of the 19th century agrarian reform privatized indigenous lands to create timber and mining concessions for foreign and national investors through an approach based on 'forestry mining' (FAO, 2004). President Diaz gave massive forest concessions in Quintana Roo to local political allies who supported the creation of the federal territory, as well as to foreign companies. The administrations that followed the Revolution also created new concessions according to their interests; since at that time there was no distinction between new and old concessions and Mayan territories, this often created conflicts during the exploitation of timber and chewing gum (Ramayo Lanz 2014).

In 1917 the new constitution reasserted that ownership over forests and natural resources rested with the State, and in 1926 the Forest Law mandated that forest resources should be managed by *ejidos* through cooperatives, but there was no technical or financial support for this and thus exploitation in practice still relied on the private sector. The Forest Law from 1940 reintroduced forest concessions (of 25 years in average) in favour of large national and foreign companies working in Logging Industrial Units and during the 1950s banned areas were established to protect some of the forests. This negatively affected the direct use of timber products by local communities but did not stop illegal logging due to collusion with forest police (FAO, 2004). Throughout the 19thcentury and until 1953, timber production in the Yucatan Peninsula was based on selective logging without any management plan and it was focused on mahogany (*Swietenia macrophyllla*) and cedar (*Cedrela odorata*) (Flachsenberg and Galletti, 1999). In the south of the peninsula the largest harvest of mahogany and cedar occurred in Campeche during the 1950s through the public company Caobas Mexicanas or Impulsora Forestal Peninsular, although later MIQRO, Maderas Industrializadas de Quintana Roo focused on this state. From 1953 to 1983, forests in Quintana Roo were managed under a concession by MIQRO whose production was focused maximising the harvesting of cedars and mahogany trees with diameters of 50 cm or more. Since these two species represent only 2% of the stocks, the result was low intensity exploitation, and the clearings opened were not sufficient to allow natural regeneration of these species (Flachsenberg and Galletti, 1999).Some estimates indicate that from 1900 to 1990 around 156,000 mahogany trees were cut in the southern part of the Peninsula only (Klepeis, 2004; Bray and Klepeis, 2005).

Once the production of these species declined, public efforts focused on the promotion of agriculture (e.g. large scale rice production), and cattle rearing through the colonization policy (Bray and Klepeis, 2005). By the 1970s it was evident that the agrarian reform had failed and public land distribution was reactivated to reduce rural discontent, this included large areas of tropical forests (FAO, 2004); during the clearance for agricultural lands timber was often burnt. Much forestland was converted to agricultural use (Flachsenberg and Galletti, 1999); however forest

management plans and economic benefits from chewing gum exploitation in general were important incentives to keep parts of the original forest resources in the Peninsula (Galletti, 1989).

Following a period of opposition of *ejidos* to this policy, in 1986 the new Forest Law ended the concession system and the associated rental of land by *ejidos* while recognizing the rights of *ejidos* to manage their forests. This created the foundations for community forest management (CFM) in Mexico (FAO, 2004). The 1992 Forest Law liberalized the forest sector, opened the market for forest technical services (previously part of the public apparatus) and introduced the concept of sustainable forest management (the first certificates were delivered in 1993: note that ´sustainable forest management´ in Mexico usually refers only to sustainable timber management, in contrast to its use in other countries, which is broader) (FAO, 2004). The former public forest services at this time had little presence in the field but were more involved in the associated administrative and bureaucratic tasks. The 1992 reform helped to overcome centralized bureaucracy but the lack of clear regional forest management criteria dispersed the technical authority and created feuds between different technical service organisations (Flachsenberg and Galletti, 1999). In 2001 the National Forestry Commission (CONAFOR) was created as a decentralised entity to implement the forest policy and in2003 the Sustainable Forest Development Law was enacted. This reduced the regulation for commercial plantations, reinforced the rights of communities and *ejidos* to forests and their many benefits, promoted the creation of regional units for forest management and created the Mexican Forest Fund to support the provision of environmental services and production systems (Montes de Oca y Domínguez, 2004). The new forestry policy 2012-2018 has set as one of its objectives the increase of productivity of forests (CONAFOR, 2014).

1.3 Methodology

1.3.1 Drivers: literature review and fieldwork

The methodology adopted to prepare this report included extensive review of the literature and consultation of socioeconomic and demographic statistics, interviews with key informants from the three states of the Yucatan Peninsula and direct observation on the field. In combination with work that CIGA is doing for CONAFOR we carried out a series of field trips over the Peninsula covering different regions of Yucatan, Campeche and Quintana Roo from May 2014 to March 2015 (Box 2). The objective of the visits was to identify areas recently affected by deforestation and/or degradation in order to describe the drivers of these processes at the level of *ejidos* or private property owners. Different *ejidos* and regions were chosen because they presented specific dynamics related to the drivers of emissions, these include: commercial and subsistence agriculture; urban development; firewood collection and charcoal production; grazing; hurricanes; and unsustainable forest management.

Box 2. Communities included in the study made for CONAFOR study, Skutsch, de los Ríos and Balderas Torres in preparation.

Yucatan: Cantamayec, Cholul, Bolmay, Nohsuytun, Lol be, San Antonio Chuc, Chumbec, Chuyamel, Hunucma. Campeche: Katab, Xmaben, Chun Ek, Adolfo López Mateos (la desconfianza), Silvituc, Nuevo Becal, San Antonio Soda, El Lechugal. Quintana Roo: Tomas Garrido, Tres Garantías, Caobas, Petcacab, Tabi, X-Pichil, Gustavo Díaz Ordaz, Caoba, Noh Bec.

Although the analysis of the abovementioned work is on going, here we consider some of the qualitative information gathered in 40 interviews made in 20 ejidos and case studies to identify different processes and dynamics associated to each of the drivers of emissions and the stakeholders involved. Based on these notes specific dynamics associated with each driver of emissions and productive activities associated were identified. Drivers and emissions differ in terms of local

ecological and socioeconomic conditions. Based on the description of the different drivers, we made an assessment of which stakeholder groups are involved in each driver. These stakeholders are characterised as ´poor´ or ´non-poor'. It is understood that in some cases whole communities may be characterised as ´poorer´ and that in most others, there are individuals or social groups within them that are so characterised. Later we identify the potential interventions to address each of the typical drivers of emissions from deforestation and forest degradation stemming from efforts at the local, regional and national levels. Each of these strategies is assessed according to its theoretical capacity for reducing emissions or increasing sequestration rates and the associated requirements for implementation. Finally the REDD+ activities and policies are analysed identifying the potential niches for implementation and for pro-poor benefit sharing schemes. The following section describes the specific consideration for the analysis of pro-poor approaches.

1.3.2 Pro-poor approaches

With focus on pro-poor approaches for REDD+ benefit sharing, two aspects are important: first the design of the interventions to address drivers of emissions and secondly the impact these can have in poorer groups. The impact that REDD+ can have in alleviating poverty is evaluated from an asset-based approach (Carter and Bennett, 2006). In this context pro-poor potential of REDD+ interventions can be evaluated in terms of the expected changes in the income of poor households (e.g. when a group of stakeholders is compensated in cash or in kind for their participations or results), or by monitoring the changes in their productive assets. The analysis considers the impact the dynamics driving emissions and the potential REDD+ interventions can have on the productive assets of different social groups in the Yucatan Peninsula.

1.3.2.1 Solutions to poverty.

Social policies can only partially address problems caused by failure of economic policies, economic crisis and institutional change, thus it is necessary that poor communities participate in markets in a more profitable and equitable manner (Escobar Latapí, 2005).In order to walk out of poverty, if neoliberal policies are going to be implemented the governments need to make sure that the citizens have a minimum asset base and market access to save, accumulate and succeed in a market economy (Williamson, 2003, in Carter and Barrett 2006).General strategies that can help to overcome poverty are asset accumulation, technical change towards more productive activities and favourable trade in terms of market access (Carter and Barrett, 2006). In the specific rural context, De Janvry et al (2000) identify four paths out of poverty: exit (immigration), agricultural, pluriactive, and assistance. Successful rural development to promote the agricultural and pluriactive paths would require a new approach based on regional development, decentralization and participation. The transference of best practices and technological packages in rural areas has an important role to play in the above two strategies. In Mexico, the bulk of the benefits from technological change and modernization have not been captured by the low-income rural population. As shown in Table 12, overall less than a fifth/a third of the members of ejidos have received capacity building in the last five years according to the censuses from 2001 and 2007 respectively (INEGI, 2007). It is important to note that in the last census, the topic most commonly included in training was Agrarian Rights, while commercialisation was rarely included (these topics were not included in the earlier census); lower figures obtained are for the state of Yucatan, in terms of ejidos receiving capacity building, around 59% and 51% of all ejidos did not receive any training at all in 2001 and 2007 respectively (INEGI, 2007).

Table 12. Figures on capacity building to ejido members by main topics in the last 5 years according to the 2001 and 2007 censuses (total individual receiving training and % in relation to figures from Table 11)(Based on INEGI, 2007)*.

	Organisation		Land Management		Management (Crops, Forest)		Livestock		Commercialisation	Agrarian Rights	Total Figures (share of individuals)	
	2001	**2007**	**2001**	**2007**	**2001**	**2007**	**2001**	**2007**	**2007**	**2007**	**2001**	**2007**
Campeche	4,198	2,606	1,453	1,214	4,321	4,696	2,429	4,104	1,487	4,672	12,401 27.3%	18,779 40.3%
Quintana Roo	5,219	3,233	1,600	1,408	4,600	4,059	1,258	1,546	1,029	6,708	12,677 36.0%	17,983 49.8%
Yucatan	5,552	5,927	937	2,073	5,904	1,948	2,579	2,757	1,287	9,226	14,972 11.9%	23,218 18.0%
Total**	**14,969 (37%)**	**11,766 (20%)**	**3,990 (10%)**	**4,695 (8%)**	**14,825 (37%)**	**10,703 (18%)**	**6,266 (16%)**	**8,407 (14%)**	**3,803 (6%)**	**20,606 (34%)**	**40,050 (19.4%)**	**59,980 (28.4%)**

*It is assumed that the training from each topic was received by different individuals, thus overall figures are optimistic as some individual might have participated in different courses.
** Percentages refer to the figures on each census.

It is important to note that the international development programs promoted by the World Bank (WB, 2005) related to agriculture and natural resource management are specifically rural. These interventions include the construction of roads and social infrastructure (i.e. electricity, drinking water, transport infrastructure, housing). There are however different specific demands and provision costs in urban and rural areas in terms of the engineering; the operation and maintenance of such systems; and the forms of community participation are usually also different.

Considering rural poverty, it is a fact as De Janvry et al 2000 state, that the decline of rural poverty during the last decades has been uneven across countries in Latin America. The reduction in the number of rural relative to urban poor has been mainly the outcome of migration, not of successful rural development. Rural incomes may be explained by the assets held by households and the characteristics of the context where such assets are used. Given heterogeneity in asset positions and contexts, many strategies to escape poverty consequently exist.

Rural development of larger populations of small farmers living under poor conditions took place in Southern Europe under a combination of three circumstances: (1) a strong pull of surplus labor away from agriculture into more productive occupations both within rural areas and outside them; (2) relatively low natural population growth; and (3) fast overall economic growth, which allowed considerable investment in the education, the expansion of high productivity employment and the modernization of rural areas (Janvry et al 2000). However these conditions are not yet in place in Mexico. It is true that there are important migration flows (i.e. Rural-to-urban and rural-to-U.S.), but the demographic turning point has not yet been reached: the rural population is still growing and is expected to stabilize only around 2020. On the other hand rural education is rapidly decaying. In this context most of permanent migrants to urban areas in Mexico seem destined to swell the ranks of the urban informal sector where labor productivity may be larger than in marginal rural areas, but remains very low. Fertility rates in rural Mexico are falling but are still high. Finally, Mexico's long-term economic growth has been disappointingly low, at an annual average of around 0.3% per capita from 1981 to 2003and has only shown a quite modest recovery ever since.

At the individual and micro level, the *Voice of the Poor* can offer interesting insights that can be noted for the design of poverty alleviation strategies. The majority of the poor who participated in the study felt they had little chance for improvement but strikingly they were satisfied with their lives; nevertheless they believed their children would enjoy better conditions in the future (Palomar, 2005). Nearly 60% of the sample of the *Voice of the Poor* considered that the best way to overcome poverty is through employment, higher income (i.e. higher prices for crops) and better salaries (Cordera Campos and Flores Angeles, 2005); prospects for future improvements were also associated with higher levels of education (Palomar, 2005). On the other hand the remaining 40%, who associate poverty with fatalistic causes (e.g. they cannot do anything because they are poor because it is divine will), have more urgent needs and prefer "traditional" social programs (Cordera

Campos and Flores Angeles, 2005). It has been suggested that fatalistic beliefs about the causes of poverty can be changed if different churches join efforts against poverty (Dieterlen, 2005). Although employment is seen as one of the most important ways out of poverty, because of the socialist values that were dominant at the time when many ejidos were formed, the rich are often identified as the main enemies of the poor (Dieterlen, 2005). This may result in potential conflicts or mistrust in eventual collaboration in development strategies. When the poor were asked which institutions they would prefer to collaborate with to alleviate poverty, less than 5% said they would collaborate with the church, and less than 2% responded they would collaborate with a NGO/CSO; the first choices were the government and their own families (Székely 2005). This has important implications as regards the definition of the relevant actors and development agencies that can collaborate in poverty alleviation efforts. In the analysis of the effect of social assistance programs in Mexico, Hernandez Licona and Razo Martínez (2005) found that recipients of these policies perceive themselves to have a higher level of wellbeing than equivalent groups not receiving them; however those not receiving these programs were more likely to start their own business, with a higher labour effort often involving children. Neither of these groups considered social assistance programs were sufficient to overcome poverty. Based on their findings, the authors indicate paternalistic approaches to poverty alleviation can address urgent needs of the most vulnerable groups, but they have the risk of producing benefits only in the short term (Hernandez Licona and Razo Martínez, 2005).

1.3.2.2 Empowerment

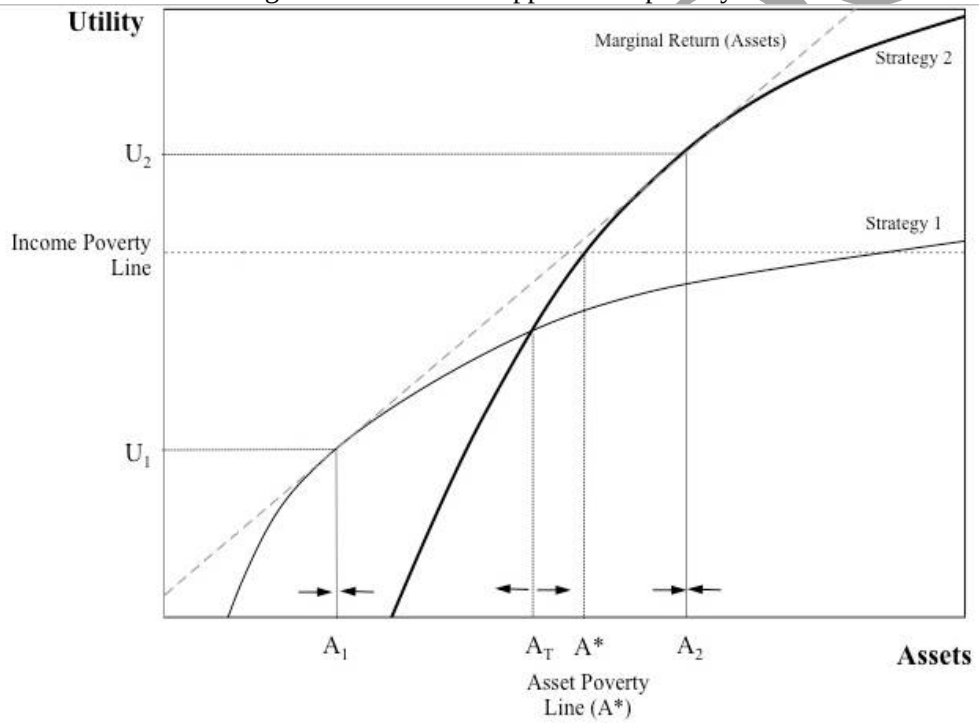
In order to take the opportunities to generate income, accumulate assets and overcome poverty, among many other factors, it is necessary that individuals and social groups hold a minimum level of power and motivation; an integral strategy for poverty alleviation should consider the creation of the enabling conditions by which individuals can increase their authority and power over decision-making processes affecting their lives and resources they have available (Perez Fernandez et al 2005).Dimensions for empowerment include economic capital, social capital, citizenship, familiar relationships and individualization (sense of self determination and independence) (Perez Fernandez et al 2005). Perez Fernandez et al (2005) analysed the responses of the *Voice of the Poor* from a perspective of empowerment to identify the variation in the responses depending on the degree of individualization. Results showed that respondents with higher levels of individualization were more productive and considered poverty is not caused by divine design but by a lack of hard work. Their analysis also indicates this group searches for autonomy, employment, opportunities and education. It is important to remark that individuals are empowered by themselves, not by the government or by others (Sen, 1997 in Perez Fernandez et al 2005) and that empowerment takes place through experience and not only through capacity building. Specific options for poverty alleviation in this context include microcredit, self-employment, distribution networks, supply chains, cooperatives and the creation of public spaces for the formation of citizenship. For those groups less empowered, recommendations for poverty alleviation policies include, but obviously should not be limited to, the promotion of actions to increase self-esteem, proactivity and citizenship (Perez Fernandez et al 2005).

1.3.2.3 An asset-based approach to poverty alleviation

Carter and Barrett (2006) define assets as the conventional privately held productive and financial wealth along with the social, geographical or market access positions that provide economic advantages. A livelihoods approach to development is based on the idea that prospects for prosperity relate to the stocks and changes of livelihoods or communities in five dimensions or capitals: natural, social, human, productive and financial capitals (Carney, 1998).Different livelihood strategies use and transform the resources available and thus produce different patterns of

accumulation of assets, goods and money; it is possible that some sets of activities are preventing the accumulation of capital and investment as productive assets, in other cases it may be possible to identify clear patterns of accumulation or degradation of the different productive capitals (Carter and Barrett, 2006).By using a dynamic asset-based approach to poverty it is possible to identify groups that may be escaping poverty by luck or by random reasons and those who might be structurally poor; for this it is necessary to elucidate if poor groups are accumulating assets and if they experience increased returns to those assets over time (Carter and Barrett, 2006). As pointed out by these authors, if the reasons why people is getting into or out of poverty are not identified and the processes that are influencing the accumulation of capital or loss of assets are not identified, it will not be possible to identify consistent policies to alleviate poverty. In order to evaluate the potential pro-poor benefit sharing schemes in REDD+, a qualitative analysis of the productive assets of the poor is made for the different drivers of emissions and the potential interventions to address them. Figure below is taken from Carter and Barrett (2006) and it shows the level of income for a household that can follow two development strategies depending on its level of productive assets (Strategy 1 and Strategy 2), for instance Strategy 1 corresponds to a subsistence activity in agriculture, while Strategy 2 can represent an off-land employment.

Figure 8. Asset based approach to poverty alleviation.



It is possible to have more strategies lying to the right of the diagram in Figure, each depicting a higher level of utility associated to increasing levels of assets. Strategies producing higher returns require a minimum scale so only wealthier or organised groups can access to them. Additionally it is important to consider that some poor households may use assets to reduce risks rather than to produce gains (e.g. in rural areas small scale cattle rearing is usually quoted as a form of savings as the animals are used in case of need). Following the framework proposed by Carter and Barrett, the diagram assumes reduced marginal returns to assets; for any given movement in the horizontal axis to the right, the gain in income associated with an increase in assets tends to diminish. The line of Marginal Return (Assets) shows the points for Strategies 1 and 2 at which further increases in assets produces an increase in utility by only a fraction. Considering this, a household basing its survival on Strategy 1 and an initial asset level below A_T will tend to reach a steady state at A_1, with an

associated income of U_1 well below the poverty line. Likewise a household following a Strategy 2 will find a steady state at A_2 with an associated income above the poverty line (U_2). A_T marks the threshold at which assuming there are no restrictions to the transition from livelihood strategies, households can change from strategy 1 to strategy 2. Given the relative higher returns to assets after A_T, associated with strategy 2, households can continue accumulating assets until reaching a way out of poverty and finding a new equilibrium in A_2, U_2. It is possible that households staying at asset levels of A_1 save capital and accumulate assets so they can reach A_T and shift to Strategy 2, but this is quite unlikely considering it requires large further sacrifices in consumption in order to save. Ideally this long process could be bypassed if households have access to credit and there were an efficient transition from one livelihood strategy to the other. However this is not often the case in rural marginal areas. In this diagram, households with assets below the critical of assets A_T are expected to remain poor while those with assets above this threshold are expected to get out of poverty. This approach allows the evaluation of the existence of minimum configurations of assets or economic conditions to get out of poverty and identify minimum asset bundles (Williamson, 2003 in Carter and Barrett, 2006). The existence of a threshold is influenced by the degree of exclusion to capital or inter-temporal exchange (e.g. credit, insurance, savings); by increasing access to capital the household will have the resources to build its assets and income (Carter and Barrett, 2006). An important question in relation to the critical threshold level is how far the poor households are from it since the longer the distance the smaller the probability of shifting the strategy. This approach can also help to design contingency plans and safety nets by acknowledging that in the long term the impact of a shock, for instance a hurricane, does not depend only on its magnitude but on the final state in which the households end in the asset-level scale after the shock (Carter and Barrett, 2006).

The analysis of potential for poverty alleviation from an asset-based approach departs from the description of the livelihood strategies of poor groups and their available typical assets. The aim is to identify the critical assets and conditions that might enable them to shift to livelihood strategies to produce higher levels of income and the impact that drivers and shocks can have on this. The analysis does not include a quantitative estimate of the income of specific groups since actors have many different strategies for productive activities which they can choose from, often their choices are restricted by socioeconomic and natural conditions and their labour and capital available in the household; this type of analysis requires an extensive research effort to apply ad hoc surveys and perform econometric analysis out of the scope of the present work but can be a matter for further research.

2 Identification of drivers of deforestation and degradation

2.1 Drivers of forest carbon emissions in Mexico

The drivers of deforestation and degradation in Mexico as a whole have been described in broad terms, for example in the Vision for REDD+, a document that underlies Mexico´s REDD+ policy. In this it is recognised (pp. 14-15) that the problems underlying deforestation and degradation are structural (CONAFOR, 2010). Although the larger part of change of forest land to other uses is the direct result of activities in the agriculture and cattle rearing sectors, and to lesser degree to urban and infrastructure development (direct drivers), underlying these there is a general lack of coordinated land use planning controls (indirect driver) and poor coordination across sectors, particularly between policies for agricultural and forestry, for example in the distribution of subsidies to *ejidos* and to individual land owners. While production of timber is not very competitive commercially because of poor accessibility and low productivity, there are short term subsistence demands in poor rural areas for use of forest products and forest areas (for timber, poles, firewood, fodder and grazing as well as agriculture) which need to be satisfied. Even though Mexico´s tenure situation is relatively clear, there are nevertheless problems of property rights where there are conflicts within or between communities, and where there has been illegal parcelization of the community territory (indirect drivers). Degradation is associated with shifting cultivation, unsustainable forest management, overgrazing, firewood extraction, fires, forest diseases and pests. In specific regions land tenure conflicts are linked to illegal deforestation (CONAFOR 2010). Indirect drivers include lack of investment; lack of coherence between different government policies; low competitiveness of forest sector; poverty; unemployment; perverse subsidies; and natural disasters (e.g. hurricanes)(ER-PIN 2014; FIP 2011). Conditions vary greatly in different parts of the country, and the Vision suggests that there is a need to develop consensus on both the causes and the trends in different regions. It may be noted that not much distinction is made in this report between causes of deforestation and causes of degradation. This conceptual gap, which as noted above may have its origins in the general lack of data on degradation, is one that could seriously hamper the design of interventions under REDD+.

2.2 Drivers of emissions in the Yucatan Peninsula

At the level of specific regions it becomes easier to focus on local processes that result in deforestation and degradation. There have been more academic studies on these in the Yucatan Peninsula than in almost any other region in Mexico, perhaps because of international interest in the Mesoamerican Biological Corridor. However it should be noted that most of this literature refers to deforestation rather than degradation[4].

In studies on the Yucatan Peninsula, a variety of definitions of forest, methods, and scales of analysis for assessing rates of deforestation have produced vastly different estimates (Rueda 2010).For example, one study estimated the annual deforestation rate in the southern Yucatán region to be 2% between 1975 and 1985 (Cortina Villar et al 1999).At the same time, the estimated rate of deforestation for the entire state of Campeche was 4.5% between 1978/1980 and 1992 (Mas Caussel 1996).By counting late successional growth as forest, Bray et al. (2004), reported a net deforestation rate of only 0.1% for central Quintana Roo from 1984-2000.In contrast, by eliminating successional growth of less than 25 years from their definition of forest, the southern Yucatan Peninsular region project reported an annual deforestation rate of 0.29% in southern

[4]The following paragraph which reviews the available literature, was prepared by CIGA for CONAFOR in 2013 by Skutsch et al 2013.

Quintana Roo and Campeche for the period 1984-1993, and a reduced rate of 0.21% from 1987/1988-2000 (Turner et al. 2004).The region is much in the eye of environmentalists and ecologists and has been designated as a biodiversity and deforestation "hotspot" (Archard et al. 1998). Consequently, a large number of academic and other studies have been carried out focusing on the loss and partial recovery of forest cover, with particular attention to the central and southern regions (e.g. Reyes-Hernández et al, 2003; Turner et al, 2004; Bray and Klepeis 2005; Vester et al, 2007; Ellis and Porter-Bolland, 2008), probably in connection with the international designation of this part of the Peninsula as a biological corridor. Interestingly, despite the relatively high levels of deforestation that pertain to the state of Yucatan, very few studies explore land use changes in this particular state.

Field observations undertaken for a parallel study undertaken for CONAFOR (Skutsch, de los Rios and Balderas Torres in preparation) indicate that a large number of drivers are involved in deforestation and degradation (Table 13) but that the pattern varies across the region. In the sections on each individual driver, this will be explained in more detail.

Table 13.Summary of the main drivers of emissions in the Yucatan Peninsula.

Type	**Drivers**
Direct	
Deforestation	Commercial Agriculture; Large scale pasture development; Urban Expansion; Infrastructure; Mining (small scale).
Degradation	Shifting Cultivation (subsistence); Overgrazing; Natural disasters (Hurricanes and fires); Unsustainable Forest Management for timber and associated illegal logging; Firewood Extraction; Charcoal Production; Forest Diseases and Pests.
Indirect	
Demand Side Factors	International markets; Commodity prices; Population growth; Demand from domestic markets; Land grabbing; Speculation (foreign investment).
Institutional Factors	Poor governance enforcement and coordination; Corruption; Land tenure uncertainty; Inadequate planning/ management; Conflicting policies; Poor capacities; Leakage; Perverse subsidies; Low institutional presence; Lack of local rules for management and conservation
Local Socioeconomic Factors	Poverty; Poor capacities; Lack of investment and competitiveness of forest sector; Unemployment (off-land income); Migration and labor opportunity cost; Risks and perceptions; Savings and liquidity; Land availability (age, *ejido* size, population); Distance to forest.

We describe the dynamics associated with commercial agriculture, pastureland development, urban expansion in the case of deforestation; and of shifting cultivation, hurricanes, unsustainable forest management, firewood extraction and charcoal production in the case of degradation. In the narrative of each of these main direct drivers we mention other indirect drivers. We also specifically describe aspects related to conflicting policies (subsidies) and governance given the importance of this driver.

2.2.1 Shifting cultivation and subsistence agriculture

Subsistence practices based on *milpa* involve a long-cycle in which an area is cleared and burned before being used for cultivation of maize, beans, squash and other crops for a period of two or three years; later the area is left during several years to allow the vegetation to regrow (Figure 9).The landscape thus consists of a mosaic with occasional patches of cultivation spread out over large areas of *acahual* at various stages of development. Teran and Rasmussen (2009) offer a comprehensive review of the *milpa* system of Mayan communities in Yucatan and identify various factors which limit the productivity of this traditional agricultural system, these include: the reduction of fallow cycles, the impact on soil fertility associated with the parcelisation of agricultural land, population growth, the displacement of milpa practices from the once most productive lands to marginal areas; and the poor knowledge of traditional practices particularly

among non-Mayan immigrants. To this list we may add the effects of PROCAMPO, an agricultural subsidy to individual farmers which is tied to specific parcels of land, which has the side effect of reducing the rotation length in shifting cultivation cycles. The productivity of the *milpa* in prehispanic times was higher because it was the predominant if not unique agricultural practice and all land was under a common or open access use; the latter allowed members of families and communities to move throughout the Peninsula more or less freely in the search of *high* forests (*monte* or *selva alta*) to clear it an grow the *milpa* (Teran and Rasmussen, 2009). Clearing of *selva alta* is no longer permitted for *milpa*, but in Yucatan state, where most of the forest is *selva baja* and *selva mediana*, *milpa* was carried out on around three quarters of agricultural land in the 1990s (Teran and Rasmussen, 2009).

Figure 9. An area of *milpa* in Yucatan and a fallow recently cleared in Quintana Roo.

In Yucatan State the soil is young, stony and poor, thus the fertility lies in the vegetation; by burning the fallow or *monte*/*selva*, nutrients are transferred to the soil (Teran and Rasmussen, 2009). The fertility of the *milpa* is one of the main productive assets of farmers and is related to the age of the *acahual* or *monte*, which requires from 16 to 25 years to be replenished. According to Teran and Rasmussen (2009), each producer should work over a large area, ideally having a parcel of 32 to 50 ha with 2 ha of "active" milpa every year. However for various reasons the fallow cycles have been reduced. They note for instance that in Xocen Yucatan, due to population growth and the size of *ejido* parcels, the length of the cycle has been reduced to 6 to 8 years, thus reducing also the productivity (Teran and Rasmussen, 2009).

The *milpa* traditionally does not involve either irrigation or animals, and production rates are around 0.8 to 1.2 tonnes of maize per ha (Teran and Rasmussen, 2009). *Milpa* is a multi-crop strategy which helps to reduce vulnerability to risks since if one crop fails others may succeed. The relatively recent geographical confinement of communities to specific cultivation areas within the *ejido* territory together with population growth has increased the pressure on land and reduced the fallow cycles. Thus the only option available to increase the productivity of the *milpa* at present is through the application of fertilisers, or compost, which comes at a cost for the producer. In some cases it is observed that farmers are now using herbicides instead of fire a strategy to control weeds. Producers can access subsidies for some agricultural practices (e.g. PROCAMPO) to finance these costs.

However the historical knowledge of traditional *milpa* is being lost. One factor to consider is that in many *ejidos*, particularly in Campeche and Quintana Roo and at a lesser extent in Yucatan, many farmers are immigrants from other parts of Mexico (e.g. Michoacán, Veracruz, Chiapas). Immigrants coming from different socio-ecosystems, such as temperate or semiarid areas do not possess the local knowledge on how to manage local species and resources and on how to perform

traditional agriculture effectively. Immigrants trying to replicate their older practices in the new territory often failed. The emigration of young members of Mayan communities to urban and tourist centres for employment also threatens the transfer of the traditional knowledge about *milpa* as a farming system.

Milpa and Commercial Activities

It is important to point out that manual *milpa*-based agriculture can also target commercial markets and cash crops. The case of Guatemalan Mayan immigrants communities of Mayatecun camps in Campeche present an example. The immigrants arrived to the camps in the 1985 following the civil war in Guatemala and were endowed with very small areas (around 1 ha per family). Initially, the communities had no access to social or agricultural subsidies but had strong social capital and traditional agricultural knowledge and started to develop intensive agroforestry systems with various production cycles (Figure 10); this enabled them to accumulate profits particularly from the sale of pumpkin seeds. Back in Guatemala many producers had successful experience in the commercial production of cardamom in the Petén area. Given their migratory status as political refugees some of them were able to emigrate and work to the U.S. and capitalize to invest in more land from neighbouring *ejidos*, which was incorporated, into their successive productive practices. At the local level there are different views on the pathways that immigrant communities have followed in contrast with ejidatarios. In the opinion of the immigrants, the ejidatarios do not work hard and rely on public subsidies, while in the opinion of the latter, prosperity in the camps was due to the possibility to go to the U.S. and capitalize. Under this more intensive model of manual agriculture, demand for agricultural land for subsistence practices can be reduced and may provide even some cash income; it is expected that the limiting factor becomes the labour available in the household.

Figure 10. Agroforestry practices close the camps of Guatemalan refugees.

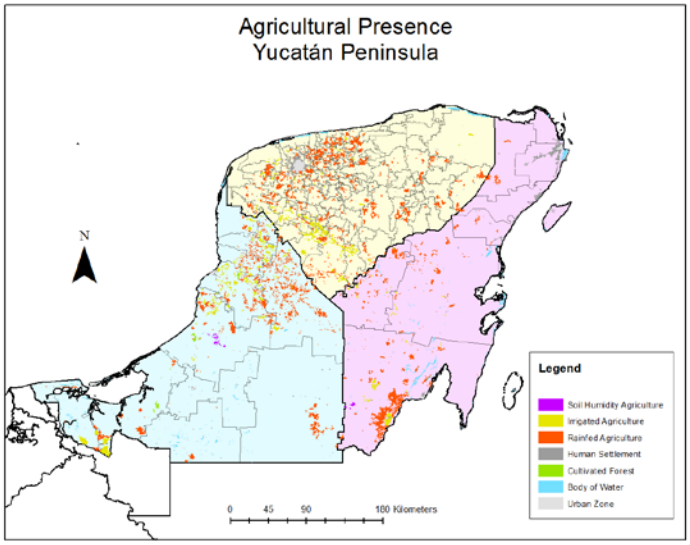
2.2.2 Commercial agriculture

Commercial agriculture, along with cattle rearing, is the most important direct driver of deforestation in the Peninsula. The main commercial crops in the region are maize, sugarcane, fruit trees (Figure 11). In later years there are some palm oil plantations that have been developed and there is one oil plant in the Peninsula; the majority of palm plantations are in the vicinity of the plant to take advantage of low transportation costs.

Figure 11. Commercial agriculture (citrus fruit, henequen, soy and sugarcane).

In the past, during the late 1800´s and the first half of the last century, large areas were used to grow henequen particularly in Yucatan. Later in the 1930s to 1970s, several waves of state interventions shaped agricultural practices in the peninsula. This resulted in clearance of both, secondary or primary forests. Figure 12 Presents agricultural areas identified on the Serie V of INEGI which was developed from 2012 to 2013 based on the analysis of SPOT imagery (INEGI, 2015a; Victoria-Hernández et al. 2011); due to its low resolution the map is unable to capture small areas dedicated to agriculture under shifting cultivation systems or those in small parcels much smaller than 25 ha.

Figure 12.Agricultural areas in the Yucatan Peninsula (INEGI, 2015a).



High input and low labour commercial agriculture requires good soils and availability of water over large and compact tracts of level land to develop economies of scale particularly when agricultural machinery is used (i.e. tractors, seeders, harvesters, etc.). These practices are usually highly capital intensive and require purchase of inputs such as improved seeds, fertilizers and pesticides. Capital or credit is also required for investment in machinery, improvement of access roads, in some cases for the provision of electricity, wells and irrigation systems and to install equipment to dry and store products (i.e. in the case of grains). Some other commercial crops are highly intensive in labour and represent employment opportunities for members of local communities (i.e. tomato, cucumber). Regarding the use of improved seeds, there have been controversies and conflicts related to the use of genetically modified crops in the Peninsula, particularly since this poses a threat to producers and exporters of organic honey. In 2014 a group of honey producers obtained legal protection and a prohibition on growing Monsanto GM soya in the Peninsula (Boffil-Gómez, 2014).

There have been many public projects to promote the establishment of commercial and mechanized agriculture throughout the Peninsula (e.g. for producing maize, fruit trees and rice); as part of these programs, producers have received preferential credits and subsidies to buy productive inputs. Many of these projects and initiatives failed and often the equipment and machinery can be seen abandoned or dismantled on the field and villages (Figure 13, for instance in the image on the right, the transformer required for powering an irrigation system was stolen to sell the copper).The failure and in some cases the mismanagement of these initiatives resulted in a lack of resources for reinvestment to maintain the productive assets and commercial activities. As it could be observed in the field many such programmes have shown themselves to be unsuccessful as the development of the valley of Edzna and Yohaltun and the production of rice in Escarcega; however these cases are poorly documented.

Figure 13.Abandoned and dismantled agricultural equipment and machinery

Since the late 70´s/early 80´s different Mennonite camps have been created in the Peninsula to host families from the communities from the northern part of Mexico (e.g. Durango and Chihuahua). These have been associated with large areas (greater than 500 hectares) of forest cover being converted to agriculture in one go to establish larger, market-based agricultural clearings for mechanised, high-input production of maize (Skutsch, de los Rios and Balderas Torres, in preparation) (Figure 14).These communities have been successful in establishing mechanized agriculture and investment cycles which are reflected in the renovation of machinery and agricultural infrastructure, purchase of additional land for further development and provision of technical services in the region to reactivate abandoned machinery. The creation of economies of scale through the cultivation of large tracts of land and the access to facilities for post-harvest management and storage increase the leverage of these producers to access external markets, negotiate prices and make a profit.

Figure 14.Inputs and mechanised commercial agriculture.

This type of investment can only be made if there is certainty over the permanence of productive activities in the long-term for which clear forms of access to land have been devised. Much of the land used by the Mennonite communities in the Peninsula has been rented or leased from *ejidos*, which is permitted for up for 30 years. However after the reform of 1992, *ejidal* rights can also be traded and ultimately *ejido* land can be disincorporated to become private under freehold or "small property" (i.e. in Spanish *pequeña propiedad con dominio pleno*).Figure 15 shows machinery used for large-scale deforestation recently in the Peninsula, denoting that commercial agriculture is a capital intensive activity.

Figure 15. Machinery used for deforestation for commercial agriculture.

2.2.3 Cattle rearing and pasture development[5]

The conversion of forest to pasture is one of the most significant changes documented over the past decades in the southern parts of the Yucatan Peninsula. Busch and Geoghegan (2010) found that for the period of 1997-2003, conversion of forest cover to pasture for cattle ranching was the main driver of deforestation[6] in this region. The underlying cause of pasture development is the shift from more labour-intensive activities since cattle ranching frees up labor that can be used for other income generating activities, such as off-farm employment, often involving migration (Busch and Geoghegan, 2010; Radel et al 2010; Busch and Vance 2011; Radel et al 2013; Radel and Schmook, 2008a; Radel and Schmook, 2008b). Cattle ranching is well suited to households with abundant land but scarce labor availability, is less risky than crop cultivation in the face of climatic extremes

[5]The first three paragraphs of this section are based on Skutsch et al. 2013.
[6]Busch and Goeghegan (2010) define deforestation as "land under agricultural use whether clearance of primary or secondary forest" (191).

in that the animals serve as a form of savings (i.e. Radel et al 2013; Busch and Vance 2011). This conversion does not translate into a direct threat to primary forests as long as there are fallows still available for agricultural activities (Vester et al 2007). However, despite an increase in pasture, between 1993 and 2000 deforestation trends decreased compared to other periods and only 0.5% (6,130 ha) of upland forest was cut (Rueda 2010). This was due to households' increasing use of successional-growth land (acahual) for agricultural production activities (Vester et al 2007). Despite the prevalence of *milpa* and chilli cultivation in the area (see Keys 2004), Radel and Schmook (2008b) found that households engaging in labor migration to the U.S. were more likely to expand land under pasture and less likely to be cultivating maize or chilli.

The effects of migration on deforestation and the conversion to pasture, particularly the gendered patterns of migration, are significant in the region. In the early 2000s, male migration had a significant influence on shifts away from *milpa* and chilli cultivation to pasture (Radel et al 2010). During the later part of the decade, remittances from migrating daughters provided the necessary capital for further pasture and cattle expansion for some households. Meanwhile, sons are expected to save in order to establish their own households upon return.

However, it is important to note the significant difference in the region between actual cattle ranching, and simply converting forest cover to pasture without cattle. Radel et al. (2013) have shown that the number of households in the municipality of Calakmul who actually own cattle, although slowly increasing (10% in 2003 and 12% in 2010), remains significantly lower than the number of households which have pasture (49% of households in 2003 and 61% in 2010). It seems that pasture is often established in anticipation of purchasing cattle or more likely for the purpose of renting to cattle owners. During this same time period, households with cattle increased their herd size from an average of 11 to 43 heads (Radel et al. 2013), indicating a more than fourfold increase in the cattle population of the region and demand for (rented) pastureland.

In the central part of Quintana Roo in the 1970s and 80s deforestation occurred for the establishment of pastureland, promoted by public programs, however most of these efforts failed since the cattle did not arrived, and thus some parts became acahual and others were integrated into subsistence agriculture (Bray and Klepeis, 2005). Pastureland and cattle have been traditionally developed in northern Yucatan close to Tizimin area, around Champoton and Escarcega in Campeche. Underlying drivers relate to the demand for beef and dairy products at the local, regional and national levels. In some towns, animals can be slaughtered locally to supply beef to butcher shops and milk is used to produce artisan dairy products (Figure 16).

Figure 16.Local butcher in an *ejido* in the Yucatan Peninsula.

Links to external markets are usually established via intermediaries to take the animals to regional or certified slaughterhouses (*TIF*, Federally Inspected Slaughterhouse Type); in Yucatan there is a

TIF slaughterhouse in Tizimin but it is insufficient to serve all the producers in the state thus often producers need to transport their cattle to other regions, at greater cost. One facility in Tabasco was closed down, concentrating market control in the hands of intermediaries and large companies. There are petitions to build this type of facilities closer to Mérida and there is one being built in Campeche. Large intermediaries and companies from the food industry are starting to build stables to buy the cattle directly from the producers and integrate the animals into their production system; for instance, SuKarne is a large private company that pays directly to the producers in cash and processes and trades around one third of all beef products in Mexico (Rodriguez Munguia, 2013) (Figure 17).

Figure 17.Collection point of cattle for SuKarne.

Regional cattle ranchers of medium size often agree with ejidatarios and community members to breed the cattle through joint ventures called *medias*, or *medieros* (a term which originally meant ´share croppers´). In this case the intermediary or *ganadero* pays the ejidatario for the calf after it is weaned and the ejidatario covers the costs of fattening the animal. When the animal is ready for sale they share the commercial value of the animal by 50/50. In this case the ejidatario also covers the cost and risks in fattening the animal.

The large cattle ranches often belong to individuals living in the cities and usually it is not their primary productive activity; in these ranches activities are less intensive with labour as the limiting factor of production. The private ranches usually have good access by road and when cities or tourist areas expand they may be developed for residential urban uses. The cattle ranching for many of these owners is not really a profitable activity but simply one that is performed to hold the land until better opportunities arise. The production of cattle in tropical lands developed in the late 60´s as a result of certificates of agrarian safety (*inafectabilidad agraria*), new roads and a growing urban population, and caused deforestation of a lot of land in the 1950 in La Huasteca, in the 1960s in the south of Veracruz, Tabasco and parts of Campeche, and Tizimin and south of Quintana Roo in the 1970s.

Small-scale cattle-rearing is common in the Peninsula (Figure 18 b), usually limited to a couple of animals per family which are held in small cowsheds close to the house; one factor preventing the presence of more cattle in the *milpa* fields and larger *acahuales* is that producers are required by law to build fences to confine their animals and this is too expensive (Teran and Rasmussen, 2009).

Figure 18.Examples of cattle rearing, a) large-scale, b) small-scale.

2.2.4 Firewood collection

Firewood is an important source of energy in rural areas. It is estimated that in Mexico the consumption per capita is between 2 to 3 kilos per day in rural areas. It produces health problems due to indoor pollution mainly on women and children (Masera et al 2005). In marginal and isolated areas firewood is the first fuel choice for cooking and warming water; in poor regions around urban areas households usually also have the option to use LPG for cooking but will switch from gas to firewood depending on economic conditions (i.e. if they have employment and considering the relative costs of gas and availability of firewood close to the household). Thus, demand for this resource depends on the distance to urban centres, the extent of use of improved cook-stoves and economic conditions of households; improved cook stoves can reduce firewood consumption by around 67% (Berrueta et al. 2008)

There are belts around cities such as Merida and Valladolid where the peri-urban population may be active in extracting firewood for self-consumption and also for trading (e.g. Hunucma) (Figure 19). Collection of firewood for self-consumption is a good indication of marginality, and demonstrates the low opportunity cost of labour, particularly of older people and women who are most engaged in this activity. The price of firewood usually represents only the labour costs of gathering it. There are no legal restrictions on collection of firewood for domestic/subsistence purposes. However there is also demand for firewood for commercial activities and trade. Although in these cases collection practices should have a management plan authorized by environmental authorities, in practice there is very little control of trading at the micro level, and it common to see poorer people (particularly older men) transporting bicycle loads of firewood into the cities for sale. This firewood is used in small industries and restaurants in the cities (e.g. bakeries, pizza restaurants, tortilla producing shops).

Figure 19.Examples of the use of firewood for commercial purposes.

The impact of firewood collection on forest carbon stocks depends on the size of the population living in a region, the accessibility and means of transportation available; better-off actors with more capital and resources might have a higher capacity to collect and trade firewood and will have a potential higher impact on carbon stocks (i.e. availability of vehicle, warehouses and chainsaws) (Figure 20). Often the commercial consumers of firewood in the city can go to collect firewood by themselves in what seem to be abandoned properties.

Figure 20.Examples of vehicles used to collect firewood.

2.2.5 Charcoal production

Most of charcoal production in the Peninsula is made for commercial purposes. As with other timber products, the commercial elaboration and transport of charcoal requires an approved management plan. Some *ejidos* have organized cooperatives to prepare management plans with the aid of technical foresters and produce charcoal (Figure 21). However, obtaining such a permit is complicated, requiring both internal cooperation of charcoal makers within the *ejido* (the actual manufacture of charcoal is always individual, in Mexico as other developing countries) and extensive paperwork. As a result, many people produce ´illegally´, often using the trees cut during annual clearance on their own land for milpa, or renting forest resources (acahual) from other owners, or simply taking advantage of available forest resources in areas which appear to be abandoned. The recent use of chainsaws has increased the impact of charcoal makers in some regions creating conflicts between charcoal makers and *milpa* growers (Torres Mazuera, 2014a). The problem arises mainly due to the existence of demand for charcoal from street food vendors and restaurants; charcoal middlemen are the ones who supply the chainsaws in rural areas, buy illegal charcoal and later they “legalize it” by the trade of permits (De los Ríos, 2007).

The production process of charcoal by individual producers takes place in the field, usually in a small clearing of around 20 meters in diameter, since this reduces transportation costs of the wood used. A variety of kilns are used (Figure 23). Setting up the kiln can take anything from a few days to several weeks, and burning takes less than one week. When the kiln is cool, the charcoal is extracted and in some cases stored before it is transported by the producer to the city for sale or to the facilities of intermediaries or traders.

The risks to small individual producers are high, since if they are caught transporting the charcoal to market and cannot produce a permit, they will be fined. As is to be expected in this situation, there are many opportunities for corruption. There are authorised dealers with permits who can exploit this situation, purchasing very cheaply from producers.

Figure 21.Charcoal produced, stored in a warehouse.

Demand for this product comes mostly from urban areas and restaurants from the cities in the Peninsula but also from centres as far away as Mexico City, Monterrey or Guadalajara. In these areas charcoal is traded under the brands of the intermediaries and large buyers.

Figure 22.Examples of the small-scale commercial use of charcoal.

The production process of charcoal is more complex than that of firewood. Charcoal is often produced on the field to reduce transportation costs and then is stored in warehouses before it is transported to the facilities of intermediaries or traders. It can be produced in a hole underground, aboveground covered by earth, or in special kilns (Figure 23).

Figure 23.Different processes used to produce charcoal in the Yucatan Peninsula (traditional earth kiln, pit and metallic kilns).

2.2.6 Production of timber and NTFP

There is considerable potential for the forest sector in Mexico. From 25% to 72% of the forest territory has potential for development of the timber industry (Montes de Oca y Dominguez, 2004; FAO, 2004) (Section 1.2.4.3 describes briefly the background of Mexican forest policy). There have been policies since the 1980s to stimulate the sector and to encourage sustainable timber management by communities to supply timber to the internal market. As mentioned in section 1.2.4.3, in the Peninsula, this was mainly the context of the so-called Plan Piloto (Box 3). However there are major restrictions on timber production, because of the earlier over-exploitation of the resources which left many forests degraded and stripped of the largest and most valuable trees. As a result, forest policy since the 1980s has favoured passive conservation of forests, which has limited the development of viable local timber industries and has favoured imports (Fernandez Vazquez and Mendoza Fuente, 2015). From 1994 to 2013 the contribution of the forest sector to the gross domestic product (GDP) decreased by 20% (it accounts for only 0.59% of the GDP), and timber production was reduced 30% from 2000 to 2012.95 sawmills and other processing units were shut down from 2004 to 2009 (Fernandez Vazquez and Mendoza Fuente, 2015). More than two thirds of CONAFOR´s budget goes to activities not related to the promotion of timber management, additionally the environmental protection attorney agency (PROFEPA) has been criticised for using its limited budget to oversee legal practices instead of addressing illegal timber extraction activities which of course flourish where there is demand (Fernandez Vazquez and Mendoza Fuente, 2015).

According to these critics, national policies are not promoting CFM consistently and the sector is overregulated (Fernandez Vazquez and Mendoza Fuente, 2015). In order to obtain a forest management permit for timber extraction, it is necessary to obtain up to 50 different authorizations (Garcia Aguirre, 2014). In Quintana Roo transaction costs of bureaucracy and permits represent 23% of the expected revenues from intended forest production (Chapela, 2012). In addition it is necessary to consider transaction costs of bureaucracy, for instance the *ejido* 20 de Noviembre, which has a history of good timber management, needed to make more than 12 trips to the state capital of Campeche (more than 300 km away) to renew its management plan and still the response from the secretary took more time than that defined by the law(Fernandez Vazquez and Mendoza Fuente, 2015). During fieldwork in this *ejido* we observed that it has not been authorized to continue its management in 2015. The reason was that the municipal government had commissioned a non-local consultancy firm (from Cancun), to develop the municipal ecological land use plan. The plan was made without full consultation with local stakeholders and 20 de Noviembre and other forest *ejidos* were placed inside a conservation management unit despite their pre-existing authorized forest management plans. The municipal ecological land use plan was approved and hence the federal environment ministry (SEMARNAT) stopped granting the harvesting and transportation for timber permits. This has already led to problems: the *ejido* had bought a truck on credit to transport its timber directly to the buyers, but due to the current problem

it has not been used for almost a year, while the credit still has to be paid off (Villaseñor, personal communication). This case illustrates the problem of developing coherent policies for the management of forests; even within the sector of environment and forestry, and the difficulties that many *ejidos* face in trying to develop their own timber industries.

Other problems relate to the communities´ internal organisation for timber exploitation. Two systems of distribution of the benefits from timber are found. In some *ejidos*, the forest is held communally. Forest technicians mark the trees to be felled each year, usually on a rotational basis, and the profits from sales are shared every year between all the ejidatarios. In others, the forest is parcelled such that each ejidatario owns a specific part of the forest; this means that individuals may receive very large returns in one year and nothing for many years after. Either way, but particularly in the second model, there can be problems in ensuring that a sufficient part of the returns is ploughed back into management and investment in infrastructure. In several *ejidos* we were informed that many ejidatarios play no part in the forest work or in management but still expect to receive their full share, which leads to friction. While to some extent training in management techniques (book keeping etc) has been given to alleviate these problems, at heart there is in many communities a lack of solidarity and trust, which undermines the effective running of such community enterprises. The lack of internal cohesion has been growing over many years and has been stimulated by the relative decrease in the profitability of land-based activities at the level of the *ejido* compared to employment in other sectors, the desire of many parents to get their children educated and out of the rural areas, and by PROCEDE. There is an important previous experience in the region related to forest management through the Forestry Pilot Plan (FPP, Plan Piloto Forestal, Box 3).

Box 3. The Forestry Pilot Plan (Plan Piloto Forestal)

In 1983 a two-year collaboration between Mexico and Germany started in Quintana Roo as a process to promote the local appropriation of the forest resources by *ejidos* and to halt deforestation through the generation of economic wealth to *ejidos* and communities, this was known as the Plan Piloto (Daltabuit Godás et al 2005; Flachsenberg and Galletti, 1999). The plan intended to intensify management by exploiting more species to create larger clearances to promote natural regeneration (Flachsenberg and Galletti, 1999).

Flachsenberg and Galletti (1999) describe the activities and outcomes of the Plan Piloto in three phases. The first stage was the creation of community organizations for extraction and production of logs (1983 to 1986). The initial aim was to introduce the necessary innovations to allow a rational use of the resources, but it was difficult to conciliate local needs and the forests' carrying capacity. Initially *ejido* assemblies defined Permanent Forest Areas (PFA) where agricultural activities were not allowed, although usually they were not demarcated on the field, which later generated problems. The basic activities related to field practices (e.g. machinery operation and production of seedlings in nurseries) since it was difficult to create more entrepreneurial decision making processes (Daltabuit Godás et al. 2005).

The second stage was the development of initial management plans (1986-1989) for this, ten *ejidos* organised a union of timber production (Sociedad de Productores Forestales Ejidales de Quintana Roo, SPFEQR) (Anda, 1986, in Daltabuit Godás et al. 2005). It was necessary to set up inventories but it proved difficult to create participatory brigades and gather data consistently due to the high turnover of brigade members and lack of adequate technical structure. During the earlier period of forest concessions there had been no geographic information system to aid the spatial planning. In the Plan Piloto, different criteria were included. The first ecological principle was the control of clearances to favour the regeneration of mahogany, the key species given its economic importance; it was necessary to help natural regeneration with enrichment plantations (Stoger, 1988; Flachsenberg et al 1992). Commercial diameters were set at 55 cm for cedar, mahogany, *zapote* or chewing gum tree (*Manilkara zapota*), shaving brush tree (*Pseudobombax ellipticum*) and *parota* or *pich* (*Enterolobium cyclocarpum*) and 35 cm for other species; the plan was to produce 2 m^3 of new species for each 1 m^3 of mahogany/cedar.

The third stage was the subsequent follow-up and review of the plans. The review of the plans showed that *ejidos* rarely demarcated the PFAs or they were ill defined; this was in part because at this time PROCEDE was demarcating parcels for agricultural activities. The evaluation shown that the data from the inventories from the days of the concessions did not in an way match the extraction records, due to errors in the inventory and inefficient extraction practices wit left important volumes in the field. The paths created for making the inventories over a grid of 25 ha units facilitated the operational tasks during the extraction. Regarding the intensification of management practices it was difficult for the

industry to adapt and include new species; thus the regeneration of mahogany was not sufficient but supporting plantations increased the ratio of harvested to standing trees from 1 to 10 to 1 to 18 (Lopez, 1994 in Flachsenberg and Galletti, 1999). Noh Bec was one of the model ejidos, still today they have an active sawmill and have developed local industries around timber production (Figure 24, Figure 25)

During the implementation of the FPP it was clear that the supporting technical structure was not enough; there was a low density of technical services, for instance there was 1 technician per each 20,000 ha of forests while comparatively in Germany there is 1 per every 1,000 ha (Flachsenberg and Galletti, 1999). Resources are also needed for forest inventories and for planning and opening of access paths; *ejidos* did not see these activities as part of forest management. In the FPP it was not possible to promote post-harvest activities since there were not technical specialists to strengthen the next stages of management (e.g. the operation of sawmills and commercialization of timber).

Figure 24. Images of the sawmill in Noh Bec.

Figure 25.Small-scale carpentries and furniture in Quintana Roo.

As described by Flauchsenberg and Galletti (1999) it is important to highlight that CFM is not implemented at a 'community' level but requires the emergence of a specialized group to be in charge of it and to collaborate with external agents. Experience of the FPP shows it is hard to consolidate a community forestry enterprise within the *ejido* assembly given the changes in local authorities and decision-making processes; often these are subjected to local and regional political interests and technical aspects become secondary. Another critical problem is that the managerial style under *ejido* structure does not save resources to reinvest in CFM or other assets since traditionally all revenues are shared among ejidatarios, particularly in *ejidos* with little forest resources (Flauchsenberg and Galletti, 1999).

2.2.6.1 Recent developments

Zamudio Valencia (2011) presents a diagnosis of challenges for forest management in the region based on a series of workshops with forest technicians from the Yucatan Peninsula; his consultancy report discusses many of the very same problems identified almost 30 years ago when the FPP started. The main problems for forest management identified in the Peninsula include the following: *ejidos* are not appropriately organised and have a low entrepreneurial culture; CONAFOR does not provide support for the marketing of new timber species; management practices do not produce enough clearances to promote natural regeneration; there is little added value to products sold by *ejidos*; specific management activities are not properly defined within the *ejido* (poor professionalization); periods of *ejido* administrations are too short to establish a solid management; there are conflicts regarding land rights; forest management is a secondary practice and only a few people participate; there is immigration; there is lack of technical support for forest management; there is insufficient technical assistance for the development of local industries; regulation is a barrier to incorporating small areas into formal management; and given the difficulties of developing a management plan some *ejidos* without one the timber to other one, making sustainability very difficult to achieve

During fieldwork it was also possible to confirm some of the situations reported in the literature. There are still sawmills in operating condition within a few *ejidos*, and several small private ones in addition. Figure 26shows a new private sawmill a) and a new sawmill in an ejido b) which has not been used in around 5 years (Villaseñor, p.c.). (It was observed that sawmills in some *ejidos* were old and lacked maintenance, which reflects the lack of resources for reinvestment in these assets (Figure 27).

Figure 26.New a) private and b) ejido sawmills in the Yucatan Peninsula.

Figure 27. Sawmills with poor maintenance or dismantled in the Yucatan Peninsula.

Members of communities indicated that after considering the volume authorized in the forest management plan in terms of cubic meters of timber and with knowledge of the price, ejidatarios know how much money to expect at the end of the cycle. Since the forest management plans provide the authorized harvest volumes for periods of five years, sometimes ejidatarios sell their quotas in advance at lower prices to cover more urgent and immediate needs. It is clear too that sawmills at the *ejido* level are underutilised and often in poor condition. Some *ejidos* that have sawmills prefer to sell the timber as logs. Because demand is low and sales unpredictable, they wait for the buyer to place and order and put down a preliminary payment before cutting the trees already marked by the forest technicians for felling, or they sell the timber standing. The number of ejidos with official permits for timber harvests have reduced over the years; in 1995 there were 61 ejidos and although the number increased to 80 in 2006 it later dropped to 46 in 2010 (Ellis et al 2014 based on SEMARNAT (2006, 2010)). In practice, there are very few buyers and one virtually a monopolistic company (identified by locals only as Azuara) dominates. However much of the authorised volume is not sold since it finds no market because sawmills have not evolved and integrated into the timber industry (it still focus on selling planks to local carpenters.

There have been efforts in the Peninsula to train *ejidos* in best practices to reduce the impact of logging, but this is can only be effective if *ejidos* harvest their own trees and do not sell the timber standing. The report by Zamudio Valencia (2011) confirms that indeed most *ejidos* sell their timber still standing on the trees. This situation represents a *de facto* step back to the system of concessions where a large private industry takes most of the benefit from timber exploitation. The difference now is that it is no longer necessary for the company to take legal responsibility and formally cover the cost of developing the management plan or take care of the forest and associated infrastructure for access. Timber buyers may finance the making of management plans by asking for in-kind payment in the form of timber of the most valuable species (Zamudio Valencia, 2011) but the legal responsibility for how the forest is managed is of the *ejido* and the technician validating the management plan. In this system, the *ejidos* retain all the responsibilities while intermediaries keep the lion's share of the benefits.

2.2.6.2 Chewing gum production

Chicle is one of the most important non-timber forest products produced in the Peninsula. Historians indicate that during his stay in the US, Mexican ex-president Antonio Lopez de Santa Anna introduced Thomas Adams to the *chicle*, the resin of the zapote tree used for centuries by the Mayans (Figure 28); Adams aimed to obtain a substitute for rubber, but it was by chance he introduced *chicle* as chewing gum to the American consumers (Redclift, 2004). This became a large industry and by1910, 3,200 tonnes per year of chicle from the Peninsula were being sold on international markets; production decreased during the economic crisis of 1929 but it increased later

reaching a peak in 1942 during the second world war (4,000 tonnes) after which it declined after synthetic substitutes entered the market around 1950 (Ramayo Lanz, 2014; Forero and Redclift 2006). Now production of organic *chicle* is increasing to meet niche markets. Is important to point out that the *ejidos chicleros* were the areas with the lowest deforestation rates observed during the last century (Bray and Klepeis, 2005; Bray et al 2004), this was partly due to the lack of access by road, in the 1960s chicle was transported by air.

Figure 28.Chewing gum tree.

Before the Mexican Revolution, in order to produce and commercialise *chicle*, owners of forest concessions hired contractors who were in charge of extraction, and who employed *chicleros* (labourers who harvested the resin from the trees). The owners of the concessions traded the product directly with representatives of foreign companies (Ramayo Lanz, 2014). *Chicleros* were among the poorest people in Peninsula and spent several months per year in the forest living in really harsh conditions while extracting *chicle*. For this they use ropes, machetes and bags; once extracted from the trunk the gum was 'cooked' and transformed into blocks. Aiming to improve the living conditions of the *chicleros*, the regional and federal government tried to organise cooperatives as early as the 1920s, and displace the middlemen; during the presidency of Lazaro Cárdenas in the late 1930s cooperatives were established but later they became the object of dispute by politicians who mismanaged their resources (Ramayo Lanz, 2014; Forero and Redclift2006). For instance Forero and Redclift 2006 explain the social provision funds for *chiclero* workers of the cooperatives were mismanaged by politicians for their own interests and were lost; in 1956 there was a Mayan revolt against governor Margarito Ramirez who fled to Mexico City. It was only after 1978 that the cooperatives were allowed to elect their own leaders, but public control over this sector remained, as all the production was bought by the publicly supported monopsony IMPEXNAL (*Impulsadora y Exportadora Nacional*) which fixed the prices to producers and captured most of the profits from international trade; as the international prices dropped the government stopped intervening in IMPEXNAL, but former employees created the new company Mexitrade (Forero and Redclift, 2006).

Forero and Redclift (2006) describe how in 1994 the Chicle Pilot Plan (CPP) was created following the idea of the Plan Piloto as means to contribute to forest conservation. This included the creation of a new National Union of Chicle Producers (NUCP). Slowly the NUCP started to open new commercialisation channels including the organic market and started to negotiate higher prices. Important problems for the development of the chicle industry in this new stage are bureaucracy and intermediaries. Initially it was difficult for cooperatives to sell their product directly to international buyers. As the president of the union of cooperatives said in 2000 this was "because

international buyers do not want to deal with cooperatives or unions (of rural producers) since they do not comply (with the contracts and agreements made), they prefer to deal with the private sector" (Daltabuit Godás et al. 2005, pp. 52). Production in the 1990s was around 400 tonnes per year, only 10% of the historical maximum. By 2003 the potential production was around 2,000 tonne per year but given bureaucratic restrictions it has been difficult to supply the markets, thus the actual output was limited to around 900 tonnes per year (Aldrete cited in Forero and Redclift, 2006). The chewing gum sector is said to be over-regulated and includes 'hidden' taxes to the ejidos, reducing the potential for exports as much as 40% (Aldrete Terrazas, 2008). By 2004 the CPP had restored some confidence in the cooperatives and also among *chicleros* and started to pay fairer prices and provide social services (retirement fund and health services); new rules required that representatives of the cooperatives elected were former *chicleros*. However, following a legal conflict between the NUCP and Mexitrade, intermediaries were encouraged by Mexitrade through PFSCA (Forest Products of Southeast Mexico and Central America, owned by Azuara); intermediaries buy *chicle* directly from the local cooperatives aiming to displace the NUCP. Intermediaries can offer higher prices than those offered by NUCP, since they do not cover the cost of providing social services to *chicleros* (Forero and Redclift 2006). The NUCP now represents 46 cooperatives, with more than 2000 producers working over 1.3 million ha; in 2003 it started plans to develop a factory to produce organic chewing gum and by 2009 the newly created company *Chicza* was exporting organic chicle to the international market (FIRST, 2009). This strategy effectively reduces the role of intermediaries as it integrates a new step adding value to the product chain.

In addition to the difficulties for chicle production imposed by regulation and intermediaries, the industry suffers threats from climate change due to changes in rainfall and its distribution (Hernandez, 2015) and by the selective logging of young *zapote* trees to supply poles for traditional constructions in tourist facilities in the Riviera Maya (*palapas*) (Aldrete Terrazas, personal communication); this may limit the future production of chicle, which is a source of income to quite a number of forestry based ejidos. As regards the management of the cooperatives, it can be very bureaucratic since many administrative tasks and permits need to be made by the comisario ejidal and not by the cooperative itself; only members of the ejido can be members of the cooperative (Forero and Redclift, 2006).

2.2.7 Urbanisation and land speculation

One important driver of deforestation is the economic pressure associated with real estate development for urban uses and tourism. Prior to the announcement of large development or infrastructure projects, there are usually leaks of information to insiders/privileged persons and land brokers commence to buy *ejido* land at relatively low costs. For instance, in the Cantamayac area, deforestation seems to be largely linked to economic speculation of land. It is precisely in the regions around urban areas where more *ejido* land has been privatized and gone under *dominio pleno* (Torres Mazuera, 2014b).*Ejido* land has been sold off to absentee landowners who are awaiting higher land prices and/or infrastructure development for future urban expansion (Figure 29). As a result land is effectively under an open-access regime and all large commercial or useful trees have been cut. In this area, which is accessible to Merida, degradation is also being caused as a result of exploitation of these areas for firewood, which may lead eventually to deforestation; this is observed also in Hunucma. When forest areas are deforested or gradually degraded down to the point of deforestation, all the carbon is emitted. On the other hand, when urbanization takes place over grasslands or agricultural land this process may have secondary effects on forests and remaining old growth fallows by displacing the agricultural frontier. Recently a land-trade conflict for tourism development reached the media, and it was shown that there are plans by large local investors (linked to BEPENSA –Coca Cola company-), for tourism development on the island of Holbox (Noticaribe, 2014). Reports indicate that there are two groups of ejidatarios (pro and anti)

and that there are claims that illegal assemblies were held with the protection of the regional government, to authorise fast-track development plans (Noticaribe, 2014).

However land-trade and speculation is not limited to urban and tourism development. The development of commercial agriculture over large and consolidated areas of land often involves the purchase of rights over land. In this context a range of producers and companies including Mennonite communities have bought rights to significant portions of communal land in some *ejidos* (Ellis and Porter-Bolland 2008).

Figure 29.Land-trade and urban development.

2.2.8 Land tenure and governance[7]

There are a growing number of studies that examine the relationship between different land tenure types and management strategies with forest cover in the region (Porter Bolland et al. in press; Ellis and Porter Bolland 2008). Significant among these, Ellis and Porter Bolland (2008) compared deforestation rates for protected areas with those for community-based forest management (CFM) areas. Specifically, the authors compared the sub-region of *La Montaña* (LM) Campeche which is comprised of 8 *ejidos* in the buffer zone of the Calakmul Bioreserve, to the Zona Maya (ZM) which is comprised of 12 community forest-based *ejidos* in Quintana Roo. In LM the authors found that deforestation rates increased from -0.3% from 1988-2000 to -0.7% from 2000-2005. Gross forest loss was 6.2% in 1988-2000 and 7% in 2000-2005 (Ellis and Porter Bolland, 2008). On the other hand the ZM, has a lower deforestation rate than LM (4.4% from 1984-2000 and 3.6% from 2000-2004). The deforestation trend in LM is attributed to agricultural expansion, particularly land cleared for *milpa* and then subsequently converted to pasture for cattle, bypassing fallow periods. This pattern occurs mostly in transition areas between lowland flooded forests and upland forests and in proximity to roads (Porter Bolland et al 2007). This finding is consistent with other studies that show that in this period the public subsidy program PROCAMPO increased pasture establishment in the region (Busch and Geogehan 2011; Keys and Chowdhury, 2006; Klepeis and Vance 2003), although this cannot explain later deforestation since the subsidies are tied to lands registered for agriculture prior to 2003.

The lower deforestation rates in ZM are attributed to a younger population with no formal land rights who tend to rely more heavily on wage labor (Ellis and Porter Bolland 2008). There are also strong relationships between the size of ejidos (total forest area) and the extent of deforestation. Large ejidos conserve larger portions of forest cover (Ellis and Porter Bolland 2008; Bray et al. 2004) and communal areas (Torres Mazuera, 2014b) where forest areas are usually better conserved. As we have shown elsewhere (Skutsch and Balderas Torres 2015), the amount of

[7]This section is based on Skutsch et al.2013.

forestland varies hugely both in absolute terms and per ejidatario. Many of the ejidos with abundant forest have established internal protected areas and/or obtained PES support for parts of their forest property. These ejidos often also develop stronger local institutions at the ejido level, with stricter rules on agricultural land uses as well as agricultural and forestry zoning within the ejidos, which may have discouraged the expansion of pasture and other types of agriculture. These large ejidos may also benefit from economies of scale in their timber industries, while ejidos with relatively little forest will always be at a disadvantage when it comes to overhead costs and infrastructure investments needed.

The results indicate that the creation of protected areas is not sufficient to reduce deforestation and that CFM based on good governance can be effective, although it is not always so (Ellis and Porter Bolland 2008). This is illustrated in the case of La Montaña where despite the establishment of the Calakmul Biosphere Reserve in 1998, deforestation has increased to levels greater than those in the period before its establishment. Meanwhile in the areas with CFM in the Zona Maya, despite higher population growth and density, the presence of local forest management institutions and migration have seemingly counteracted deforestation. The authors conclude that the presence of forestry institutions at the regional, national, and local levels, as well as a higher availability of wage labor in urban centres and the proximity to tourism (see also Radel et al 2013, Radel et al 2010) is presumably conducive to forest conservation and regeneration (Ellis and Porter Bolland 2008), although they did not investigate the effects of economies of scale. When "communities have working rules for managing forested areas" the presence of infrastructure development, population growth, agricultural expansion and development programs do not result in an increased deforestation rate, according to Ellis and Porter Bolland, (2008, pp. 9).

2.2.9 Public programs, subsidies and deforestation[8]

Although environmental risks and migration dynamics are two factors influencing the conversion to pasture, the influence of agricultural subsidies in conversion to pasture may also be important (Schmook and Vance 2009, Klepeis and Vance 2003, Chowdhury 2007). During the 1970s as part of the National Clearance Plan (*Plan Nacional de Desmonte*) large parts of the Peninsula were deforested particularly in Quintana Roo and Campeche; for instance in the southern part of Yucatan more than 17,000 ha of selva where *milpa* was practiced were deforested from 1975 to 1985 to promote commercial activities (i.e. mechanised agriculture, fruit trees and cattle rearing) (Rosales, 1991 in Torres Mazuera, 2014a); for instance during the period in which MIQRO had the concession to exploit timber, 170,000 ha were deforested for agriculture and the number of *ejidos* went from 12 to 65 as part of the policies to populate the territory in Quintana Roo(Anda, 1986 in Daltabuit Godás et al. 2005).

In recent times, there have been two prominent subsidy programs: PROCAMPO and *Alianza para el Campo* which provided government subsidies designed to cushion the effects of agricultural liberalization in the 1980s and 90s, in particular NAFTA. However, at present the main cash transfers in rural areas come from Procampo and Prospera (agricultural and social subsidy programs) (WB, 2005). The effects of PROCAMPO have been mentioned above already; they were limited to the period from the late 1990s to early 2000s, since registration of new patches of land was not possible after 2003, although subsidies are still paid on land registered before this. Most of the studies described in the literature are based on land use changes observed before 2003. PROCAMPO is often used for pasture and other cash crops, such as chilli (Schmook and Vance 2009); there are no restrictions on how the payments are spent, but there are conditions on land use such as abatement of soil erosion and the promotion of conservation (Schmook and Vance 2009).

[8]Most of this section is based on Skutsch et al. forthcoming.

Moreover, one of the central tenets of PROCAMPO is the promotion of agricultural intensification and payments are conditional on the beneficiary maintaining the same plot of land under productive use until the termination of the program. *Alianza* payments on the other hand were directed to particular agricultural activities that the recipient agrees to perform, but implementing them is not subjected to any restrictions other than an effort to avoid environmental damage (Schmook and Vance 2009). Subsequently, *Alianza* was more flexible, allowing the recipient to allocate the assistance to either plots under cultivation or those previously under fallow (Schmook and Vance 2009).

In a study comparing these two government agricultural subsidies, PROCAMPO and *Alianza Para el Campo*, Schmook and Vance (2009) found that both programs resulted in increased area under cultivation, particularly in pasture, although only PROCAMPO resulted in decreased forest cover. Specifically, the authors found that a $100 pesos increase in support is associated with 0.196 hectares less under forest (Schmook and Vance 2009). In an earlier study Vance and Geoghegan (2002) found that every $1,000 pesos of PROCAMPO increased the risk of deforestation by 2.34%. Another study finds PROCAMPO responsible for fostering deforestation in the Peninsula. Klepeis and Vance (2003) suggest that PROCAMPO's requirement for maintaining the same plot under productive use is at odds with the cycle of forest fallow, which is practiced by the majority of the region's inhabitants, partly as a mechanism for maintaining soil fertility. As noted above, traditional *milpas* in the region include fallow periods of 10-20 years after 2-3 successive years of production (Chowdhury 2007). By requiring the same plot of land to be kept under productive use, PROCAMPO effectively removes this land from the fallow cycle, which possibly results in increased clearance of mature forest (Klepeis and Vance 2003). However, Abizaid and Coomes (2004) did not find a statistically significant relationship between PROCAMPO payments and fallow area. Instead, the authors found that labour availability and the age of the household heads are more important determinants of fallow length. Fallows are shorter for younger households because with little land to fallow, younger households are forced to rotate their fallows more frequently (Abizaid and Coomes 2004). Additionally, availability of male labour is associated with less land under fallow and greater areas in crop or pasture (Abizaid and Coomes 2004).

In analysing the relationship between household demography, agricultural subsidies, and fallow type within two parcelized *ejidos*, Chowdhury (2007) did find a strong, positive relationship between PROCAMPO and proportion of the parcel devoted to fallow. Comparing traditional fallows, or those with fallow periods of over 10 years after a 2-3 year successive *milpa* cultivation, and enriched fallows with timber and fruit trees[9], Chowdhury (2007) found a positive correlation between PROCAMPO payments and larger areas in traditional fallows. She argues that although PROCAMPO is supposed to be for spatially fixed cultivation, in practice households continue to receive the payment while relocating areas under cultivation, resulting in a larger area under traditional fallow over time. This follows Klepeis and Vance's (2003) hypothesis regarding the contradictory logic of PROCAMPO with regional practices of forest fallow cycles. Chowdhury (2007) also analysed the state and NGO subsidized Roza-Pica-Siembra (RPS, or zero burn) conservation program and found that RPS has a weakly significant, negative effect on traditional fallows.

The interest in establishing boundaries of parcels in common areas is growing as right holders receive resources from public programs (e.g. for cattle grazing), and many of these public rural development programs require the applicant to be in possession of land certificates (Torres Mazuera, 2014b). Following the demarcation of individual and communal parcels as part of

[9]Enriched fallows include a distinct disturbance regime whereby successional growth is opened for plantings, weeding and other maintenance activities.

PROCEDE some regions appear to have experienced deforestation (Concheiro and Diego, 2003, in Torres Mazuera, 2014b), but the overall evidence on this is still unclear.

2.2.10 The impact of hurricanes

Hurricanes are frequent and often sever in the Peninsula, the effect of such phenomena can be felt deep inland due to the lack of mountain ranges that otherwise could reduce wind speeds. For instance, hurricane Janet in 1955, destroyed *chicle* and timber production and *chicle* producing forest areas in southern Quintana Roo (several tonnes of *chicle* in the harbour of Vigia Chico were destroyed along with 300,000 m^3 of timber stored in Chetumal)(Forero and Redclift, 2006). During the hurricane the southern chicle producing zone of Quintana Roo was devastated which later caused the overexploitation in the central Mayan zone; uncontrolled extraction of supposedly 'fallen' trees to prevent fires promoted by the local governor contributed to degradation and deforestation (Forero and Redclift, 2006). In 1988 hurricane Gilberto destroyed all the *milpa*s in the areas affected in Yucatan; only those already matured by the time of the hurricane produced grain – early sown, short cycles-, tubers needed to be used for food (Teran and Rasmussen, 2009). In 2002 Isidoro and Wilma in 2005 destroyed most bee hives of the cooperatives Kabi´tah and Lol Kan Chunup in Campeche and Yucatan respectively (bee hives were destroyed by winds, fallen trees and flooding) (Ojeda Lopez, 2009). Due to problems of accessibility producers were only able to reach their hives after a few weeks; some producers needed to take extra care of surviving colonies (with support facilitated by the cooperatives), those who lost all their hives abandoned the activity (Ojeda Lopez, 2009). Following a hurricane, mortality of cattle is not always registered but in 1995 at national level more than 100,000 animals were lost due to hurricanes (Sanchez Sesma et al 2009). The costs of Hurricane Wilma to tourism in the Peninsula were around $17,000 million pesos (Sanchez Sesma et al 2009), this reduced the touristic activity and job opportunities.

Hurricanes also have a negative long-term effect in the local economy. During fieldwork it was observed that in Noh Bec the sawmill is operational and there are a series of workshops and local carpentries working with local timber in the region; however these activities are not what they used to be. In 2007 hurricane Dean had a massive negative impact on the region, this modified the terms of the forest management plan reducing the area for authorised harvests. Due to the hurricane the ejido also lost the certification that enabled them to export the timber at higher prices (Martín, 2014). Before the hurricane Dean hit the Peninsula in 2007, in Noh Bec each *ejidatario* received a yearly participation of the community forest enterprise of around $23,000 pesos; this benefit was additional to other direct and indirect benefits (e.g. wages, maintenance services). The inflation from 2007 to 2015 was 38.01% (INEGI, 2015b), considering that the yearly average income to cross the poverty line in 2015 was around $89,500 pesos (for a family size of 4.5 in average), the yearly participation in 2007 was enough to cover 66% of the income required to cross the alimentary poverty line and 35% of the total poverty line (adjusted for inflation). For an old *ejidatario* and his wife (household size of 2), the income was sufficient to cover 80% of the poverty line and 150% of the alimentary poverty line. Nevertheless given the destruction caused by the hurricane and the further restrictions imposed by authorities to timber extraction permits, nowadays yearly participation had been reduced to around $7,000 pesos. This is a reduction from 35% to 8% of the required income to cross the poverty line (and from 66% to 15% of the alimentary poverty line) for a household of average size; for a household size of two, the participation covers 18% of the poverty line and 33% of the alimentary poverty one. In order to maintain the same purchase power as before Dean, yearly participations should be around $32,000 pesos per ejidatario (almost 5 fold current levels). These losses need to be added to the damages made in other sectors of the economy such as agriculture and *milpa*, honey, chewing gum, cattle and tourism. Moreover, under these conditions some ejidatarios sold their land certificates in order to satisfy their needs and continue paying for the education of their children in Valladolid which is seen as a long-term

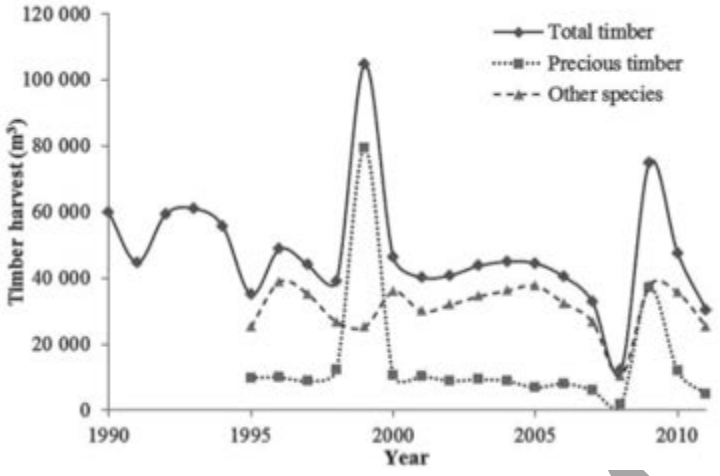
investment. These impacts provide an idea of the “new” level as regards assets and income at which rural households and communities find themselves after an event such as a powerful hurricane. Still the ejido authorities are confident in restoring the degraded area and recover from the damage suffered, nevertheless this situation highlights the importance of preparing ad hoc responses and adaptations plans to reduce the losses to the *ejidatarios.*

After a hurricane a high load of fuel and deadwood is accumulated which can increase the risk and severity of fires, this accumulation is proportional to the intensity of the hurricane and the initial stock of biomass; the area with high risk of forest fires caused by Dean is around 2 million ha mostly in Quintana Roo (Rodriguez Trejo et al 2011). Figure 30shows still the effect that hurricanes can have on trees still after a few years. The load of fuels post-Dean was around 40 ton of dead biomass per ha in average over the affected area, and higher levels in the areas closer to the coast (higher than 60 ton per ha and up to 137 ton per ha) (Rodriguez Trejo et al 2011). Fire risk is also increased by the destruction of the canopy since this increases the rate at which biomass get dry (Myers y van Lear, 1998). Fires can occur a few years after the hurricane, for instance in 2009 there were still fires in areas affected by hurricane Wilma in 2005 thus it is important to implement fire prevention practices several years after the events (Rodriguez Trejo et al 2011).However, in terms of carbon emissions hurricanes alone are not related to changes in forest basal area in the long term (Urquiza Haas et al 2007), this implies that under certain conditions forests can recover themselves and replenish carbon stocks. Nevertheless this potential regeneration might be strongly affected by the management of *ejidos* and communities which may be in urgent need and then may recur to land conversion and trade of timber, NTFP and land itself to satisfy them.

Figure 30.Effect of hurricane on trees.

Hurricane Dean produced an spike in the production of timber in Quintana Roo. Ellis et al present a figure based on ITAM (2004) and SNIF (2013) showing that timber production had a diminishing trend from 1990 to 2011, and although it increased around four-fold after Dean, it afterwards production went back to the previous trend (Figure 31) (Ellis et al 2014). Based on the situation observed in Noh Bec, it seems that the profits of the extraordinary levels of production of timber post-Dean did not reached the community forest company, nor were they used to generate a transition plan to stabilise the situation in the future.

Figure 31.Harvests of timber in Quintana Roo for the period 1990 – 2011 (Taken from Ellis et al. 2014).



2.2.11 Degradation of mangroves

The processes causing degradation and deforestation of mangroves differ from those affecting other vegetation types, not only because of their different utility as regards human uses but also because most of the mangroves in the Yucatan Peninsula are now within natural protected areas. This means that logging is currently much less of a factor than it is in other forest ecosystems. Nevertheless mangroves are under pressure, particularly from the development of the tourist industry (Herrera-Silveira et al. 2012; Rodriguez-Zuniga 2013;CICY 2010; CONABIO 2013). The vast majority of the carbon stocks in mangroves are in the soil layers (from 68% in peten to 87% in scrub mangrove, Caamal 2012), hence when mangroves are cleared, the emissions caused by the loss of the aerial biomass in mangrove forests represent only a relatively small fraction of the total. It is also evident that soil carbon storage is closely related to the health of the mangrove aerial biomass, and this may be heavily affected by human interventions, in particular those that affect the water balance in the root zone, i.e. the salt and dissolved oxygen concentrations. However there are also natural factors which affect mangroves. Hurricanes and tropical storms cause changes in water levels and modify the landforms, which may disrupt water flow and affect mangrove populations in the long run, this is observable for example in the areas where hurricane Isidoro made landfall during September 2002.

Currently the coastal areas of northern Yucatan, are under a process of rapid economic activity shift, population is increasing and more infrastructure is being built. These changes are having important effects on the mangroves. We observed some evidence of fuelwood gathering from the mangrove, which is an illegal activity, though there is some surveillance in the zone, which discourages it. However the major causes of degradation of mangrove are environmental conditions that promote the replacement of mangroves species by other vegetation types, when conditions become relatively more favourable for the other vegetation type. In the coastal area of Yucatan, mangrove forests interact in this way with the following vegetation types: Coastal dune vegetation; deciduous low tropical forest; dry tropical forest; salt adapted grasslands and bushes; and fresh water marshes, which are usually covered with annual plants such as bulrushes and aquatic grasses.

The following anthropogenic degradation drivers are known to promote changes in water balance conditions, these may occur singly or in combinations: road construction in the coastal zone, (parallel to the coastline and transversal to it); the opening of river mouths and the construction of

small ports for recreational boats; silting, which can cause a reduction of underground water flows; dumping of waste material, both windborne and poorly organized solid waste management; over fishing and over use of other natural resources, this can disrupt food chains and the whole environment, particularly crabs (Schories et al. 2003; Smith et al 1991); pollution due to various chemical products, and by lack of waste water treatment (coastal quarries and other mineral resource use (salt));land use changes, particularly those related to the filling of land occupied by mangrove with construction debris or garbage, to elevate ground level and drainage works; and extraction of mangrove wood products at a rate higher than the recovery rate.

In short the primary drivers observed during fieldwork in Yucatan state were: mismanagement of solid waste; road construction directly causing loss of mangrove cover; roads that run transversal to the coast line that interrupt natural water flows and the balance of salt and fresh water, causing gradual degradation; and roads that run along the coast line, ditto. The last two processes are strengthened by natural factors such as hurricanes, since they greatly reduce the capacity of mangrove to recover from hurricane damage and open up the way for invasion by other plants.

Mismanagement of solid waste is most visible where illegal and unauthorized dumping of household or construction waste takes place on the margins of lagoons, probably to avoid the payment that would be needed to take the material to an approved municipal dump, but the official dumps are often landfills and may themselves have negative effects on water flows. This is not generally a driver related directly to poverty, more to lack of enforcement. Road construction is also not a poverty related factor; it has to do more with construction of new *fraccionamientos* (gated communities) for holiday houses and hotels for tourism. In general, the mangroves are not really under the use and management of communities. Steps to reduce pressure on mangroves are likely to require municipalities to take action on the basis of a better understanding of the impacts of roads and waste dumping.

3 Identification of actors

3.1 Actors and productive assets

The description of the drivers of emissions is used to identify the actors involved in each of them, their general characteristics and role they play, and also to describe the assets they own and use as part of this process. The following sections briefly describe the characteristics of the different stakeholders, divided into those dedicated to subsistence and cash oriented activities, those engaged in other relevant processes such as providers of technical and other services, intermediaries, actors participating in different steps of the value chains, consumers, the financial and public sectors, etc. At the end of this section, poor and non-poor groups are identified.

3.1.1 Subsistence activities

In this section the main actors dedicated to subsistence activities or holding small bundles of productive assets are described. In general, given the configuration of population centres in *ejidos*, all residents owning a house have a specific area that can be dedicated to the production of food called *solares*. The main productive assets of these groups are labour, social networks associated with family and land access (informal and informal); in general all actors have possibilities to engage in off-land labour, however this is not described here as the focus is on the processes driving emissions from deforestation and forest degradation. The potential for off-land employment can be assessed at the municipal level, but in general it is very low outside the main urban centres. There can be some overlap over the different groups since individuals can adopt a pluriactive strategy (as defined by De Janvry et al 2000) to satisfy their basic needs depending on the local ecological and socioeconomic context, their abilities, labour available, attitudes and beliefs.

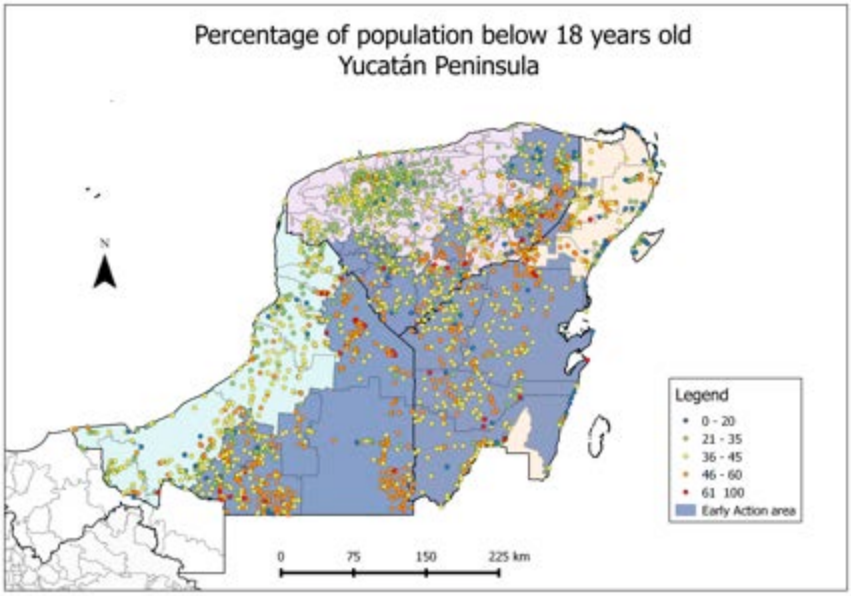
Immigrants, landless. This groups is landless and it is made up of people who have arrived from other parts of the country without the network of their families or other kin, they have no access to capital or credit and have little knowledge of how to adapt their agricultural practices to the local context. Once they have settled they may negotiate access to land or rent it for subsistence agriculture; in the case of "planned" migration to populate the territories the government may grant them rights over national lands. When arriving at existing *ejidos*, they are not formally identified as avecindados, and in some *ejidos* they are charged a fee to be recognised as such. For this group their main productive asset is labour, which they can sell for different agricultural or off-land activities. Sometimes there is short-term migration to close urban centres to perform temporary jobs usually in the construction sector (from two weeks to two months).

Avecindados, formally landless. This group corresponds to the adult population living in *ejidos* who have been officially identified as agrarian subjects; a large part of them are sons and daughters of deceased *ejidatarios* who did not inherit formal rights to land. This group also includes immigrants who have lived for more than a year in the *ejido* and who have been formally acknowledged as *avecindados*. Although they may not have formal and permanent access to land they have stronger local links to extended family and networks to access to common areas or rent lands. The main productive asset is labour and the legal recognition as *avecindados* that entitles them to pursue legal access to land in the *ejido* following a clear path established in the agrarian law, although this may be a long and difficult process.

Young population, landless. The young usually live in the home of the nuclear family where they contribute with their labour. In general they have access to a better school education than the previous generation. This may enable them to get better off-land jobs and although they often need

to emigrate for this they usually have the support of the family in the places of origin and destination. Depending on the case they may send remittances back home, and in the case of emigrating males possibly accumulate some capital enabling them to acquire formal rights to land either as *ejidatario* or private smallholder if they decide to return. In this context, they do not receive the complete knowledge to continue with traditional production systems. According to the information of 2010 census and the demographic pyramid in rural areas, around 43% of the population is under 18 years old (INEGI, 2010a); Figure 32 shows that areas with a larger share of younger population are in the eastern part of Yucatan and the southern parts of Campeche and Quintana Roo. This may indicate both population growth and emigration patterns searching for external sources of work; the central part of Yucatan around Merida have a percentage of youth population which is slightly lower than this average.

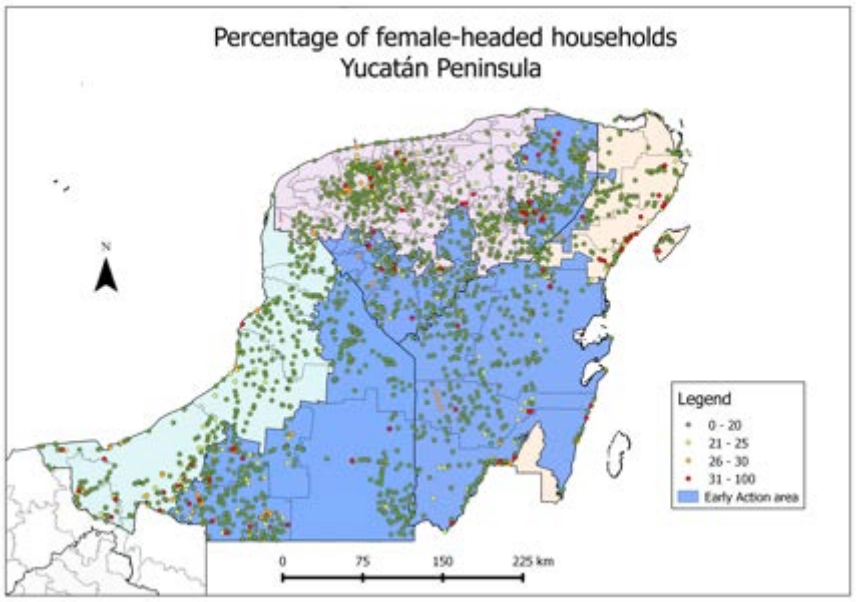
Figure 32. Population centers by share of the population under 18 years in the Yucatan Peninsula in 2010 (INEGI, 2010a).



Women head of household. In Mexico poor women are one of the most vulnerable groups, they usually have more problems than poor men (Székely 2005). The main reasons behind this are: because they need to take care of the children; they have fewer development opportunities and there is discrimination or machismo; women have problems to overcome poverty because there are no employment opportunities for them; because of pregnancy and childcare and the lack of academic studies (Székely 2005). When men emigrate looking for job opportunities, when they remain unmarried or are single mothers or become heads of household, they may be landless or they may have access to land. In the better cases they may receive *remittances* from their husbands and they may also have *land rights* or access to land either as ejidatarias or by being a wife or a daughter of an ejidatario. In this case they can rent the land, develop pastureland and cattle-rearing or more rarely work on it themselves for subsistence practices; this may give them additionally access to *subsidies* (e.g. SAGARPA) and to *benefits under the ejido* (i.e. projects, timber exploitation). They often have the support of the extended *family*. Usually their main asset is labour to work at the *solar* at home in the population centres; the solar might be their most important physical asset if they are *landless*. Nationally, in 2010, 24.6% of the households had a woman as head (INEGI, 2011); regions with higher than the national average are in the central-eastern part of Yucatan, part of the Riviera Maya, around Merida and in the southwestern part of Campeche (INEGI, 2011).

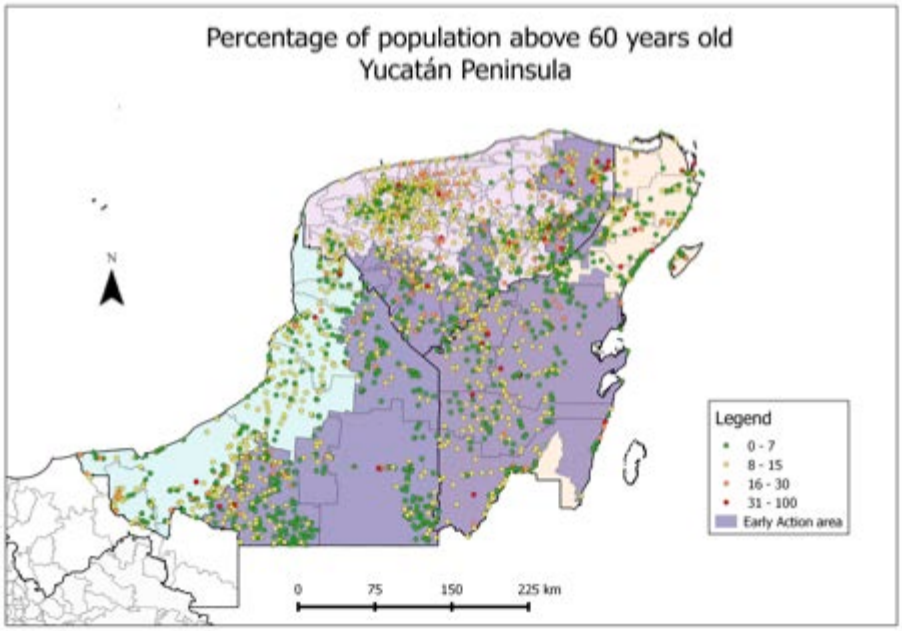
Interestingly in general the percentage of households with women as head is below the national average, but this is ambiguous; it may indicate that even when the husbands are absent due to migration, women may not being reported as head of household.

Figure 33.Percentage of female-headed households in the Yucatan Peninsula (INEGI, 2011).



Old Ejidatarios. The main assets of this social group are land and labour, which they may use for subsistence agriculture (*milpa*), the certificate as ejidatario might give them access to subsidies and benefits under the *ejido*. The most skilled producers may have knowledge of best traditional practices. They may have also be small-scale cattle-rearers and receive remittances if have children living away and enjoy the support of their family. If they have no descendants interested in continuing working the land, they may sell their rights to land, particularly in areas subjected to pressure for urban or touristic development. Rarely this extraordinary income will be invested in productive activities and most likely will be spent to cover daily needs. Only in some *ejidos* with well functioning community forestry enterprises (e.g. Noh Bec) or where there are organic chicle cooperatives or strong agricultural unions (e.g. sugarcane producers) may they have social provision services. Given demographic dynamics, by the age when successors receive the formal rights to land they are already too old (about 50 years) and thus manage their assets conservatively (Warman, 2003). According to the information of 2010 census and the demographic pyramid in rural areas, around 12% of the population is above 60 years old (INEGI, 2010a); Figure 34 shows that areas with a larger share of older population are in the eastern part of Yucatan; there are large parts of the rural areas where the old population is within the national figure (in yellow). However in the central and southern part of the peninsula the share of this group is small (in green), this may indicate a higher level of productive activities of the younger population.

Figure 34. Population centers by share of the population of 60 years or more in the Yucatan Peninsula in 2010 (INEGI, 2010a).



Small-scale cattle-rearers, landless, ejidatario or private property. In general this activity is developed complementarily in *solares* since animal breeding is seen as a savings strategy. The main asset is cattle itself and labour, they may also have small stables to keep their animals but often lack access to veterinary services and medicines. Cattle-rearers may have strong local networks to obtain access to land for their animals and they may even rent it from other members of the community or from the *ejido* assembly if they are landless; they also have connections with middlemen. If the individuals have rights or access to land, small-scale cattle rearing can be part of their livelihood strategy.

Ejidatarios, posesionarios or comuneros, subsistence agriculture, milperos. Usually producers dedicated to *milpa* belong to the poorer groups of *ejidos* and communities (Torres Mazuera, 2014a). *Ejidatarios* can grow their crops in their own parcels while *avecindados* and residents without land rights sometimes need to get agreements to use or rent parts of communal land. The availability of land and labour for *milpa* depends on population growth and the balance of emigration and immigration and opportunity cost of alternative income. The main assets of milperos are land, labour in the household (possibly including children), knowledge of traditional practices and products from subsistence practices for which they use hand tools and small barns (*trojes*). Fallow age, is a critical aspect determining the productivity of their practices. As members of the *ejido*, they can be more empowered for decision making in the assemblies, they have access to subsidies, to benefits under the *ejido*, and can also run for positions in the *ejido* authorities (committee). This is not the case for *posesionarios* or *comuneros*, which may be in possession of individual parcels but are not *ejidatarios*. However normally *milperos* are local groups with low power. They can also sell their rights to land but might not invest it in productive practices.

Individual charcoal makers, landless. Often the charcoal makers are among the poorest members of the communities (Torres Mazuera, 2014a) particularly if they are dedicated exclusively to this activity. In some cases better-off charcoal makers have chainsaws (machinery). They may get into trouble with landowners and milperos if they produce charcoal without authorisation, and can benefit from large land use changes to produce charcoal. Their main asset is labour, technical

knowledge on how to prepare charcoal and connection with intermediaries; rarely they have formal management plans. Charcoal making is illegal unless the ejido has such a plan, but it goes on widely nevertheless.

*Individual timber loggers (small-ejidos).*This activity might be a complementary livelihood activity and might be done with or without permission of *ejidos* or landowners. For these activities, forests, labour, basic machinery (chainsaws) and pick up vehicles, are the most important assets. In small *ejidos* where forest management is not well organised, ejidatarios and other local actors might perform selective logging without control to cover local and/or external needs. Without a formal management plan such activity is illegal.

Individual chicleros (chewing gum producers, ejidatarios).Chicleros have in their labour and forest resources their initial assets, additionally they need to be in good health conditions to spend a long season on the forest where they are exposed to harsh conditions. They use hand tools to climb the trees, extract the resin, cook it and produce the tablets. Usually they are ejidatarios and also members of the local *chicle* cooperatives, if additionally they are part of the national union of *chicle* cooperatives they can sell it to Chicza and receive social benefits. They might be more aware of best management practices and its documentation as organic production. Those *chicleros* who are not members of a cooperative face poorer conditions.

3.1.2 Primary producers who are oriented to cash activities

The second group of actors corresponds to those producers oriented to commercial activities in the agricultural and forestry sectors. Non-poor actors are able to focus on cash-crops to accumulate capital and satisfy their survival needs, additionally they generate enough revenue to maintain their productive assets, increase and maintain them and payback any financial credit.

Immigrants (empowered; technical knowledge; mechanised activities). Among the groups of immigrants described in the previous section, there are two, which deserved particular attention in the context of the current study. These groups have strong social capital for the organisation of their activities; they develop commercial activities either based on manual practices (the immigrants from Guatemala), or through the mechanisation of agricultural practices (the Mennonites). In the first case, immigrant groups have benefited from previous productive experiences, a high sense of empowerment, external networks to access off-land wage, and higher yields and productivity from agroforestry intensive practices and orientation to crops of higher price, this has enabled the accumulation of capital; initially they did not have access to social or agricultural subsidies. In the second case capital accumulation is attained through economies of scale, experience, access to capital for the renovation of machinery and purchase of agricultural inputs (agrochemicals and seeds) and post-harvest management; all of this provides certain market and negotiation power. Capital accumulation is also often translated in the purchase of additional rights to land usually under freehold, cattle, vehicles and machinery. Family and kinship are also strong assets for these groups.

Ejidatarios, posesionarios or comuneros (cash activities). Ejidatarios can also focus on cash crops particularly if they have access to capital and machinery, water wells and irrigation systems, agrochemicals and if they can generate economies of scale through the accumulation of larger tracts of land. Their assets include labour, land, subsidies and benefits from *ejido* activities as described earlier. They have stronger local and family networks and local influence particularly if they are affiliated to unions of rural producers.

Local cooperatives. Members of local agricultural cooperatives are usually *ejidatarios*; these groups have a stronger social capital and networks to access to benefits from public programs, credit and external markets. Historically they have used and secured rights over the most productive lands within *ejidos*, this has helped them to accumulate capital and gain political visibility.

Private landowners. Private landowners can perform similar activities as *ejidatarios,* focused on cash crops, or as groups performing highly intensive mechanised agriculture as described above; their decision-making process is faster as does not require approval by the local community or *ejido* assembly. Usually they have access to capital, machinery, agricultural inputs and are in possession of large tracts of land which enables them to create economies of scale. They rely more on institutional support than on family and local networks; when land is bought from *ejidos* and taken under freehold sometimes is a preamble to urbanisation (economic speculation), land is usually conceived as an investment. "Original" private landowners are also remnants from times of the haciendas, previous to the agrarian redistribution of land and represent local groups with political influence.

Community forest enterprises (ejido, local technicians, machinery operators, drivers, brigades, sawmills...). In the forest-based *ejidos*, mainly in Campeche and Quintana Roo where community forest management is undertaken, the main assets are the forest, authorised management plans, access infrastructure, information on the state of the forest (e.g. inventories, GIS, harvestable volume), machinery for extraction, transportation and processing (sawmills). This requires a certain scale to produce meaningful levels of income to the population (more than 20%, according to Flauschenberg and Galletti, 1999); it is better if forest patches are consolidated, personnel is well trained and professionalised, the *ejido* is well organised, there are good organisational skills and there is access to technical services. If the enterprise is well managed and productivity allows it part of the profits can be used for reinvestment and provide social services to the community.

Large-scale ranchers. These are usually private landowners in possession of large tracts of land where labour is kept as a minimum for production, cattle is a valuable asset along with transport vehicles, access to capital and veterinary services. Sometimes land is held speculatively waiting for opportunities for urban or tourist development.

Ejido committees and leaders of cooperatives. Members of *ejido* committees are among the local groups with higher levels of power, they are elected in the assemblies for three-year periods and manage the financial accounts of the *ejido*, sign contracts with public offices and providers of technical services to receive subsidies and projects, and have access to privileged information. Committees are the public face of the *ejido* and negotiate with institutions and other actors in projects that can range from the attraction of private projects and investment to the definition of layouts and authorisation for building roads or dams. They also play an important role in recognizing avecindados, posesionarios or ejidatarios, in the processes of succession and transmission of land certificates, and in the trade and privatisation of *ejido* land. All these enrich their personal networks and areas of influence. Usually former members of committees or their relatives continue acting in the public spheres as public servants in local and regional government offices. The managerial groups of cooperatives can also benefit in similar ways as the members of *ejido* committees since they usually have a more entrepreneurial approach to their activities which helps them to enrich their personal and social networks, and obtain and manage resources for projects.

3.1.3 Services and inputs

There are a series of actors and companies in the private sector associated with each productive activity that provide necessary inputs and services for their development. These actors determine the scale and intensity at which activities can be implemented and their productivity in the development of agriculture, cattle-rearing, forest management, production of non-timber forest products and urban and touristic development.

For instance in the agricultural services these actors include agrochemical companies (e.g. Monsanto, Pioneer), providers of machinery (tractors, harvesters), maintenance services, well drillers, etc. For pastureland and cattle, the required services include veterinaries and supplementary foods. In the forest sector these groups include machinery providers and maintenance services and most critically the services provided by forest technicians to develop management plans for timber, charcoal or firewood production and to obtain the associated permits (harvest, transport).Forest technicians are usually intermediaries between *ejidos* and public offices playing a key role in the management of information and resources. There are also the services provided by certification agencies that can target the evaluation of productive processes and specific goods and products including agricultural crops, beef, timber and NTFP (e.g. organic, fair trade, smart wood, FSC, grass fed). It is important to highlight the contribution that academia, NGOs and international agencies and consultants provide to different producers in efforts related to transfer of technologies and best practices. Banks and other credit institutions offer financial services; most governmental subsidies in the primary sector target the purchase of productive inputs.

Credibility is an important asset for offices managing certification schemes, academia, NGOs, international agencies and consultants. When there is competition to offer these inputs and services, providers will benefit from an efficient administration to offer effective and cheaper services. However the presence of these actors is usually low in marginal and poorer areas reducing the competitiveness; usually potential poor “clients” cannot afford to pay for their services/products or access to finance to improve their practices.

Regarding land trade there is a need for specific services for the demarcation of parcels and legal services to follow the procedures established in the agrarian law; however these procedures are not followed always and thus many transactions may be irregular or even illegal thus creating uncertainties on land tenure which can later affect the clear distribution of REDD+ benefits.

All of these actors undertake their activities beyond subsistence levels and in many cases are pro-profit and oriented to cash activities. The main assets of these actors are access to capital, technical knowledge and higher education, ownership of advanced machinery and management systems and access to external markets.

3.1.4 Intermediaries and additional steps in value chains

While the actors described in the previous section provide input to facilitate primary productive activities, there are other groups participating in the post-production and transformation stages. These are the intermediaries and other industries and actors participating in different steps in value chains, transforming the products to satisfy demands of end consumers. Here these groups are divided into intermediaries and other actors of the value chain.

There are intermediaries in the different productive sectors: agricultural products, firewood, charcoal, timber, chewing gum, honey land brokers, cattle *medieros*, former public servants -inside information, networks for land trading-. The main contribution of these middlemen to the

production system is the creation of certain economies of scale. This is made through the provision of transport services to collect the production from individual producers to take it to the next step in the value chain. In the absence of a competitive market that may reduce the costs of transportation or increase prices offered to the producers, intermediaries control prices paid in rural areas and usually capture considerable profits. For instance in the case of honey production and commercialization from the Peninsula to European markets there can be as many as nine intermediary steps where the price increases by margins from 100% to 400% (Ojeda Lopez, 2009; Güemes and Yaá, 2003)

Ojeda Lopez (2009) describes how rural cooperatives fulfil an initial objective of displacing the first intermediaries in the value chain; this helps producers to negotiate higher prices and reduces the individual transaction costs of negotiation with traders. However it has been difficult for cooperatives to increase their productivity and innovate the production practices by adding further processing steps (Ojeda Lopez, 2009). This is also the case of many community forestry enterprises and *ejidos* which sell the timber standing on trees to external buyers (Zamudio Valencia, 2011).

There are local, national and international actors who trade different goods depending on the requirements of the specific markets and the characteristics of the goods. For instance intermediaries can trade charcoal or firewood to satisfy informal energy markets in poor areas, organic honey for the European market, or certified timber that later is sold in the U.S. or Asia. There are a few cases where ejidatarios are organised to commercialise and add value to their production and provide finished goods to consumers thus bypassing intermediaries and other actors in the value chain. The first example of this is the production of organic chicle by the union of cooperatives and Chicza. Other cases include the *ejido* of Noh Bec where timber is marketed by the community itself, and has even been exported (Martín, 2014), and the honey cooperative Lol Kan Chunup which has plans to develop its own brand, buy a honey bottler, and make the exports of their own products aiming to target final consumers (Ojeda Lopez, 2009). Still, in order to create some economies of scale intermediaries or cooperatives that function as such require additional assets as vehicles for transportation, warehouses and areas to store the products (e.g. barns, driers and pesticides for crops; tanks, filters and bottlers for honey; sawmills, warehouses, and driers for timber; warehouses for chicle, timber of charcoal; fire emergency equipment; lifters, cranes).

There can be many steps involving actors and industries associated with each productive chain, adding value to the products before they are sold to final consumers. These actors are non-poor and oriented to cash activities and often have capital intensive physical productive assets (e.g. factories, processing and storing facilities, machinery, vehicles). These actors include those in the national and international value chains for agricultural products –corn, soy, sugarcane, pumpkin seed, henequen, citric and other fruits … -, biofuels, timber, beef, honey, chewing-gum. There are prominent companies controlling many of these sectors for instance certified TIF slaughterhouses and SuKarne in the beef industry, PFSCA and other private sawmills in the timber, sugar mills, giant corn flour and tortilla producers (GRUMA, MINSA), and Chicza and Mexitrade in the chicle segment to name a few ones. Primary products satisfy local, regional and national and international demands. Examples of actors satisfying local needs are local butcheries and workshops producing dairy products or tortillas and local carpenters; the operation of these productive units is more labour intensive.

A critical group of intermediaries are land brokers and other actors related to land trade. These include actors with access to inside or privileged information of development public projects and lobbyists promoting them, real estate companies, former public officers and *nacionaleros* trading illegally national lands. Land trade requires specialised legal services accompanied with

topographic services for the demarcation of lands for the negotiation with *ejido* committees, assemblies and agrarian authorities in order to take land out of the *ejido* and put it under freehold.

3.1.5 Consumers

Final demand and consumers include the local populations of *ejidos* and municipalities consuming agricultural, beef and dairy, and timber products; if this consumption is part of a local "closed" economy, endogenous consumption of the goods relates to self-consumption for alimentary and subsistence activities of both poor and non-poor populations. Although there may be some effects in the redistribution and accumulation of wealth in general equity gaps increase when certain groups commence to obtain additional resources from trading with external actors and markets. Consumers can also be identified at the regional, national and international scales. Population growth drives the demand for food, economic growth is associated with changes to diets including more beef products and demand for precious woods in international markets (e.g. Asia). Local population growth, strongly influenced by immigration, increases the pressures on land and demand for food and thus agricultural areas. Usually the consumers of agricultural and forestry based products are unaware of the origin, methods used during production and environmental impacts associated to the goods they purchase.

3.1.6 Public sector

The public sector is a critical actor present in most of the drivers of emissions. The main asset of the different public offices and public servants is the recognition of the formal authority and power in their specific areas of influence. Within their legal attributions, they manage public resources and facilitate the development of infrastructure, grant subsidies and support development projects increasing or decreasing the assets in different regions and of different groups. The government also has the responsibility to safeguard the property rights of other actors over their assets through crime control, but this is often ineffective, although Yucatan is among the states in Mexico with lower crime rates. How these resources are managed depends on the balance of technical, social and economic factors. These actors are not poor, and strictly would not be accumulating capital at rates higher than those related with their formal salaries, but when there is corruption, conflict of interest, nepotism, and trade and use of inside information this will not be the case. As mentioned in the previous sections, current challenges of the public sector relate to the provision of subsidies which have deforestation as a direct or side effect, overregulation of the timber an NTFP sector, lack of coordinated action, leak of inside information, ineffectiveness of poverty alleviation subsidies, problems with enforcement and sanctioning illegal activities and the effective management of natural protected areas.

Historically there have been specific policies to promote deforestation with the aim of populating the Peninsula and promoting extensive pasturelands and commercial agriculture; still there are agricultural subsidies promoting deforestation and shortening cycles of shifting agriculture. Overregulation has been said to affect productivity of timber and non-timber forest products as it increases transaction costs and the minimum size of viable projects/enterprises (forest management plans and chewing gum) (e.g. Fernandez Vazquez and Mendoza Fuente, 2015; Forero and Redclift, 2006); the transaction and bureaucratic costs associated can prevent the development of productive activities for smaller and usually more vulnerable groups since they are not able to cover them and thus are targeted by intermediaries. In this context, activities involving poorer actors in management of natural resources beyond mere subsistence practices are often considered illegal, given the lack of permits. A dilemma then arises because legislation aims to protect the environment and fight illegal activities, but in many cases the development of legal activities –particularly at the small scale-is prevented by the transaction costs imposed by the legal and institutional framework. The

fiscal regime also discourages the operation of rural enterprises in the private sector which have t0 compete with imported products (Fernandez Vazquez and Mendoza Fuente, 2015).

Another problem is the lack of coordination between different government levels (municipal, state and federal): the case of the *ejido* 20 de Noviembre has been cited above, as an example; there are also conflicting interests between and within different ministries (environment, communications – road development-, social development, rural development and agriculture). Leaks of inside information about infrastructure projects or development plans can affects the management of natural resources by sparking speculative processes in land trade. The presence of legal services and courts also offer an option for the resolution of conflicts and controversies, however poorer groups often lack access to these services in marginal areas. Experience shows that public efforts to promote the conservation of forest cover may be more effective if they promote the sustainable management of forests and stronger local governance over resources instead of taking a conservationist approach (e.g. natural protected areas). This requires a stronger presence of institutions related to the forest sector and technical services.

3.1.7 Financial sector

Banks and other credit institutions provide resources for the development of productive activities described in the previous sections, for instance to facilitate access to more efficient agricultural machinery by farmers and for the operation of the firms and companies producing inputs and providing services for the development of activities in the primary sector; these activities are associated with the direct drivers of emissions. The financial sector also facilitates the operation of different actors and firms working in different steps of the value chain, including the construction of new urban centres and even the co-financing of public development projects (e.g. harbours, roadways); banks also offer credit to final consumers that increases the demand for goods and services. These actors are profit-oriented and usually do not consider the impact the projects associated to their operations will have on the environment or include the associated costs.

3.1.8 Other actors

Finally there are other groups related to different drivers of emissions. The first are criminal groups that can be involved in illegal timber exploitation and trade of other products; here criminal activities take place within the extractive and trading links of the value chains to satisfy intermediary or final demand for valuable goods. The second group are the importers of agricultural crops, timber and other forest related goods. The lower relative prices from imports set a ceiling price for the development of productive activities that difficult the development of these sectors in Mexico particularly in the agricultural sector given the subsidies given to farmers in other countries.

Table 14below gives a summary of the main groups of actors and their associated assets/productive factors. Specific productive activities change from one region to another depending on the natural and socioeconomic contexts (e.g. agricultural versus forestry based activities, availability of off-land income opportunities). However the main differences between local poorer and non-poor actors are whether they have access to land and whether their activities are connected or not to markets favouring capitalization and investment.

Table 14.Summary of main actors and productive factors/assets.

Actors	**Main Productive Factors/Assets of Group of Actors**
Poorer groups	
Immigrants, landless	Labour and access to areas to extract firewood
Women heads of households , landles	Cattle, labour, land and remittances (*husband)
Residents *avecindados*, landless	Labour, recognition by *ejido* authorities (legal rights access to subsidies, not to land)
Elderly people	Land, Labour
Young dwellers, landless	Labour
Small-scale cattle-rearers, landless	Cattle, Labour
Resident, with land access, subsistence agriculture	Labour, land access, fallow, beekeeping
Community landowners/ *ejidatarios*, subsistence agriculture	Land, land certificate (share, subsidies) labour, fallow, beekeeping
Communities/*ejidos* with timber production	Land, labour, land certificate, forest, management permit, chewing-gum production
Better-off/Non-Poor	
Commercial agricultural producers (*ejidos*/private)	Land, labour machinery, irrigation, capital for reinvestment
Community/*ejido* authorities	Institutional networks
Large-scale cattle-rearers	Cattle, grassland, capital for reinvestment
Technical foresters	Institutional networks, brokers for public programmes
Intermediaries of timber, charcoal, firewood, honey, beef, crops, chewing gum.	Infrastructure, transport, scale of activities, market access, capital for reinvestment
Land-brokers	Information, networks
Firms processing primary products	Infrastructure, transport, scale of activities, market access, capital for reinvestment
Investors	Access to capital, evaluation skills
External consumers	

3.2 Identification of poorer groups

3.2.1.1 Conditions associated with poverty in rural areas

Ejidos promoted productive activities in smallholdings to satisfy subsistence needs of agricultural workers under the revolutionary banner 'land to the tiller' (*la tierra es de quien la trabaja*) (Warman, 2003). Returns from individual parcels were complementary to income from agro-industrial exports that collapsed with the 1929 crisis (Warman, 2003). During the period1940 to 1960, the state promoted the participation of *ejidos* in commercial activities and the economy through different public companies (e.g. credit, agrochemicals, irrigation, insurance, public monopolies, etc.) (Warman, 2003). In this period national agricultural production increased more than population growth and rural producers could satisfy their needs by bundling their produced and purchased products thanks to cash activities (Warman, 2003); irrigation and the green revolution contributed to this. However productivity and the prices of agricultural products dropped due to the introduction of mechanized agriculture in developed countries; lower yields in some areas increased production costs to the farmers (e.g. fertilisers, agrochemicals) (Warman, 2003). Mazoyer (2001) identifies these dynamics as being at the root of rural impoverishment processes of subsistence and under-equipped farmers, since low prices of agricultural products reduced the resources available for reinvestment in productive assets and to provide food to households. Given the urgency of satisfying immediate alimentary needs, this resulted in even lower productivity rates. This represented a shift from an agricultural policy to an alimentary policy and trade liberalisation, and with depressed prices it was relatively cheaper to supply food to rural areas rather than support local production particularly in areas with lower natural productivity as Yucatan. Recently, productivity of manual versus mechanized-chemically assisted agriculture has been on the order of 1 to 500 or to

2000 world-wide (Mazoyer, 2001).Local social networks and economy have been eroded by the change in public agricultural policies and the depression of regional rural and urban employment markets that makes necessary to emigrate to more distant places in search for employment often outside the country (Escobar Latapí, 2005).

In order to fight malnutrition, the social development ministry, in Mexico sells food products, including maize, at subsidized prices in rural areas (i.e. DICONSA); prices are subsidized and lower than the already low prices set by international markets as a result of efficient, mechanized production in developed countries. This is popular with consumers, but the subsidies reduce incentives for local production and trade (Mazoyer, 2001). There are however alternatives to promote local agricultural economies, such as providing coupons for food (but keeping higher prices), or by creating a system to offer better prices to rural marginal producers, which could be partly financed by taxation on large mechanized producers (Mazoyer, 2001) although this would be difficult to implement for political reasons and requires of international cooperation.

3.2.1.2 Property, family, land access and the poor

The poor value policies and measures which help to clarify property rights over their patrimony. According to the *Voice of the Poor*, in this context, 93% the poor would prefer to live in a house of their own even if it does not have all the basic services, rather than renting a fully equipped house (only 6% of respondents preferred this); likewise, 80% preferred to have a plot of agricultural land of their own even if it was in an isolated locality rather than to live in an area with all the services and work in someone else's land (18%) (Székely, 2005). This explains partially the existence of marginal and isolated rural communities in areas were potential productivity is low, and the continual migration of landless looking for a plot of land (this in fact was one of the reasons why the Peninsula was recently populated). However, the fact that land in Mexico is now mostly ´occupied´ and under the legal control of defined owners, has led to a considerable increase in the last 20 years of families within ejidos who do not have land.

There is a strong feeling of confidence in the family. While the government is perceived as a distant actor and responsible for poverty and social problems, family is perceived as capable of supporting the poor in case of sickness, unemployment and debt (according to the Voice of the Poor, 70% of the poor go first to their family when they are in monetary need; 67% in case of accidents or when they do not have food; 36% in case of natural disasters; and 43% to look for employment) (Dieterlen, 2005; Cordera Campos and Flores Angeles, 2005; Székely 2005). Communities have social protection mechanisms (such as networks, promotion of employment, and local credit) but usually they are not specifically oriented to the poor (Escobar Latapí, 2005). It is the family and not the community (or the *ejido*) that is the strongest institution supporting the poor at local level, however the focus of social policies has ranged from targeting communities or individuals, bypassing the family (Székely 2005; 2005b).

Finan et al (2005) performed an econometric analysis using the data of 13,700 households from different states in Mexico to determine the contribution of land access to welfare of poor households and potential for poverty alleviation. Their results show that access to EVEN small plots of land can increase the welfare of poor households considerably. The probability of being poor increases drastically for households with land endowments smaller than 2 hectares (in their national sample, 62% of households with less than one hectare were poor, while when the parcel is larger than 8 ha the proportion of poor is 38%) (Finan et al 2005). Another unsurprising finding is that when the 20% of poorest households are compared with the 20% better-off, results show poorer households have fewer farm animals (1.1 versus 4.4 heads), fewer years of education (1.9 versus 3.9 years), a tendency work more as a farmer instead that off-land jobs (i.e. work in agriculture 88%

versus 63%; has family business 38% versus 70%), and there is also a correlation of poverty with indigenous ethnicity (59% versus 17%). In Mexico 80% of the indigenous population live in poverty (versus 17.9% of non-indigenous population) (Psacharopoulos and Patrinos, 1993, in Finan et al 2005). Finan et al (2005) present a parametric regression to explore how different conditions affect the average welfare, and income of poor households, Table 15below presents a selection of the factors analysed.

Table 15.Contribution of different factors to the welfare of rural families in Mexico (taken from Finan et al 2005)

Factor	**Average marginal gains in household welfare (pesos per month; 1997-1998 values)**
Land access (1 ha)	$125
Head of household (male)	$1223
Year of extra education of head of household	$374
One male (female) adult finishes primary education	$925 ($2213)
One male (female) adult finishes secondary education	$2795 ($4267)
Old male (female) older than 55 years	-$480 ($973)
Children under 17 years(per individual)	-$31
Indigenous household	-$3117
National emigration (per person emigrating)	$60
International emigration (per person emigrating)	$230
Health centre in locality	$964
Access to a state (federal) road	$882 ($898)
Access to an agricultural cooperative	$56
Distance to urban center (state capital) (per km)	-$18 (-$6.5)

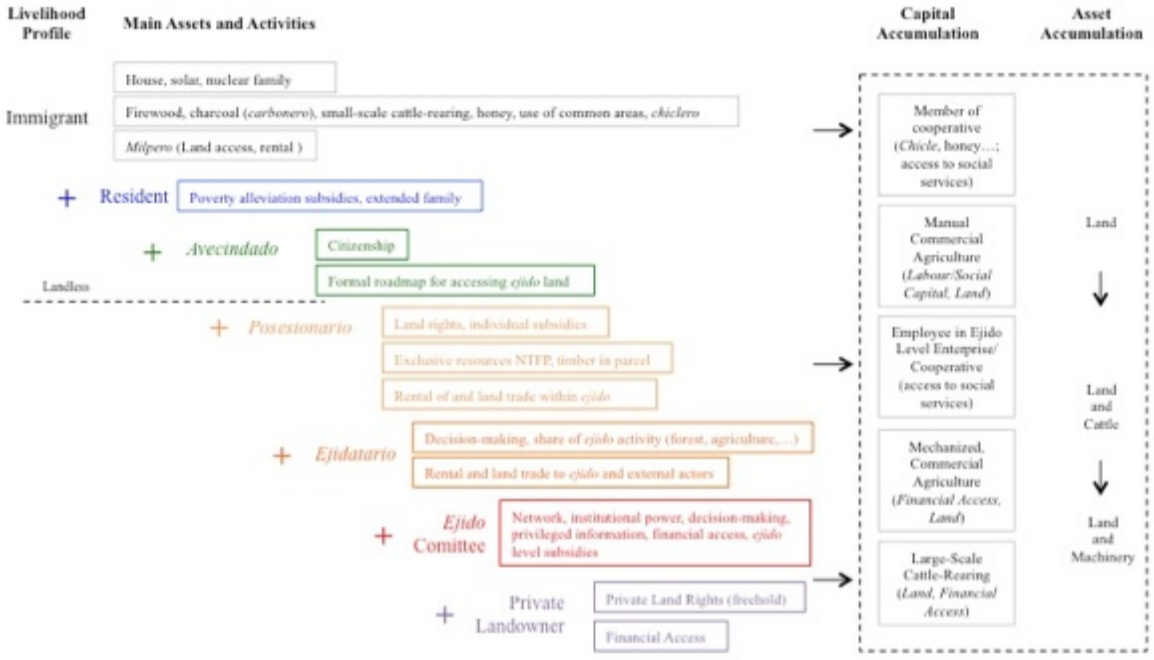
These results show the importance of education (particularly for women), land access, emigration, health services and access to roads as means to reduce transaction costs. However the relationship between the size of landholdings and welfare is not linear, hence contribution of land to household welfare is even higher for those without land or with very limited access to land (less than 1 ha); in this case the value of the first hectare of land is around $880 pesos which at the time of the study represented 1.3 times the income of an agricultural worker (Finan et al 2005). Benefits are increased further in areas with access to road and when households have at least primary education. In fact, land access does not contribute much to alleviate poverty in households with low levels of education. Conversely for households in settlements with have access to a paved road, as little as 1 ha may suffice to cross the poverty line due to the possibility to engage in off-land work (Finan et al 2005). The results of this study provide insights into the role that different strategies can play in poverty alleviation particularly land access (even in modest levels) in combination with education, access to urban areas through paved roads and health services.

3.2.1.3 General livelihood models

Based on the description of the drivers and the different roles of local stakeholders it is possible to identify a variety of livelihood strategies that individuals and families have undertaken in rural areas to cover their needs. The main rural producers are immigrants, residents (who have family in the population center but have no agrarian citizenship), avecindados, posesionaros or comuneros, ejidatarios, the leaders of *ejido* committees or rural cooperatives and private landowners. It is recognized that any of these groups can emigrate or engage in an off-land job which can increase their income. The analysis of poverty here thus focuses on the activities and assets related to land-based productive and subsistence activities to find out how the processes driving emissions and REDD+ interventions on the ground can affect different social groups. It is acknowledged however that the creation of alternative off-and income is a major and effective pro-poor strategy. Figure

35below presents a general diagram of the different activities that can be developed by different social groups depending mostly on their prior knowledge and the land ownership regime.

Figure 35.Different activities and assets for general livelihood profiles.



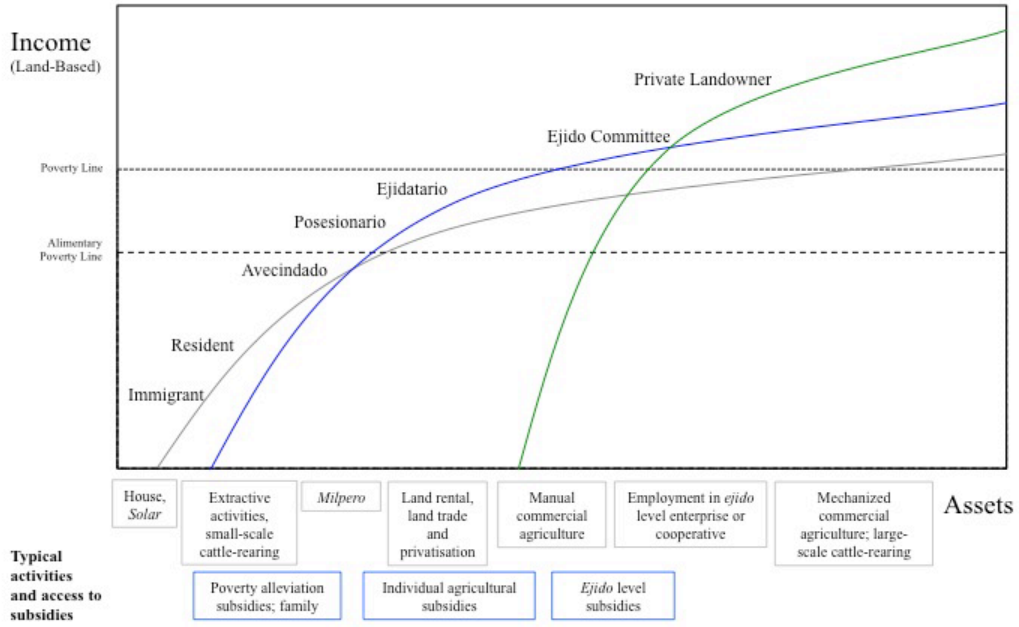
Activities can be incremental and part of a pluriactive strategy, for instance immigrants initially arrive in a place without a social network apart from their nuclear family and their assets are restricted to the home and *solar*, once they have established themselves in a population center. They can focus initially in extractive activities (e.g. firewood collection, charcoal making) or cattle rearing. If they are able to create basic agreements with the local *ejido* assembly or individual landowners they may be hired as labourers, and they may also be able to access common areas and rent or use an area for *milpa*, set bee hives, and even engage in *chicle* extraction (locally in Quintana Roo or Campeche) or externally, by moving to the *chicle* producing areas during the harvest season. On the other hand, residents –who are not official *avecindados*, but have been living in the population center for a while-may additionally, have access to individual poverty alleviation subsidies and a more extensive family and social networks. More benefits and income may be forthcoming depending on the restrictions imposed by labour availability, skills and other enabling conditions (e.g. empowerment, capital access, social agreements, etc). It is possible for immigrants to move towards cash activities, but it will require more time, as they need to cover their basic needs and then accumulate capital before they can buy productive tools and land. In Figure 35, there are three archetypical cash activities individuals can get engaged in, these are: manual productive agriculture (e.g. Guatemalan immigrants, agroforestry), mechanized and commercial agriculture (e.g. Mennonites and irrigation districts) and large-scale cattle rearing (e.g. private –usually absentee- landowners). In the first case the main productive factors are labour constrained by access to land use (and productive skills), in the second the main productive factors are financial access (to buy machinery, silos and agrochemicals) and land (economies of scale), and in the third case is land and financial access. Collective options to engage in productive activities in the primary sector are possible through membership of cooperatives mostly for commercialization, and employment in

ejido/community level/cooperatives (e.g. CFM, chewing gum); when these activities are performed individually with a non-subsistence focus these will be very likely to be “illegal”.

Given the potential to develop many productive activities it is difficult to identify a clear and unique boundary between poor and non-poor actors. One important consideration is off-land income and remittances, which can represent a large share of income. The analysis of off-land income and remittances requires a specific study surveying the prevalence of these sources of income linked to economic diversification and regional demand for labour. Nevertheless it is possible to identify specific poor groups. The groups formally landless are immigrants, residents and *avecindados*. According to their main productive activity poor groups can be identified as *carboneros* or *milperos*; traditionally *chicleros* were also poor and marginalized, this started to change through the setting up of the cooperatives for organic *chicle*. Women, the young and the old population are special groups that can be located in any of the profiles identified but are in general more vulnerable. The processes of asset accumulation will be reflected first in the house and land, and later in the increase in the number of the cattle reared (even number of bee hives), and finally to productive machinery; investment in agricultural machinery makes sense if it is possible to create economies of scale either by possessing a larger tract of land or through an organized collective action. According to a study made in the Peninsula, honey production can be an economically viable activity for an individual if the number of bee hives is higher than twelve (break even) (DCA, 2001 in Ojeda Lopez, 2009)

Figure 36presents the transition of three different livelihood strategies, first that of immigrants (gray), secondly of agrarian subjects under the *ejido* (blue) and finally private landowners (green). It is assumed that when actors obtain formal or informal access to land they can engage in subsistence agriculture that can reduce their levels of alimentary poverty. In this context only when livelihoods are oriented to commercial crops, are households able to accumulate capital and assets and cross the poverty line. The members of *ejido* committees are a particular group which sees a rapid change in their prospects for development due to the enriched institutional and social networks, the access to privileged information and power in decision-making and management of ejido resources and projects. There can be poor private landowners but they can rapidly increase their income as privatized properties can be used to access credit and to be sold for urban development. The poorer groups have access to poverty alleviation subsidies (e.g. SEDESOL), but hardly to agricultural subsidies (e.g. SAGARPA); only the members of the *ejido* committee, on behalf of the assembly, have access to *ejido* level subsidies (e.g. CONAFOR).

Figure 36.General transitions between general livelihood strategies.



3.2.1.4 Critical assets

Based on the description of the different stakeholders and their assets, we have made an analysis to evaluate their importance for poor households using multi-criteria analysis. The criteria for analysis of assets and benefits received by social actors are presented in Table 16and are: the magnitude or relative importance, whether the assets is physical or intangible, tradable, represents access to liquid cash, it is renewable or if it is related to a subsistence activity. Additionally assets and benefits are described according to the type of the capital to which they relate: natural, social, human, productive or financial; a sixth category is added to describe if the benefit/asset increases the level of power of the social groups. Power, productive, and financial capitals have higher weight in the combined index since they can be used in more immediate ways to satisfy urgent needs, on the other hand human, social and natural capitals are necessary enabling conditions and constraints which have effect in the longer term.

Table 16.Criteria for the pro-poor evaluation of productive assets and activities.

Criteria	**Description**
Relative importance	Scale of assessing the relative importance of the asset and potential contribution to livelihood: low, medium or high, for which an asset receives a value of 1, 2 or 3; examples are firewood, access to agrochemicals, and ownership of a home.
Tradability	Potentially tradable assets receive a value of 1.
Liquidity/Cash	Direct benefits in cash receive a value of 1.
Renewable/Unique	If the benefit can be obtained periodically the value is 1 (e.g. extraction of chewing gum, timber); if not the value is 0 (e.g. land once it is sold).
Subsistence Activity	If the asset or benefit relates to a subsistence activity it gets a value of 1.
Combined Capital Index (natural, social, human, productive, financial, power)	A weighted value of the asset or benefit is made depending the type of capitals involved: Natural, Social, Human, Productive, Financial and Power; each factor takes a value of one sixth thus the value of the index is smaller or equal to 1 (if an asset or benefit relates to the six dimensions described)
Critical Asset	Assets which are non-renewable, potentially tradable and related to subsistence activities.
Total Value	This is the total obtained by the product of the combined capital index and the summation of obtained considering the other criteria.

Three groups of assets and benefits are identified in the analysis: those that offer access to liquid cash; critical assets that if sold imply a long-term de-capitalisation of the poor; and finally a ranking of the most important assets and benefits in rural areas related to poorer actors. The liquid cash benefits are off-land work, public subsidies, social provision services of cooperatives or *ejido* level enterprises, participation of economic *ejido* activities (only ejidatarios), potential aid received from families, potential access to credit (if eligible –ownership of a physical asset-), subsidies, the rental or sale of land, and remittances. The ultimate critical productive assets which may compromise the long-term de-capitalisation of households would be the sale of formal rights to land (*ejido* or private), of their house and solar, conversion of perennial agricultural crops to other land uses, not keeping seeds of seasonal crops for the next cycle, non-motorised vehicles and the sale and dismantling of basic tools and assets for subsistence activities (hand tools, barns and stables).

Table 17 below presents a summary of the main assets, benefits and conditions contributing more strongly to the development of poorer groups. The first factors with the highest mark are: the access to off-land work, knowledge and implementation of intensive agroforestry practices; the participation in ejido activities (decision making and income share) and formal access to land rights; access to subsidies; and a strong and effective institutional presence in different areas (e.g. health, education, agriculture, forestry, enforcement). A full table of the assets identified can be found in the Appendix (Section 0).

Table 17.Assets and benefits with higher contribution to the development of poor groups.

Assets and Benefits	**Characteristics**						**Capital/Dimension of Livelihood**							**Total Value**
	Relative	**Tradable**	**Liquid/Cash**	**Renewable**	**Subsistence**	**Sub-Total**	**Natural**	**Social**	**Human**	**Productive**	**Financial**	**Power, Political**	**Combined Value**	
Off-land work	High		X	X	X	6		X	X	X	X	X	83%	5.0
Knowledge of/Organisation for, labour intensive cash oriented agricultural practices	Medium	X		X	X	5	X	X		X	X	X	83%	4.2
Participation of ejido activity (membership as ejidatario)	Medium	X	X		X	5	X	X		X	X	X	83%	4.2
Formal access to land (ownership) (posesionario, comunero)	High	X	X		X	6	X			X	X	X	67%	4.0
Subsidies (poverty, agricultural)	High		X	X	X	6		X	X	X	X		67%	4.0
Institutional presence	High				X	4	X	X	X	X	X	X	100%	4.0
Private parcel (freehold)	High	X			X	5	X	X			X	X	67%	3.3
Empowerment, motivation	High			X	X	5		X	X	X		X	67%	3.3
Links to markets and intermediaries	Medium		X	X	X	5		X		X	X	X	67%	3.3
Use and access to resources (timber, NTFP)	Medium	X		X	X	5	X		X	X		X	67%	3.3
Social rules for resource access (Firewood, timber, land rental)	High				X	4	X	X	X	X		X	83%	3.3
Water and irrigation	High	X		X		5	X			X	X	X	67%	3.3
Formal education	High	X		X	X	6		X	X			X	50%	3.0
Emigration	High		X	X	X	6		X		X	X		50%	3.0
Access to transport services	Medium			X	X	4		X		X	X	X	67%	2.7
Fallow Age	Medium			X	X	4	X		X	X	X		67%	2.7
Family (nuclear and extended)	High		X		X	5		X		X	X		50%	2.5
Food and crops (perennial)	Medium	X		X	X	5	X		X	X			50%	2.5
Cattle (small scale)	Medium	X		X	X	5			X	X	X		50%	2.5
Remittances	Medium		X	X	X	5		X	X		X		50%	2.5

In addition to access to water and irrigation, agricultural producers also benefit greatly from the use of machinery and infrastructure for post-harvest management. In the region agriculture in general is either manual or mechanized; in general there is no use of animals for ploughing. The use of animals can offer means to combine agriculture and cattle rearing by increasing the productivity of these activities. According to Mazoyer (2001), animal based agriculture could increase planted area from 1 to 5 ha; however it is necessary to consider soil fertility of *milpa* systems and the cost-benefit analysis of this type of innovation.

4 REDD+ interventions to reduce emissions and increase carbon stocks

4.1 Alternatives for reducing emissions from deforestation

Usually when forestland is converted to commercial agriculture, the vegetation is removed with machinery and/or is burnt, thus all carbon in the original vegetation is lost. This activity can be highly labour intensive and may require employing members of local communities. During this transition some timber and firewood may be collected. Likewise members of local communities may be allowed to plant seasonal crops for subsistence and produce charcoal; these can be identified as temporary positive side effects for the local population. When land is converted from primary or secondary forest to permanent pastureland carbon previously stored in the vegetation is also lost. This effect can be of second order if agricultural land is converted to pasture; if the demand for agricultural land remains the effect could be seen in the expansion of the agricultural frontier and/or the reduction of fallow areas or fallow cycles. If activities can prevent the conversion of forests to agricultural and grazing areas, potential carbon gains will be associated with the original carbon stocks in forests and the rate at which deforestation occurs.

It is important to point out that not all land use changes observed in the field or through remote sensing correspond to illegal deforestation. It is possible for landowners, companies and *ejidos*, to initiate administrative processes and technical studies to justify and to obtain permits for land use change. This procedure usually implies paying a compensation fee for the environmental services lost to the National Forest Fund; these resources are used later to finance restoration activities elsewhere in areas with the potential to produce comparable environmental services. However in practice it is quite difficult and sometimes impossible to identify in the field whether a specific plot has been cleared legally or not and if the corresponding contributions have been made to the forest fund. Currently contributions to the fund do not consider the extent of emissions from deforestation and there is no process to earmark the resources and use these within the jurisdictions. Both legal and illegal land use changes are included, but indistinctly, in the definition of the baselines for REDD+.

In the case of “legal” land use changes producing deforestation, these projects or initiatives will need to follow the legal channels and apply for land use change permits. From a REDD+ perspective, the contributions to the forest fund should be made sufficient high to recover the lost carbon over a given time period (i.e. to pay for sufficient tree planting to recapture the losses), and this should be transparent and traceable. This applies for the development of large tracts of commercial agriculture and pastureland and for land use changes for urban and tourist development. Land-trade and speculation do not necessarily imply illegal deforestation of an area if the new landowners follow the official processes to obtain the land use change permits. However the governance of land use change and management of natural resources is sometimes ineffective, such that many transactions are illegal. Much stricter enforcement would be required to prevent this or to ensure that when it occurs, contributions to the forest fund are levied so that the carbon may be replaced. In addition, we note that there are conflicting subsidies promoting deforestation (particularly between ministries of agriculture and CONAFOR). In this context it is necessary to coordinate and align public programs and subsidies of different sectors (e.g. agricultural, development, infrastructure, environmental sectors); strengthen the mechanisms for the enforcement of regulations (land use change control); and promote the adoption of effective governance and management schemes.

4.2 Alternatives for reducing emissions from degradation

Shifting cultivation generally results in degradation rather than deforestation, since in the *milpa* system, ejidatarios only use 1 to 2 hectares for cultivation in any one year, and the rest of the parcel remains as acahual in the fallow stage. The clearing of a new section of this land for milpa can be identified as a ´land use change´ but this is not deforestation as it is merely a phase of use of land which was previously also under agriculture but in the resting phase. Moreover, its woody tree cover will be restored within a couple of years after its use for cultivation. In the longer term and provided the rotation cycles are not reduced, carbon stocks will recover, although if there are reduction in the cycles lengths there maybe a degradation of carbon stocks. Factors acting for the reduction of cycles are the presence of agricultural subsidies and demographic pressure on land (e.g. more milperos or smaller parcels).

Shifting cultivation is important in terms of the area involved and the contribution to poor livelihoods, if it is possible to implement best practices (some of which are presented below) these may help to reduce emissions from degradation; the areas for intervention are the parcels with *milpa* systems and *solares*. It is recommended to test this hypothesis and evaluate if this will suffice to reduce the demand for agricultural lands, increase rotation cycles, reduce alimentary poverty and if enough surplus can be produced, if this can help households to accumulate capital. Teran and Rasmussen (2009), list more than 170 plants associated to the traditional mayan productive system which were used for food, medicines, construction, to build utensils and for other uses; in the late 80s producers in the Xocen area planted more than 30 species in their *milpa*s (Teran and Rasmussen, 2009). Corn varieties of different growth cycle lengths, can be sown to increase the availability of food throughout the year. Maize can be stored in the parcel, in small barns (*trojes*), or in the house (Teran and Rasmussen, 2009). Traditional systems also include actions to preserve better the grain, one distinctive characteristic of the Mayan *milpa* is the bending of mature maize stems, since the cob points down it prevents the entrance of eventual rainfall while the grain dries out (Teran and Rasmussen, 2009); this way of storage of the grain also reduces the risk of propagation of insects attacking the grain (e.g. weevil) (Figure 37).As part of the whole system, producers obtain additionally to crops a series of benefits including honey, meat from hunting and traditional cattle-rearing, collection of firewood, poles, timber for construction and medicinal plants. An important part of traditional and subsistence agriculture takes place in small kitchen gardens and areas surrounding the houses (*solares*) where families grow different crops and trees (up to 130 species), and keep farm animals (i.e. poultry, pork, cattle) (Teran and Rasmussen, 2009).

However the traditional *milpa* includes many activities that need to be planned and organized during the productive year to obtain higher yields. The activities include the selection of the plot for *milpa*, opening of access paths, measurement, clearance, installation of fences, preparation of firebreaks, burning, preparation of seeds and sowing, fertilization, weeding, bending of corn stems, harvest, storage, and then abandonment to allow regrow (*barbecho*). For these activities, hand tools are used as axes, machete, *coas*, grinder, rope, torches, hand sower, baskets and sacks (Teran and Rasmussen, 2009).Currently milpa in Yucatan is a safety net in case of unemployment with a larger participation of the older population; it may be a practice that will die a natural death as younger people appear less willing to use it.

Figure 37. Image of a manual, cash oriented labour intensive *milpa* system with two production cycles.

In the traditional system, the clearance of fallow land occurs during the rainy season (July-October). There are various advantages in choosing this time, during this season the vegetation is wetter and thus easier to cut, the organic matter will have more time to dry and will burn better at the beginning of the next cycle. Moreover, due to the humidity the leaves will rot faster and be incorporated to the soil, and the seeds of shrubs and weeds will fall and sprout, thus after they are burnt there will be no more seeds to grow reducing subsequent weeding efforts (Teran and Rasmussen, 2009). The knowledge of best practices can help to increase the productivity of labor of subsistence agriculture this may be particularly necessary among immigrant groups without prior knowledge or local conditions.

While the *acahual* can be regarded as a degraded form of *selva baja* or *selva mediana*, its carbon content can increase up to levels comparable to that of the original vegetation. This is favoured by traditional practices since during the clearance of the *acahual*, stumps of trees are often left about waist height enabling the re-vegetation of the acahual after the *milpa* stops; valuable trees are also kept in the *milpa* fields as part of agroforestry systems (Teran and Rasmussen, 2009). The *milpa* system can help to maintain an average stable carbon stock if cycles are not reduced, thus it will not be provoking deforestation or degradation. Following disturbance, secondary forests may reach original stock levels in periods close to 50 years (Brown and Lugo, 1982, 1990, in Eaton and Lawrence, 2009), but in Yucatan this process may take from 55 up to 95 years (Read and Lawrence, 2003). The age of the fallow is the best predictor of carbon stocks which is also associated with precipitation gradient; after the first cultivation cycle the carbon stock is reduced by 36% but additional cycles do not reduce it further (Eaton and Lawrence, 2009).

The potential recovery of carbon stocks in shifting agriculture systems depends on the length of the cultivation cycles thus it is necessary to analyse different options that can be used to implement these and evaluate its impacts. With cycles of 6 to 11 years in mature forests converted to shifting agriculture, this could imply a net loss of 162 tC/ha, as secondary forests only stores 34% of original carbon stocks. It is important to point out that most of current shifting cultivation takes place in secondary forests; there will be higher risks of emissions if formerly forest based ejidos are cleared to create room for new agricultural land in Campeche and Quintana Roo. By increasing the cycle to 25 years the level of aboveground biomass and soil will reach about 62% and 90% levels respectively in comparison with mature forests (Eaton and Lawrence 2009). These results are consistent with IPCC (2003) which provides Tier 1 default values for the fraction of carbon in soil of shifting cultivation systems. It indicates that short fallow cycles are only able to recover 64% of reference level stocks, while large fallow cycles may reach 80% levels (Table 3.3.9, 3.92). However, most research on the carbon effects of shifting cultivation has been done in humid forests, where the situation is very different from tropical dry forest such as selva baja, and in the Yucatan

peninsula, much of the shifting cultivation is in selva baja. Hence we recognize that much more research is needed to account for the changes in carbon stocks under different management practices and in different ecological contexts The question of whether lengthening cycle lengths will increase carbon stocks overall needs to be examined not only for different ecosystems but also taking into account the system wide impacts, since if cycles are kept short, there should in theory be much greater areas of forest which are never cleared for use in the cycle.

There have been various programs and projects to build and promote the use of efficient cook-stoves. Domestic firewood use is usually sustainable: much of it comes from the *milpa* patches. However it is important to include the use of cook stoves not only to reduce consumption but to improve health conditions in the household; controlling indoor pollution is the main reason for adoption of this technology in rural households (Masera et al 2005). A comprehensive strategy to promote the use of cook stoves needs to promote markets, innovation and the transfer/adoption of this technology including the promotion of small local enterprises (Masera et al 2005). Degradation usually only occurs in areas where extraction is related to trade of firewood to the cities, and particularly where this occurs on ´abandoned´ land, particularly on private properties with absentee landowners –including national lands and areas under legal dispute- or when private landowners have given their consent to members of local communities. In these areas degradation is a sign that firewood collection has long exceeded the local carrying capacity of the ecosystem. Finally, the availability of firewood increases temporarily in areas affected by disturbances such as hurricanes, where the increased amounts of dead organic matter pose a risk for forest fires particularly in the proximities of agricultural areas.

Charcoal can be produced at sustainable rates which take into account biomass growth of forests. But it may also be (and frequently is) produced linked to clearance processes of agricultural areas and as part of land-use changes, where the trees are in any case being cut. Or it can be produced from the excess of dead organic matter following hurricanes. Nevertheless charcoal production is illegal in all areas unless there is an approved management plan for it. However it is costly and burdensome for individual producers and farmers to prepare and formalize management plans to add value to this resource. As a result, most production is clandestine, charcoal makers are often fined, or they make very small profits because they have to pay bribes, or are at the mercy of middlemen who do this for them. Legalising charcoal together with a review of policy on management plans for charcoal production needs to be undertaken in the context of REDD+.

The production of firewood serves to satisfy domestic needs which by definition does not allow the accumulation of capital. However individual scale firewood collection and charcoal production as produced when the milpa is cleared can be enhanced by different initiatives to allow that poor households accumulate some capital. It is necessary to undertake specific studies since it offers an opportunity to integrate more formally these activities into *milpa* systems. There is a huge quantity of biomass that is burnt periodically that could be used as alternative source of energy; nonetheless it is important to develop adequate governance systems since a higher productivity of the sector may attract newcomers that could increase emissions. It is necessary to make the appropriate studies to ensure this does not produce a degradation of soil fertility; in the regulatory context it will be necessary to create a simplified option for the formulation of management plans in order to promote that individual producers can form cooperatives to reach external markets. For the production of charcoal production may be benefited from the use of efficient kilns.

After a hurricane usually there is a large availability of dead biomass that can become a threat for forest fires. A simplified system to authorise the preventive collection of timber, firewood and charcoal production could be introduced which can potentially benefit the corresponding

landowners. This extraction of dead wood needs to include also the implementation of activities to ensure the recovery of the arboreal cover.

Timber extraction has been made historically through selective logging of cedar and mahogany, this implies the degradation of species diversity and a relatively small degradation of carbon stocks. Another case is the problem of the logging of young chewing gum trees. In this context it is possible to simplify the regulation for chewing-gum production and include enrichment reforestation practices to prevent future supply problems. In order to promote the sustainable management of forests to produce timber and NTFP it is recommended to reduce the unnecessary regulatory burden and increase the attractiveness of forest management landowners; this includes the management of firewood and charcoal production in fallows, pastureland and agricultural areas particularly for small scale management projects.

4.3 Alternatives for contributing to carbon enhancement, the sustainable management of forests and conservation of carbon stocks

Carbon stocks can be increased in forests and agricultural and grazing areas. For this the main activities are forest management, conservation, restoration, reforestation and afforestation activities including agroforestry and silvopastoral management. Activities to improve *milpa* systems and improve firewood collection and charcoal production can increase the average levels of carbon stocks over time. The inclusion of larger green areas and parks in developed areas can also increase slightly carbon stocks in cities and favour the provision of local environmental services and adaptation to climate change effects. It is expected that if the measures implemented to reduce emissions from deforestation and forest degradation are effective, will emissions stop but carbon stocks might increase in forests and soils; it is important to include MRV activities in these areas to estimate the magnitude of these changes and the effectiveness of different initiatives. Additionally management practices can be promoted in areas already deforested in order to incorporate environmental aspects and reduce emissions, for instance by introducing agroforestry practices (i.e. living fences, or mixed crops), transit to organic agriculture, sustainable silvopastoral management and zero tillage. Although these activities act over non-forest land they can increase the awareness of relevant stakeholders currently engaged in emissions processes

As shown by the results of the Forest Pilot Project (FPP), CFM (of timber) is the best option for the conservation of tropical forests but it is not possible to follow the same approach in small and large ejidos; management needs to consider the local socioeconomic context and include a process to define management objectives and silvicultural management criteria under a systematic approach including verification means. Only in large forest ejidos will income from CF timber contribute substantially to the economy of all the ejidatarios. In other cases it is necessary to promote agroforestry practices, small-scale plantations and small industries and workshops to add value to forest products. In smaller ejidos it is particularly important to provide sufficient technical support although it will be proportionally more expensive than in large ones (Flachsenberg and Galletti, 1999).

The external agent coordinating the FPP played a critical role in promoting the adoption of innovative practices. According to this experience, in future timber management programs as part of REDD+ it is important these development agents have the capacity to negotiate with farmers, institutions and have a strong technical background. It is necessary these actors maintain a systematic presence and that it is capable of promoting the systematization of practices and transference of knowledge and practices *in the field*. The promotion of certification schemes has also catalysed good management practices in Quintana Roo (i.e. Forest Stewardship Council, FSC); however these incentives may be effective to target only the most advanced ejidos (Flauchsenberg

and Galletti, 1999). The professionalization of forest management in communities is a continuous process and requires including gradually activities on the field, transformation and commercialization of timber and other products.

Forest resources offer good opportunities to increase job offers in the region (Zamudio Valencia, 2011). Other options for improving the management of forest resources in the Peninsula are the involvement of women in CFM, the creation of a revolving fund to finance extraction management practices, the development of markets for new species and an industry for trees of smaller diameters, the protection of relicts of old growth forests given the large carbon stocks and supporting activities to control forest fires (e.g. firebreaks) (Zamudio Valencia, 2011; Urquiza Haas et al 2007). If forests offer an attractive alternative to *ejidos* and landowners, either through direct management or through incentives as programs of PES this will help reducing deforestation and degradation and possibly will help increasing carbon stocks.

One option that can be included to facilitate SFM is the simplification of regulation of the forest sector, by giving more importance to certification and voluntary schemes (e.g. similar to the Clean Industry –Industria Limpia- voluntary program of PROFEPA). Another option is to decentralise functions to the state and municipalities level governments and coordinate governmental actions. It is particularly important to coordinate regional policies for road development, watershed management and waste disposals to protect mangroves

Aside from carbon enhancement, carbon sequestration and other actions to reduce emissions can take place in non-forest areas. Management practices can be promoted in areas already deforested in order to incorporate environmental aspects and reduce emissions, for instance by introducing agroforestry practices (i.e. living fences, or mixed crops), transit to organic agriculture, sustainable silvopastoral management and zero tillage. Although these activities act over non-forest land they can increase the awareness of relevant stakeholders currently engaged in emissions processes.

4.4 Potential carbon savings

Potential for reduced emissions can be estimated from methods published by the IPCC (2003) and comparing the levels of carbon stocks in forests and that of alternative land uses succeeding them (e.g. cropland, grasslands or degraded forests). In the context of REDD+ carbon stocks and stock changes in forests and reference emission levels are supposed to be developed consistently with the national inventories of greenhouse gases and removals by sinks. Considering the information submitted by Mexico to the UNFCCC in the third communication and the reference emission levels (REL) for REDD+, Table 18 and Table 19 below present information on carbon stock and stock changes (de Jong et al 2010; SEMARNAT, 2015). This information is used here to derive the potential of different strategies to address drivers and reduce the associated carbon emissions. Table 18 shows similar values of carbon content in tropical and dry forests when comparing the third national communication and the information used to estimate the REL. The information contained in the REL of Mexico additionally allows using a specific value for semi-deciduous tropical forests.

Table 18.Carbon content in main vegetation types in the Yucatan Peninsula.

Vegetation type	Carbon content in aboveground biomass (tC/ha) (de Jong et al 2010)	Carbon content in living biomass (tC/ha) (SEMARNAT, 2015)
Primary Tropical humid forest	52	49.9
Secondary tropical humid forest	19	24.5
Primary Tropical dry forest	19	
Secondary dry forest	15	
Natural grasslands	11	
Primary Deciduous Tropical Forest		21.7
Secondary Deciduous Tropical Forest		15.7
Primary Semi-Deciduous Tropical Forest		37.5
Secondary Semi-Deciduous Tropical Forest		20.1
Primary Woody Hydrophilous Vegetation		16.5
Secondary Woody Hydrophilous Vegetation		10.1

The literature has reported results of research projects in Yucatan that have assessed the levels of carbon stocks and stock changes of different types of vegetation associated to different management practices. Cairns et al 2000 found in Quintana Roo and Campeche levels of aboveground biomass around 59.9 tC/ha in tropical dry forests whereas Eaton and Lawrence (2009) found results which ranged from 57.3 to 68.1 tC/ha. In an area with a similar type of vegetation but drier conditions in Chamela Jalisco, Jaramillo et al 2003 report carbon stocks of 58.3 tC/ha. Urquiza Haas et al 2007 reported values above these results around 86.4 tC/ha in a study from Campeche and Yucatan in *selvas medianas* and *bajas*. Cairns et al 2003 reported 95.9 tC/ha in old growth forests in Quintana Roo while Read and Lawrence 2003 reported 63 tC/ha in the southern part of the Peninsula. These reported values include only carbon stocks of aboveground biomass thus it is necessary to consider carbon in roots, litter and soil. However these figures of carbon in aboveground biomass are from two to fivefold higher than the values reported in the construction of reference emissions levels (17.4, 30.2 and 40.4 tC/ha for deciduous, semi-deciduous and evergreen primary forests, when only carbon in aboveground biomass is considered). These differences can be due to the fact that national estimates in connection with UNFCCC use the most conservative approaches and the data used has a large variation considering it uses values from all the country. In any case any claim for emission reductions will need to use consistently the same methodological approaches for both the assessment of performance as part of MRV systems and the definition of regional baselines. These figures provide an initial idea of the potential gains from activities reducing the loss of carbon stocks in forests.

Similarly, average annual growth of aboveground biomass and associated carbon uptake reported in the literature is well above estimates of potential enhancements as presented in Table 19 (e.g. 1.4 tC/ha-yr by Urquiza Haas et al 2007; 1.2 to 3.4 Read and Lawrence 2003), however these values are more similar to the carbon enhancement reported by de Jong et al (2010) for secondary tropical humid forests (1.55 tC/ha-yr, although this estimates includes belowground carbon).

The potential for reduced emissions from deforestation is given by comparing the initial content of carbon in forests (Table 18) with that of the alternative land use; here the estimates are calculated using the national level data since it provides a consistent methodological approach and a more detailed stratification of vegetation types. In the elaboration of the reference emissions levels, SEMARNAT (2015) uses default Tier 1 values for cropland according to specific climatic zones, here the value of 1.8 tC/ha for tropical dry regions is used and denotes the content of carbon in the biomass of cropland. Additionally the Annex of the document describing the reference emissions levels describes the basic information to estimate emissions from degradation based on the information of some re-measured inventory plots and provide initial values (SEMARNAT, 2015). Table 19 below presents the information of the expected emissions reductions from deforestation

and from reduced degradation in the principal vegetation types present in the Yucatan Península following successful REDD+ implementation. Expected carbon gains from avoided deforestation are obtained by subtracting the default value of carbon in croplands to the values in Table 7. The magnitude of potential emission reductions from reduced deforestation are 7 to 20 times larger per hectare than those from yearly reduced degradation, but deforestation takes place over very small areas compared to degradation, and moreover it is very difficult to target (since it is never obvious which parcels of land would in fact be deforested in any given year, even if a general area is know to be under threat. This means that all landowners would have to be targeted with the area. For the case of degradation however, almost all areas within reach of human settlements are undergoing degradation and thus targeting is much easier.

Table 19.Expected carbon gains from in the Yucatan Peninsula for main REDD+ activities.

Vegetation Type	**Avoided Deforestation (tC/ha)**	**Avoided Degradation (tC/ha-yr) (SEMARNAT, 2015)**	**Potential Carbon Enhancement tC/ha (tC/ha-yr)***	**Carbon Sequestration (Reforestation) (tC/ha-yr)***
Primary Deciduous Tropical Forest	19.9	2.75		0.46
Secondary Deciduous Tropical Forest	13.9		6.0 (0.2)	
Primary Evergreen Tropical Forest	48.1	2.37		0.76
Secondary Evergreen Tropical Forest	22.7		25.4 (0.85)	
Primary Semi-Deciduous Tropical Forest	35.7	2.75		0.61
Secondary Semi-Deciduous Tropical Forest	18.3		17.4 (0.58)	
Primary Woody Hydrophilous Vegetation	14.7	1.94		0.28
Secondary Woody Hydrophilous Vegetation	8.3		6.4 (0.21)	

*Considering a period of 30 years.

Although Mexico is not currently contemplating the crediting of increased stocks of carbon due to forest enhancement or sequestration (the REL considers only avoided deforestation and forest fires), it is worth considering the potential for these processes for the future. A first estimate of the potential for carbon enhancement and carbon sequestration can be obtained by considering the potential carbon gains of going from secondary to primary forests for the first, and of going from cropland to alternative forests (deciduous, semi-deciduous) for the latter. In the case of reforestation or afforestation activities starting in cropland the potential carbon sequestration once forest cover has established, might be equal to the values of the first column in Table 19 (Avoided deforestation), In order to obtain the expected yearly gains it is necessary to prepare a forest growth model for areas where degradation will be addressed or for reforested areas. An initial yearly estimate can be obtained considering a management period of 30 years, which is the typical length of forest sequestration projects in carbon markets; however it is necessary to perform further analysis to estimate mean annual increments for different restoration/reforestation practices. Considering that the reforested areas could reach the same level of stocks as primary or secondary forests in 30 years then potential for yearly carbon sequestration can be obtained (last column in Table 19). Similarly, the Table presents the potential carbon enhancements in degraded forests if any degradation is halted and carbon stocks can recover to those comparable to primary forests; in this case the value in parenthesis shows the yearly average in a 30-year period. It is important to point out that these values only consider carbon content in aboveground biomass, this means that potential carbon benefits might be higher if other stocks are taken into account (litter, dead organic matter, soil).

Table 20 below presents a qualitative characterization of potential carbon gains that could be attained for each of the drivers of emissions identified and described in this work. For each driver, potential carbon benefits associated to reduced deforestation and/or forest degradation are described as high, medium or small considering the expected carbon gains per hectare and the area for intervention. This characterization will be used later to prioritize the best pro-poor interventions.

Table 20.Potential contribution to emissions reduction for each driver.

Drivers	Carbon Emission/ Removal Process	Relative potential for carbon gains under REDD+ per ha	Potential area for intervention
Expansion of commercial agriculture	Deforestation	High	Large
Shifting cultivation, subsistence agriculture	Degradation	Medium	High
Expansion of cattle rearing and pasture development	Deforestation	High	High
Firewood collection	Degradation	Small	High
Charcoal Production	Degradation	Small	High
Hurricanes	Degradation	High	Medium
Expansion of urbanisation	Deforestation	High	Small
Public programs and subsidies	Deforestation	High	High
Unsustainable forest management	Degradation/ Deforestation	Medium	High
Land trade and speculation	Deforestation	High	High
Ineffective governance schemes	Deforestation/ Degradation	High	High

Although the magnitude of potential carbon gains from reduced deforestation is higher per hectare than for degradation the area for intervention is larger to address degradation, additionally there are inherent difficulties to design incentive based policies to control deforestation. The baseline for deforestation needs to be built at a regional level to obtain a probability of deforestation, or the percentage of forest that is expected to be lost in one given year. This implies that it is not possible to know exactly which area of forest would have been lost without an incentive policy and thus all the area under the same level of threat (baseline) would have to be considered equally (i.e. see Balderas Torres and Skutsch, 2012 for a detailed discussion and example), one conclusion that can be drawn for it is that when the temporal dimension is considered to design long-term strategies to deal with deforestation despite the apparent larger carbon gains per hectare, the effective yearly incentives to address it can be considerably more modest.

Another conclusion that can be drawn from this analysis is that the geographical indetermination of deforestation diminishes the resources available to provide incentives for a specific hectare under threat; additionally the opportunity costs of activities driving deforestation are typically much higher than such modest payments, thus these efforts might be ineffective. In this context, strategies to address degradation offer a huge advantage, since it can be assessed at the management unit or per hectare level, carbon gains from reduced emissions can be determined for each individual parcel. Resources can be targeted more effectively to address drivers of degradation. However there are challenges to ensure that a sustainable management is given to forests and emissions do no restart once any payments for reduced emissions are suspended (for instance after 50 years considering the example described above). This issue is present for efforts addressing deforestation as well as forest degradation. It is desirable that REDD+ interventions are able to be self-sufficient over time independently of external financing.

4.5 Social niches for implementation

Mexico has moved towards the design of initial-early activities for the implementation of REDD+. The government is creating the institutional framework and adapting or creating the necessary regulations to implement REDD+, thus public action is paramount to lead the interventions and for benefit sharing. The extent of public actions is described in more detail in the next section describing the general characteristics of REDD+ benefit sharing schemes in the country. This section describes briefly the potential implementation of activities in different social niches.

4.5.1 Individual action

4.5.1.1 Individual landowners

Opportunities for activities targeting individuals and households relate to the improvement of productive practices such as *milpa* (production cycle and fire management), food production at home, cattle rearing, firewood collection, charcoal production, chicle extraction and management of timber and NTFP of individual parcels; individuals are the recipients of most capacity building and training efforts. Poverty alleviation and agricultural subsidies act also at this scale, thus aligning the objectives of different public programs and policies can have impact in these productive processes to reduce emissions. Land trade also takes place at individual level, it is necessary to understand the reasons why ejidatarios sell their rights to land, it can be as a preamble to emigrate elsewhere, to cash out resources as a pension, due to extreme urgency or as a strategy to increase available cash. Land trade can be prevented to reduce the decapitalisation of poorer groups through access to financial services (for saving and micro credits) and social prevision services.

4.5.1.2 Family and household level

The family is the strongest institution in rural areas and first safety network of the poor. However it has been usually forgotten by development public programs which often target either the community and *ejido* committees (as CONAFOR projects) or the individuals holding certificates to land (agricultural programs of SAGARPA). Social development efforts and subsidies have aimed to promote the development of children and families by targeting women as recipients of these benefits. It is relevant that neither the Vision of REDD+ (CONAFOR, 2010) nor the draft of the national REDD+ strategy (CONAFOR, 2014), mention *family* or *household* even once in the context of management of natural resources or local rural sustainable development[10]. The DECOFOS project of CONAFOR (Community Forest Development of the Southern States) provided subsidies for CFM and to projects for developing microenterprises and gave a higher priority to projects proposed by women; however the operational rules of the program in 2014 did not mention the concept *family* or *household* either (CONAFOR, 2015).

It is important to point out that in its study of rural poverty in Mexico the World Bank states that rural policies should be more effective if they focus on the family instead that on the farm level considering the different and multiple productive strategies developed at the household level (WB, 2005). Support of credits for microenterprises might partially overlap family level enterprises but to our knowledge there have not been examples of programs designed around the needs of productive activities of families. A development program adopting such focus would consider: alimentary, health and education issues related to children and women; personal and technical capacity building and skills to find better works, including scholarships for higher education; the technical and administrative organization of productive activities taking place in forests, fallows, agricultural areas and at home (solares); the consideration of needs of women for their participation in economic activities (e.g. help in child care); technology transfer and financing to purchase equipment to add value to their products or develop other skills (e.g. artisans, handcrafts, workshops); and the required social services for the ageing population (e.g. health services, caregivers, pensions).
Torres Mazuera, 2014b identifies familiar productive units for *milpa*.

[10] In the draft of the ENAREDD+ published on November 2014, the only reference made was to the familiar inheritance process for the transmission of ejido certificates when an ejidatario dies, but no as part of a strategy for implementation.

4.5.2 Collective action

4.5.2.1 Ejido and communities

Potential activities that can be developed in *ejidos* depend on the natural resources present and local socioeconomic conditions. Agricultural or forestry based activities can play different roles in the local economy. An initial effort that encompasses a coordinated collective action is the development of local or community based territorial land use plans; often these management tools are developed with the technical assistance of consultants and are financed by public offices as CONAFOR. Ideally the design of these instruments should be result of a participatory process including not only ejidatarios but also members of other local groups (e.g. avecindados, women, the young and old).It is in these documents where the definition of Permanent Forest Areas, areas for conservation and potential areas for participation in programs of PES can be identified. Participation in PES programs is also contingent to the eligibility criteria established by CONAFOR, the access to relevant technical services to elaborate the proposal and the budget available in CONAFOR. The decision of whether to apply to the program of PES or not, the area proposed, the programming of activities to fulfil with the program and the financing (distribution of benefits) is a collective decision made by the members of the ejido; the same process holds to the selection and application of other projects offered by CONAFOR, the assistance of the forest technicians is critical. Prospects for different productive activities depend on the specific endowment of natural resources, the relative and absolute size of *ejidos* (considering area, resources and population), the vocation and extent to which they can be classified as 'forest *ejidos*' or 'agricultural *ejidos* with forest', and the associated importance that forest can signify for the local economy and livelihoods (Flachsenberg and Galletti, 1999); based on the experience of the FPP these authors describe the different type of *ejidos* depicted in Table 21.

Table 21.Typology of *ejidos* as regards forest management (based on Flachsenberg and Galletti, 1999).

Type of *Ejido*	**Description**	**Examples**
Forest Ejidos		
1. Organised *ejidos* with large areas of forest	Ordered management including a systematic a approach to timber extraction, one harvest front, a grid system of 25 ha; updated forest inventory, local technical office and computer for analysis. Data from inventory used for decision making; professionalization of tasks. Income contributes importantly to local economy.	Noh Bec
2. *Ejidos* with large areas of forest but difficult social conditions	Difficult to professionalise tasks and control extraction, there are various harvest fronts; conflicts appeared after the demarcation of parcels of PROCEDE; potential for high contribution of forest to local economy can motivate organisation.	Petcacab
Agricultural ejidos with forest.		
3. *Ejidos* with dispersed forest resources	There are different patches of forests, agricultural activities are an important part of the economy. A large part of the population is not engaged in forest management, but receive profits from it; initial overexploitation of forests. Forest inventories were not completed and there is no control over extraction fronts. Local economy can be diversified by adding value to forest products.	Tres Garantias, Caobas.
4. *Ejidos* with small forest resources	Little contribution of forests to local economy (less than 20%). Small scale of activities prevents the formation of a specialized group focused on forests and received lower technical assistance; there are difficulties to implement silvicultural management practices. It is difficult to increase the permanent forest area. Harvests are made by individuals without a plan; revenues from timber exploitation are shared with all the ejidatarios.	Los Divorciados, Plan de la Noria, Manuel Avila Camacho, Chaccoben, Botes

As already pointed out, community forest enterprises, as well as those working in other sectors, face different challenges related to managerial decision making under the *ejido* assembly. Decision making is usually constrained by short-term perspective of members of the committee which is

renovated every three years, usually technical factors are not taken into account, the rotation of personnel hinders the professionalization of tasks, and the share-out among ejidatarios of all revenues received prevents the investment in new productive assets and/or maintenance of existing ones. The continuity in decision-making and incorporation of an entrepreneurial structure may be easier through a local cooperative or company, but this will require additional and specific promotion and capacity building.

4.5.2.2 Cooperatives

Cooperatives have been promoted in different stages since the first part of last century aiming to organize rural producers and improve their conditions. There have been different stages and challenges associated to the organization of rural producers. In the 1920s Felipe Carrillo Puerto governor of Yucatan tried unsuccessfully to organise cooperatives of chicleros to eliminate intermediaries and improve living conditions. Then in the early1930s Jose Siurob then governor of Quintana Roo tried also to create production and consumption cooperatives for agricultural and chewing gum producers; but it was only in the late 1930s when President Cardenas promoted officially rural cooperatives. Cooperatives were in theory of the workers but the cooperative movement became an object of public interest which suffered the corruption and nepotism of politicians.

From the creation of cooperatives until the late 1970s the cooperatives were more strongly linked to political interests and their resources were often mismanaged as the case of the pension funds of chicle cooperatives exemplifies (Forero and Redclift 2006).Later the cooperatives started to have more independence but still they had problems of credibility; there is lack of trust in some of the leaders due to mismanagement of resources, and sometimes new cooperatives are created by members who decide to abandon corrupt organisations (Ojeda Lopez, 2009). However still in the 1990s in Quintana Roo the governor Mario Villanueva did not recognised social solidary cooperatives (SSC) presumably because his father was the coordinator of the social rural production cooperatives of the state (Ojeda Lopez, 2009), SSCs thus were outside his political control.

There have been efforts to promote productive projects in rural areas. For instance the National Institute for Indigenous People (Comisión Nacional para el Desarrollo de los Pueblos Indígenas), has created productive projects in indigenous communities with mixed results. When projects have no technical follow-up or capacity building, these become a one-time transfer of resources. In the cases where productive cooperatives can be established, the value of investment can be increased for a while but frequently the organisation dissolves and the assets are lost. Finally in the cases where more experienced individuals participate the projects can be successful, but usually they do not target or incorporate the poorer local groups (Escobar Latapí, 2005)

Aside the political management of cooperatives and their resources and poor technical and professional capacities, another problem relates to the economic parcelisation of *ejidos*. As already described, the economic parcelisation of *ejidos* for the use of land by cooperatives in general ended up benefiting only a small and powerful group of associates who later took over control of productive land and other assets. In the case of chicle there is a new stage in the cooperative movement after the creation of the union of cooperatives and operation of the processing factory of Chicza. This case shows an example of the integration of further steps in the value chain in the management of natural resources with the involvement of *ejidos* and communities.

It is important to point out that in general cooperatives tend to focus on the commercialization to large-scale intermediaries (Ojeda Lopez, 2009); this is more palpable in the cases of timber and honey. In these cases cooperatives act as a substitution of the first intermediaries. When there are

higher organizational capacities among key personnel, cooperatives can help to promote the certification of practices and products (i.e. organic), try to negotiate higher prices, create their own brands to sell their products and diversify their commercialization processes (e.g. by purchasing bottling machinery and selling the product to final consumers in the case of honey). However in general many members of the cooperatives lack managerial and administrative skills to conduct more elaborated productive activities and continuously innovate their practices and they perceive themselves only as farmers (Ojeda Lopez, 2009).

Probably the reason behind the difficulties for collective organisation, aside from the lack of formal training in administrative tasks, is that *milpa* has been historically an individual activity that did not promote the creation of economic cooperatives or collective entities; it has been a practice for subsistence, in-kind exchange and self-consumption with only small surpluses (Ojeda Lopez, 2009). Production relies on the availability labour in the household since in general it does not provide resources to hire external workers; even today although relatives and friends may collaborate in the different activities of the *milpa* this does not entitle them to a share of the harvest. After the agrarian reform in the 1930s and 1940s there were efforts to create production cooperatives but after these failed, producers went back to subsistence practices; as a result *ejidos* deal with several aspects of community life, but there is no organized structure for collective production (Ojeda Lopez, 2009).

The ejidal censuses provide an initial estimate of the extent of collective action in ejidos of the Yucatan Peninsula. Table 22 shows for the three states the number of agrarian units that reported different types of collective activities. It can bee seen that in general Yucatan has the lowest level of collective action since around two thirds of the ejidos did not report any form of organisation; in general overall figures show that collective action is decreasing in the three states. The major changes are the reduction of social solidarity societies and groups for production in Yucatan from 2001 to 2007 and interestingly the doubling of the number of unions for the management of communal lands (INEGI, 2007); this latter case may indicate a higher pressure on these areas which could be associated with the shortening of milpa cycles and a higher demographic pressure.

Table 22. Total of collective activities reported by ejidos in the 2001 and 2007 censuses by type of activity (ejidos) (INEGI, 2007).

State	Year	Union of common lands	Rural association of collective interest	Groups for production	Rural production companies	Social solidarity societies	Business society	Other forms of association	Do not report forms of organisation, ejidos, (%)
Campeche	2001	96	24	131	112	50	3	18	138 (35.8%)
	2007	55	34	117	103	19	3	13	161 (41.8%)
Quintana Roo	2001	101	12	107	61	9	8	16	89 (32.0%)
	2007	75	32	77	39	3	4	20	119 (42.2%)
Yucatan	2001	77	6	143	62	84	3	9	458 (62.9%)
	2007	155	18	91	34	12	3	16	471 (65.2%)

4.5.3 Private sector

When the government had a higher influence over the rural economy, the public programs and subsidies were able to target only around 15% of the producers (Warman, 2003). Considering there are 4 million smallholdings in the country, and that they are subject to r fragmentation, low productivity and associated risks, only about 25% may be viable for commercial enterprises, and within these, about 70% would need special attention for successful development (i.e. capacity building, financing); the other producers would need social attention (Warman, 2003). The conditions vary across the country in terms of productivity of land, access to markets, water availability, etc., creating geographical inequalities. It is expected that the private sector can be engaged to build the capacities of potentially viable commercial enterprises and that government

focuses on those needing social services. One of the objectives of PROCEDE was to increase the participation of the private sector in the rural economies, so far this has only taken place by the purchase of lands since as reported by Torres Mazuera (2014b), there are practically no examples of these associations and a relevant channelling of private financing either.

Nevertheless activities under REDD+ could promote the creation of partnerships between community enterprises or cooperatives with the private sector for example as part of social and environmental responsibility programs. In addition to the established cooperatives and *ejido* enterprises (e.g. Chicza and forestry enterprise in Noh Bec), there are large and visible companies that could be approached to promote the inclusion of sustainable management practices, address drivers and reduce emissions as part of REDD+: agrochemical companies (e.g. Monsanto, Pioneer), beef producers (SuKarne), the agroindustry, private sawmills and timber traders (e.g. PFSCA, Azuara). In general, intermediaries control the activities adding more economic value to primary products; in some cases these are cooperatives but this depends on local organizational capacities. It should not be overlooked that it is in the interest of intermediaries to maintain things, as they are to continue controlling profits from trading. Given the economic interests when partnerships are created there is a risk that external investors end up keeping the control over the productive assets, lands and resources of communities. There are few cases of community cooperatives strong enough to deal and negotiate with external actors in a more egalitarian basis; however there is also low confidence in the private sector about the reliability of rural cooperatives (Daltabuit Godás et al. 2005).

The role of the financial sector can grow in importance if specific mechanisms for micro-credits, micro-insurance and savings are devised to target rural cooperatives and households. An additional opportunity for the financial participation of the private sector is the voluntary carbon market for forest projects; the Mexican government just issued a voluntary regulation for carbon sequestration projects. *Ejidos*, communities and private landowners can develop projects and sell the offsets to individuals and companies. If these projects comply with the requirements of the clean development mechanism of Kyoto Protocol these purchases could be deducted from the newly carbon tax created in 2014. Considering PES is included as a strategy for REDD+ in the Peninsula thus companies and individuals can collaborate with CONAFOR and co-finance it through programs based on concurrent funds. There are challenges to promote the engagement of poorer groups with NGOs in poverty alleviation efforts as they may prefer to collaborate first with the government and their families.

5 Opportunities to design pro-poor benefit distribution systems in Mexico

Considering the advances in the implementation of early action of REDD+ in Mexico, the potential for poverty alleviation relates to two dimensions, first, to the design of the interventions that can be implemented to address each of the drivers of emissions –and how these are selected for implementation in poorer or better-off areas-; and secondly, the ad hoc scheme for the distribution of the financial value of carbon benefits in REDD+. This section presents firstly a quick review of the process followed for the implementation of REDD+ with a focus on decisions related with benefit sharing schemes; secondly the analysis of pro-poor REDD+ implementation in the Yucatan Peninsula is discussed on the light of the information presented in this report; finally, conclusions are drawn on the implications for REDD+ benefit sharing schemes in Mexico.

5.1 REDD+ benefit sharing in Mexico

For REDD+, benefit-sharing schemes need to define the institutional frameworks and actors involved in the measurement and distribution of rewards/compensation for reduced emissions. Usually such schemes need to define who are the eligible beneficiaries, what are the principles for the distribution of benefits, who are the agents distributing them and what is the form of the rewards and compensation. The Scoping Paper (Balderas Torres and Skutsch, 2014), prepared for The Forest Dialogue (TFD), which is also part of this consultancy, presented a detailed and comprehensive review of different issues related with the design of benefit sharing schemes for REDD+. Mexico has advanced in the definition of the characteristics of the general benefit sharing schemes and is moving towards implementation of early activities as part of the second phase of REDD+.

It is clear that the benefits for distribution in REDD+ in Mexico relate strictly to the financial compensation received from international mechanisms in exchange of demonstrable emissions reductions. However it is acknowledged that the activities implemented as part of REDD+ can have different and many direct and indirect benefits on different social groups that also need to be taken into account. Carbon benefits will be accounted for at national level although they consider a nested implementation at sub-national level for which corresponding baselines and MRV systems will be established to evaluate performance. Efforts are made to design fair and equitable benefit sharing distribution systems based on a social agreement.

Local legislation recognizes that as carbon is stored in vegetation and soils the property rights over these resources and associated climate mitigation services reside in those holding the corresponding rights to land. Thus landowners (*ejidos*, individuals) are clear owners of carbon stocks and can easily participate in carbon sequestration schemes; they also are entitled rights to the benefits from emissions reductions. However, these will be managed by public actors to promote regional actions towards a low carbon rural sustainable development. Initial REDD+ interventions will be implemented over early action areas and will make use of incentives based on existing public programs and subsidies; at a later stage carbon based finance from reduced emissions will be channelled to continue implementation. The aim is to commence activities with more social benefits and higher contribution to rural development while addressing drivers of emissions. Examples include: community land use plans, best management practices, access to credit, voluntary carbon markets and capacity building.

5.1.1 Initiative for Reduced Emissions

Mexico is a REDD+ country participating in the FCPF Carbon Fund of the World Bank and is implementing an Initiative for Reducing Emissions (IRE) which will be implemented in the Yucatan Peninsula, Chiapas and Jalisco. Potential benefits of the initial activities of the IRE are said to be around 1.75 $MtCO_2e/yr$ valued at $25 USD/tCO2e; although the FCPF will provide initially only 27% of the resources. Public programmes will complement efforts to build local capacities. The objective of the IRE is to pay for the additional cost of sustainable management compared with business as usual practices but not to pay for the opportunity costs. The ER-PIN indicates that the initiative aims to balance individual and community interventions and that since carbon property rights (or rather, the rights to the benefits from environmental services) reside with landowners, it is necessary to devise other options and pathways to compensate or reward the efforts made by groups and individuals without rights to land.

The implementation of the IRE at the local level will be based on the preparation of local investment plans. The elaboration of these plans will be coordinated by public agents for territorial development (APDT, e.g. intermunicipal associations or biological corridor management offices); these plans will be prepared by the committees of *ejidos* interested in participating within the early action areas. Initially investment plans will focus on the selection of existing public programs of different ministries which could be used to promote local low carbon rural sustainable development according to local needs. In a second stage, the plans might include new activities to ensure the continuity of activities implemented. Once the investment plans have been prepared these will be reviewed and approved by state level committees. Based on the authorised investment plans, *ejidos*, communities and landowners will apply to the corresponding public programs; if the application is successful they will receive the funding to start implementation. After one to three years, performance of implemented activities will be assessed and results-based performance payments can be channelled through the APDT; relevant local stakeholders, public agencies and the APDT will decide how to share these benefits.

The outcomes of TFD held in Mexico in 2014 suggested that the elaboration of local investment plans should engage different stakeholders related to the drivers of deforestation and degradation, however initial methodological proposals indicate that the plans may be primarily elaborated by members of *ejido* committees (Graf, 2015; Abardía and Lavariega, 2015). Comments expressed by CONAFOR at the TFD indicated it is desirable that actors without formal rights to forestland should also have opportunities to receive incentives or rewards. TFD participants highlighted the importance of defining clear and transparent criteria for allocating resources for REDD+ implementation, but so far there are no indications that special priority will be given to applications stemming from local investment plans to receive funding as part of the different public programs involved.

5.1.2 Principles for benefit distribution

As mentioned above, one of the aims of REDD+ implementation in the country is equitable and fair benefit sharing, but liberty is given to local actors to define specific details for local schemes. One issue that needs to be kept in mind is that there is no unique interpretation of what is a *fair* or *equitable* distribution. Equitability can mean that benefits will be distributed based on rights (holders of land rights), on merit (performance based) or on social needs (including actions linked to drivers related to the poor, targeting poorer areas) (Gregorio et al 2013). From the point of view of the poor, an equitable distribution of pro-poor initiatives should aim to protect the poorer groups and in the view of a majority the principle for redistribution should consider the individual needs of the poor (60%); smaller groups proposed that the amount of personal efforts invested should be the

basis for distribution or that everyone should receive the same (16% and 15% respectively) (Székely 2005). There is an inherent challenge in the use of effort-based figures (not to say results-based) as a principle for distribution, since the potential effort depends on many aspects not under the control of individuals (capacities, skills, beliefs); before considering effort or performance based figures as principles for poverty alleviation it is necessary to address differences regarding opportunities and capacities particularly of women (Dieterlen, 2005). It is clear that not all individuals and communities are in the same starting conditions to compete for incentives based on these principles. Regarding social targeting 67% of the responses of the poor in the Voice of the Poor agreed it is the government who should identify the poor families receiving social subsidies while only 29% stated it is the communities those who should decide who should get the benefits from social programs (Székely 2005); this may indicate that the poor are not confident on the local leaders in their communities to deliver social benefits to most vulnerable local groups. Social targeting still can be improved since 44% believe that social programs do not target the poor populations (Cordera Campos and Flores Angeles, 2005). These views point in a different direction to that specified in the ER-PIN, which leaves to local committees and stakeholders the role of defining the criteria for benefit distribution of future carbon benefits. Finally, caution is needed when designing pro-poor interventions since selective social assistance programmes, in which some members of the community are excluded from benefits, can erode local social networks (Escobar Latapí, 2005). If some groups start to progress there may be hope that things will get better for all, but if only certain groups get better, the situation will be perceived as unfair (Lopez Calva et al 2005).

5.2 Pro-poor potential of REDD+ interventions

5.2.1 Involvement of poor groups in the drivers of emissions

In general the potential of REDD+ interventions to target the poor can be assessed by first identifying which drivers are more likely to target the poor, and secondly by evaluating the impact that specific interventions will have on the livelihoods of the poor. Table 23 presents a general evaluation of pro-poor approaches considering the drivers described in this document. Each driver is evaluated qualitatively in terms of the potential carbon gains that can be produce per hectare if tackled effectively, the potential area for intervention in the Peninsula, the relative costs and the potential to address the poor. Each factor is evaluated using a weight of 1, 2 and 3 for small, medium and high respectively; only for the costs the values are in reversed order.

Table 23.Potential targeting of poor groups of the main drivers of emissions in the Yucatan Peninsula.

Driver	Emission Process	Potential Carbon Gains per ha	Potential Area for Intervention	Relative Costs	Target Poor Groups	Weighted Value	Rank
Shifting cultivation, subsistence agriculture	Degradation	Medium	High	Small	High	2.75	1
Hurricanes	Degradation	High	High	Medium	High	2.75	1
Firewood collection	Degradation	Small	High	Small	High	2.50	3
Charcoal Production	Degradation	Small	High	Small	High	2.50	3
Cattle rearing and pasture development	Deforestation	High	High	Medium	Medium	2.50	3
Commercial agriculture	Deforestation	High	High	Medium	Small	2.25	6
Forest management	Degradation/ Deforestation	Medium	High	Medium	Medium	2.25	6
Ineffective Governance Schemes	Deforestation/ Degradation	High	High	High	Medium	2.25	6
Public programs and subsidies	Deforestation	High	High	High	Small	2.00	9
Urbanisation	Deforestation	High	Small	High	Small	1.50	10

The drivers that more easily can target the poor are shifting cultivation (subsistence agriculture), hurricanes, firewood collection, charcoal production and cattle rearing and pastureland development (particularly small-scale cattle-rearing and clearings for the rental of pastureland).

Degradation due to shifting cultivation takes place mainly in the central part of Yucatan in the indigenous areas, and it may be occurring where cycles have been shortened. Although there is some doubt about whether this generates system-wide losses of carbon, this can be a subject of further research. Potential carbon gains per hectare are moderate and area potentially large. Firewood collection does not in general lead to degradation, except where it is being traded to cities, and even major degradation usually only occurs where land is in the hands of absentee landlords following sales for speculative purposes. Charcoal production is causing degradation in some places; these activities are traditionally developed by poorer groups throughout the Peninsula, small carbon gains but potentially over a large area.

Activities to prepare and respond to natural disasters (hurricanes) will positively affect all poor groups throughout the Peninsula. Potential carbon gains are defined as high because if appropriate management is not given to resources, carbon stocks may not recover; moreover a deficient management of areas affected by disturbances can produce large forest fires.

Another option to target poorer groups is to work in actions aiming to control pastureland development especially in the Calakmul area and La Montaña. This is a poor region where land conversion is linked to emigration dynamics and labour scarcity (pastureland rental); most of the inhabitants are immigrants without prior knowledge of local best sustainable practices and may not know other alternative development options.

Lastly, another option to target poor actors relates to initiatives targeting selective logging in forest *ejidos*, especially small *ejidos* or *ejidos* with small forest areas with poor CFM governance (in Campeche and Quintana Roo). Degradation in these areas occurs due to the lack of control of extraction fronts. Additionally, when forests are no longer economically attractive, i.e. when valuable species are gone, the distribution of forests in small patches prevents economies of scale and silvicultural management and thus the risk of deforestation is higher. CFM is a labour intensive activity and favours wealth distribution in opposition to large scale privately controlled commercial plantations or mining which are more capital intensive (Bowen, 2014 in Fernandez Vazquez and Mendoza Fuente, 2015).

Although the activities associated with the drivers of deforestation emit more carbon per hectare and in the short-term can produce higher gains than those related to degradation it is necessary to assess the extent of the area where these processes take place. Then it will be possible to weight the importance of each driver and the role that poorer actors as a group, considering the accumulated area have in emissions. However it is clear that on individual basis poorer groups emit much less than better-off groups linked to deforestation.

5.2.2 Impact of the drivers on the poor

Table 24 presents a slightly different analysis of drivers of emissions related with the poor by evaluating the general effect that undergoing processes driving emissions have on the livelihoods of the poor. To evaluate this a multicriteria analysis is also performed considering the benefits and costs associated with each driver in terms of the scale and permanence of the effect (scale is set at large, moderate and small scale for which values of 3, 2 and 1 are granted). Similarly permanence is divided in short, mid and long term effects which also receive a value of 1, 2 or 3 accordingly. For

each, benefits and costs, the value of the scale is multiplied by the one of permanence. Then the costs are subtracted from the benefits to obtain the long-term effect. The combined capital index (Table 16) is also estimated considering the dimensions of capital/livelihoods where benefits/costs are present associated to each driver. Finally the number of poor groups are identified. Finally a final mark is given to each driver by multiplying the long term effect by the combined capital index and the number of poor groups affected. Results are presented in Table 24. Drivers are ordered by the relative impact on poorer groups; in the Appendices, section 7.2 presents the values used for this analysis. In the Table 24 the drivers located in the first rows have the largest negative impact in the long term; while the drivers at the bottom have also a negative long-term impact their magnitude is smaller. This indicates that the benefits they derive in the short term from the associated activities are larger. Due to the different criteria included in the analysis, the results show two effects, first that of the magnitude and direction of the impacts, and second the extent to which these impacts affect more or fewer poor groups.

In general poor actors have from small to large benefits in the short-term from the processes driving emissions but in general in the mid and long terms they face negative consequences due to the loss of productive assets and environmental services. The main drivers with a higher impact on the poor relate to hurricanes, urbanisation and land-speculation, diminishing production of shifting (subsistence) cultivation and firewood and charcoal collection.

It is important to remark that although land-trade has a large impact on processes de-capitalising certain social groups in rural areas, making them landless and putting them into minor livelihood strategies in the long-term, it is only an intermediary step in the processes driving emissions of deforestation for commercial activities and as part of real state speculation. It seems it will be futile to try to control land trade as means to reduce carbon emissions in REDD+ if alternative low carbon sustainable and productive practices are not developed first. However it is a factor that should not be forgotten.

Table 24.Impact of the dynamics associated to the drivers of emissions on the poor.

Drivers	Main Benefits	Main Costs	Natural	Social	Human	Productive	Financial	Power	Poorer Groups Involved
Hurricanes	Increase in dead biomass (bioenergy and timber)	Loss of Natural Capital/ES, tension on social capital, loss of livelihoods (crops and activities), poor communication, unemployment, debts and decapitalisation, powerlessness	X	X	X	X	X	X	11
Urbanisation and land speculation (land trade)	Large cash income	Loss of Natural Capital/ES, loss of productive assets, power asymmetry	X	X		X	X	X	5
Shifting Cultivation	Subsistence activities (crops)	Loss of natural capital and ecosystem services (ES), diminishing production yields, increasing production costs.	X		X	X	X		11
Firewood collection	Subsistence activities (energy and income)	Loss of Natural Capital/ES	X		X		X		11
Charcoal production	Subsistence activities (income)	Loss of Natural Capital/ES	X		X		X		11
Public programs and subsidies	Cash, income	Loss of Natural Capital/ES, powerlessness	X			X	X		8
Pastureland	Capital accumulation in cattle, cash activities (cattle and land rental)	Loss of Natural Capital/ES	X			X	X		7
Barriers SFM	Direct use, employment and cash activities	Loss of Natural Capital/ES, problems for organised management	X	X		X	X		3
Governance and environmental management regimes	That from unsustainable activities implemented due to	Loss of Natural Capital/ES, problems for organised management, power asymmetry	X	X				X	3

Drivers	Main Benefits	Main Costs	Natural	Social	Human	Productive	Financial	Power	Poorer Groups Involved
	poor enforcement (see above, cash and subsistence)								
Commercial agriculture	Organised, mechanised production, cash activities and capital accumulation, employment	Loss of Natural Capital/ES	X	X		X	X		3

5.2.3 Specific REDD+ interventions and potential impact on the poor

The study of rural poverty by the World Bank groups recommendations on the improvement of the design and coordination of public action to rural development into; promoting rural pro-poor economic development; increasing education and engagement of the youth in productive activities (WB, 2005). Regional development plans should include farm and non-farm activities; it is important to increase land and labour productivity, increase education and capacity building and promote the incorporation of the young to modernise the rural economy (WB, 2005). Pilot initiatives under the Alianza Mexico REDD+ financed by The Nature Conservancy, include the development of activities promoting the adoption of best agricultural and silvopastoral practices; improved forest management, reforestation practices, fire management and conservation practices, promotion of productive activities (beekeeping, improved coffee, ecotourism, production of NTFP), agroforestry practices, land us plans and capacity building among others (see Balderas Torres et al 2014). From 2010 the project DECOFOS (CONAFOR, 2015) has promoted specific activities to promote rural development and forest management which include among other, agroforestry modules, tree nurseries, ecotourism, technology transfer projects, formulation of local development plans, evaluation of investment projects and business plans, creation of micro enterprises, fire management practices and capacity building. On the other hand, starting in 2012, the Special Programme for the Yucatan Peninsula of CONAFOR (PEPY) has financed different activities to promote CFM, to conserve forest resources, improve fire management and promote the development of the sector (CONAFOR, 2015); specific activities include capacity building, development of local land use regulations, provision of technical services, support for agroforestry modules, tree nurseries, PES and technology transfer of CFM among others. Based on the identification of drivers, actors and niches for implementation made in this document, and on the initial activities implemented within the context of REDD+, a list of potential interventions that could be implemented in the Peninsula to address the drivers of emissions has been prepared:

Shifting agriculture

- Best practices for *milpa* production to increase productivity (fallow, soil, water management).
- Agroforestry practices in parcels and *solares*.

Firewood and Charcoal

- Install improved cook stoves.
- Bioenergy plantations (firewood, charcoal).
- Install improved kilns.
- Community management plan for commercial firewood (including small-scale participation).

Community management plan for commercial charcoal (including small-scale participation).

Forest Management
- Support for CFM (e.g. Management plans, inventories, brigades, technical offices -GIS, computer-, demarcation of areas -forest permanent areas, yearly extraction area-, paths, maintenance and renovation of machinery).
- Promote natural regeneration/enrichment of managed forests.
- Enrichment plantations of chewing gum and melliferous species.
- Fire management practices.
- Financial access for CFM practices (e.g. Revolving fund for extraction practices).
- Technical scholarships (professionalization of functions under CFM).
- Improve CFM in small *ejidos* (control extraction fronts, small scale plantations, agroforestry).
- Develop local industry and workshops around the timber industry to add value to local products.

Natural disasters
- Micro-insurance schemes for housing, *milpa*, CFM, honey production, cattle, chewing gum.
- Contingency considerations for timber and NTFP management.
- Crop diversification, technological change and sanitary measures to reduce vulnerability
- Contingency plans and shelters.

Other Activities at *Ejido* Level
- Strengthen development and enforcement of internal rules at *ejido* community level.
- Community land use plans (including, areas for charcoal and firewood production; reforestation, restoration; communal parcels).
- Regularisation of land access (recognise avecindados, posesionarios).
- Increase size of solares in *ejido* population centres (community land use plans).
-Allow the division of ejido holdings among heirs.
-Provide social security benefits to old ejidatarios who transfer their land rights earlier.

Local Economic Activities
- Promote community enterprises/cooperatives managed by specialised groups.
- Technical support for different steps in production chain (local small scale industry, family workshops).
- Support for transport services and better links to markets.
- Capacity building and support to managerial bodies for management, commercialisation, certification, added value, social services and professionalization.
- Engage with the *secondary sector* adding value to local production (greening *supply chains*).
- Certifications schemes (Timber, NTFP, crops, beef, honey) to provide information to final *consumers*.
- Explore opportunities for rural tourism services.
-Technology transfer for forest based, farm and non-farm activities.
- Fund young landless groups to develop productive non-farm activities.
Promote off farm employment and support migration

Public Sector
Deforestation Control
- Effective land use change control, enforcement and monitoring (address illegal deforestation).
- Fines and contributions to National Forest Fund (NFF).
- Earmark contribution to NFF to offset land use changes within same jurisdictions.
- Address illegal traffic of permits (timber, charcoal).
Other (Public Sector)
- Simplify regulations (i.e. timber, charcoal, firewood, chewing gum, production and transportation; consider small-scale practices).

- Voluntary compliance programs.
- Harmonise, simplify and align subsidies and public programs for rural development, Coordination across and within governmental levels.
- Effective management and budget for NPA.
- Strengthen the APDT (negotiation skills, strong technical authoritative opinion, budget).
- Increase technical presence of forest management institutions on the ground.
- Conflict management with intermediaries.
- Increase coverage of PES (Including private funds).
- Promote voluntary carbon market for sequestration practices (restoration, reforestation, afforestation).
- Waste management to protect mangroves in coastal areas.
- Control of road, urban and touristic development to protect mangroves in coastal areas.
- Poverty alleviation subsidies.
- Local health and education services.
- Allow some low impact forest management in areas receiving PES.
- Articulate rural sustainable development strategies around needs at family level.
- Innovate education and research programs to increase sustainable productivity of rural groups.
-Human and social development project to empower local population in alliance with local groups.

Activities in deforested areas (cropland, pastureland, urban areas)
- Low emissions commercial agriculture (e.g. zero tillage, organic agriculture, agroforestry, fire management practices).
- Formalise commercial firewood market in cities.
- Silvopastoral management.
- Intensive production of cattle.
- Increase green areas in urban and touristic areas.

Financial sector
- Saving and investment strategies compatible with sustainable practices.
- Greening financing (producers, inputs and services, value chains, consumers).
- Micro-credits/finance.
- Participation in the voluntary carbon market.

In order to evaluate the impact that potential REDD+ activities can have on the poor, a similar approach to the evaluation of pro-poor assets is adopted. Interventions able to reach more poor groups, contribute to various dimensions of capital (integrated capital index), and which are part of subsistence strategies, are ranked more highly in the evaluation of their pro-poor potential. The integrated capital index for each intervention is calculated following the same criteria as in section 3.2.1.4. The characteristics of the interventions are assessed in terms of the scale (Large, Moderate or Small for which they receive a mark of 3, 2 or 1), the time frame of the benefits (Long, Mid or short terms, for which they also receive 3, 2 or 1 points) and whether it is tradable, creates opportunities for new jobs, offers liquid benefits or contributes to subsistence practices (for each of these the intervention receives an additional point). The product of the combined capital index and the mark on the characteristics of the intervention is multiplied by the number of poor social groups each intervention could reach. At the end the interventions are ordered considering this final mark. Table below presents the top REDD+ interventions which potentially could have higher positive impact on the poor; the full table with the evaluation criteria is presented as an appendix in section 7.2.

Table 25.REDD+ interventions with highest pro-poor potential.

REDD+ Intervention	Combined Capital Index	Total (Intervention Characteristics)	Poor Groups Benefited	Pro Poor Potential
Harmonise, simplify and align subsidies and public programs for rural development, Coordination across and within governmental levels	100%	8	11	88.0
Articulate rural sustainable development strategies around needs at family level.	100%	8	11	88.0
Micro-insurance schemes for housing, *milpa*, CFM, honey production, cattle, chewing gum.	83%	8	11	73.3
Increase size of solares in *ejido* population centres (community land use plans).	83%	8	11	73.3
Improve CFM in small *ejidos* (control extraction fronts, small scale plantations, agroforestry).	67%	9	11	66.0
Develop local industry and workshops around the timber industry to add value to local products.	67%	9	11	66.0
Technology transfer for forest based, farm and non-farm activities.	67%	9	11	66.0
Support for transport services and better links to markets.	83%	7	11	64.2
Earmark contribution to NFF to offset land use changes within same jurisdictions.	83%	7	11	64.2
Simplify regulations (i.e. timber, charcoal, firewood, chewing gum, production and transportation; consider small-scale practices).	83%	7	11	64.2
Promote voluntary carbon market for sequestration practices (restoration, reforestation, afforestation).	83%	7	11	64.2
Regularisation of land access (recognise avecindados, posesionarios).	83%	8	9	60.0
Allow the division of ejido holdings among heirs.	83%	8	9	60.0
Best practices for *milpa* production to increase productivity (fallow, soil, water management).	67%	8	11	58.7
Strengthen the APDT (negotiation skills, strong technical authoritative opinion, budget).	67%	8	11	58.7
Local health and education services.	67%	8	11	58.7
Innovate education and research programs to increase sustainable productivity of rural groups	67%	8	11	58.7
Human and social development project to empower local population in alliance with local groups	67%	8	11	58.7
Formalise commercial firewood market in cities.	67%	8	11	58.7
Silvopastoral management.	67%	8	11	58.7
Saving and investment strategies compatible with sustainable practices.	67%	8	11	58.7
Micro-credits/finance.	67%	8	11	58.7
Private participation in the voluntary carbon market.	67%	8	11	58.7

The most important pro-poor interventions relate to the harmonisation of public action for rural development, the articulation of development policies around family level needs, and the provision of micro insurance services as a strategy to prevent losses in case of natural disturbances, namely hurricanes; these schemes can focus on the different productive activities and assets of the poor. The importance resides in the fact that the public sector is paramount in terms of creating the enabling conditions for the development of the poor (as there are no incentives for private actors to cover these needs since they are not profitable), second that the poor have diverse needs and productive strategies in different time periods, and third, the fact that after a hurricane the households will be much worse-off given the loss of their productive assets and livelihoods. In general these interventions do not discriminate among local groups (*ejidatarios* versus non-*ejidatarios*) and could be used by each group according to their specific needs. The preparation of shelters and general contingency plans can also benefit all the population. It is important to include guidelines and activities for the post-management of the emergency to allow the recovery of economic activities but also of carbon stocks and forest cover. One transversal enabling condition is local social agreement for the inclusion of different social groups in each of the activities that initially could be restricted only for ejidatarios, for instance. It is clear that the relevance of each intervention will change according to the specific conditions of a community or ejido.

Considering the relatively high importance that access to even small areas of land can have to landless groups, one policy that deserves to be explored is the increase of the *solar* areas in *ejido* population centres; this will help increasing in home food production in *solares* if it is implemented along with capacity building on best agroforestry practices. Later there are other possible interventions related to land access and organisation of local activities; local land use plans can include the clear definition of areas and rules for accessing different resources, to develop specific activities (e.g. forest management, charcoal production, reforestation practices) and to grant informal access to land to the landless (land rental in communal parcels).

Other activities with high pro-poor potential are the promotion of community enterprises and cooperatives, including at family level to add value to local production; access to markets and transport services; additionally, financial access through micro-credit can be promoted. A fourth group of valuable activities will be those building capacities of the poor related to best agroforestry and *milpa* practices in parcels and solares. It is important to reinforce efforts to increase education levels and access to health services. The promotion of small scale workshops and increase of productivity in agricultural practices is oriented to provide a surplus of income to cover immediate needs, it is important to orientate households on the best options to invest this modest capital; the financial sector can contribute in this context if investment strategies accessible to the poor and compatible with sustainable practices can be devised. Otherwise processes of capital accumulation may follow the known paths of focusing on cattle and land for agriculture which will continue driving carbon emissions.

The objective of promoting best practices for *milpa* systems and subsistence agriculture practices is to increase productivity; this could be achieved through the increase of fallow cycles of shifting agriculture (ideally to 25 years), however more research is needed in this topic to assess precisely at what point any reduction in production yields is due to this and what is the specific roles of agricultural subsidies. Best practices need to consider soil and water management. One important driver is population growth but it seems that demographic policy it is not included comprehensively as part of REDD+.

Opportunity costs associated with commercial agriculture and urban/touristic development are too high to be counteracted by voluntary incentives to control deforestation. In this case it is necessary to fortify monitoring and enforcement systems to control land use changes. Land use changes that occur following the institutional channels would have to contribute to the National Forest Fund. Ideally it would be desirable to earmark these resources to be used to finance activities to compensate for the environmental services lost within the same jurisdictions (e.g. early action area); these activities can offer opportunities for different local groups. In the central part of Campeche and Quintana Roo where development of pastureland for rental is a problem it is possible to design PES to contribute preventing deforestation).

There are other potential REDD+ interventions identified here based on the description of the drivers of emissions that although may not have the highest impact on the poor deserve to be mentioned. These are the specific areas of support for the promotion of CFM enterprises and the possibility of designing a voluntary compliance program oriented to the forest sector to reduce monitoring and compliance costs (i.e. similar to the program of Clean Industry, *Industria Limpia* of PROFEPA). In this context policies such as PES have potential to match opportunity costs in the rental of pastureland for cattle-rearing. In Jalisco farmers rent the land to cattle-rearers during the off-season for about $1000 per ha per cycle; this benefit is additional to agricultural subsidies received and to the demonstration of ownership over land (Borrego and Skutsch 2014). This type of strategies could be used also to delay the clearance of fallows in shifting agriculture by estimating

the income required to produce the crops in a *milpa*. CFM can have positive impact on poorer groups if actions are implemented to formalise and improve management in small ejidos.

The promotion of economic activity outside the domain of the *ejido* assembly/committees mirrors at the micro-scale the dismantling of the active economic functions of the government that has taken place at national level. Most economic activity is now developed by the private sector and the function of the government is that of a regulator, provider of some public services and law enforcer. According to the options to address emissions as listed above, *ejido* committees/assemblies still play a relevant role as regards the definition of land use plans and local rules and governance, but it seems their importance as economic actors –aside land trade and privatisation and reception of public subsidies- is diminishing.

It is important not to forget that there are two "types" of poor groups, those with a higher level of individualization and those who less empowered. Although it is virtually impossible to identify a priori the presence of these two groups in a region or a given community it is clear that some of the activities listed in this section might overlap better with each of both groups. The group with higher levels of empowerment may respond better to options promoting the generation of income and employment, better education, capacity building and technology transfer. On the other hand the second group might rely on poverty alleviation subsidies (health, education, income); for these groups an integral integration can include efforts to deal with self-esteem and education. Enabling conditions for the engagement of poorer groups in productive activities require among other the following: Nutrition, health and education; empowerment, self-esteem and initiative to undertake projects; technical capacity building and training for employment; transfer of technical knowledge and best practices for productive activities; administrative and organizational capacity building; diversification of local economy, participation in activities adding value to local products, certification of products and activities and enhanced access to markets; and financing and crediting of these activities.

5.2.3.1 Changes in equity gaps

Changes in the equity gap will depend on the relative rates of accumulation of assets against the rate of diminishing returns of poorer and richer groups; this is, that if better-off households stay in a steady state and poor households are set in the right track to increase their assets and utility levels they will converge overtime. However if wealthier households continue accumulating assets at a higher rate than poor households convergence will not occur (Carter and Barrett, 2006). In this context the processes driving emissions increase income gaps because poor groups are trapped in poverty dynamics without increasing their assets while better-off groups are continuously accumulating cash and assets. The land trade is a factor contributing to long-term decapitalisation of ejidatarios since they often become landless and after spending the cash received end up with no alternative sources of income or productive assets; this increases further income gaps since it is a form of accumulation by dispossession.

5.3 Prospects for pro-poor REDD+ benefit sharing schemes in Mexico

As already mentioned, in Mexico REDD+ will make use of local investment plans elaborated by *ejido* committees and initial interventions will focus on those already existing in public programs (support at *ejido* level –e.g. CONAFOR-, individual producers –e.g. SAGARPA-, other actors not necessary holders of land rights –e.g. SEDESOL-) (Graf, 2015). This has the potential to improve the coordination among different public programs and align currently conflicting subsidies. However it is only an initial step that is currently leaving outside of the plan relevant actors in the private (secondary sector), financial and social sectors (consumers) which can get engaged in

different activities to address the drivers of emissions. As part of implementation of these early experiences, the APDTs (Juntas), will validate the plans (*selection for programs of their interest*) put forward by *ejido* committees. *Ejidos* (and other local actors –ejidatarios, private landowners-, individuals) will apply, as they normally do, to the public programs. A pro-poor implementation of REDD+ can be promoted at this stage if there is a specific criterion to support the financing of investment plans in poorer areas and there is a commitment from the different public programs to guarantee the required budget to finance these.

As part of this process, successful investment plans, after one to three years may receive results-based carbon finance from the FCPF. In the context of the IRE, local committees will have to define their own agreements to share these benefits locally, although only holders of rights to forestland would strictly have the rights to carbon benefits. As discussed in detail throughout this document, landless groups are the poorer groups and strictly speaking adopting this approach may exclude them from direct access to REDD+ carbon benefits. But there is the option that local committees define other criteria for benefit sharing, these include: the use of the benefits to finance pro-poor REDD+ activities; to set up criteria to reward different stakeholders based on participation-input costs; to allow hiring member of poorer groups in the job openings derived from implementation; and to use revenues (profits) to provide social public services (education, health, capacity building), once that reinvestment in productive assets has been considered. The initial local investment plans rely exclusively on existing public programs, then it will take time to design specific interventions to include pro-poor approaches (for instance, a program designed around the needs of the family).

5.3.1 Regional differences

Throughout this document different comments and information has been presented emphasising some of the differences between the three states of the Peninsula. At the level of municipalities, the poorer regions are in the central-eastern part of Yucatan and the southern part of Campeche; these regions are also included within the early action areas for REDD+. Overall the Yucatan has a higher share of its population within poor and vulnerable conditions, followed by Campeche; however Campeche has shown improvements in recent years. However average figures can hide equity gaps within the rural and urban contexts mainly in large municipalities including big cities in Campeche and Quintana Roo. The profiles of these two populations are quite different since in Yucatan it corresponds to Mayan groups who have lived there for generations and are familiar with the environment whereas the population in Campeche and Quintana Roo are mostly immigrants. Both regions have a large percentage of young population, thus indicating that pressures over the territory and/or outmigration are likely to increase as new households are formed. Considering the relatively higher degradation of natural resources in Yucatan, it can be hypothesised that young population in that region will be more prone to move to other areas looking for employment, while in Campeche and Quintana Roo at least some of the young might try luck in farm based activities thus contributing to emissions (there is still space to grow). Population growth does not seem to have slowed, thus larger pressures over the territory are expected particularly in Quintana Roo. More conflicts for land tenure in touristic and peri-urban areas might also be expected. The central part of Yucatan around Merida is an area with a larger share of older population which may be taking part of these processes. Another factor to consider is that infrastructure development is relatively recent in Campeche and Quintana Roo, thus the impact of new roads may still continue for some time. It is important to highlight that in this context formal access to land in ejidos has grown at a rate ten times less than regional population growth. Favouring access to land by transmitting certificates at earlier ages, by providing social provision services, may reduce this, but might not be enough. Dividing the ejido holdings among heirs may increase land access but will most likely promote agricultural practices and associated emissions; this will modify the vocation of forest or chicle based ejidos to agricultural ones. One way to ensure access to minimum critical areas of land that

can increase the welfare of poor landless groups is increasing the size of solares in settlements, and promoting access to small plots in collective agricultural parcels.

The larger and disperse agricultural presence in Yucatan obeys historical reasons (early development of milpa, henequen and cattle), this means emissions occurred in the past. There are still processes producing emissions linked to agriculture, pastureland and urbanisation. On the other hand emissions in Campeche and Quintana Roo occurred more recently and are still expected to continue. It is likely that there will be further land use conversions and conflicts in the area of the Biosphere Reserve of Calakmul, which is also a poor area. Fragmentation of forest patches due to these activities may be converting areas with potential for CFM into smaller ejidos (type 3 or 4 in Table 21), where more work will be needed to organise forest management.

Regarding the economic context, the main cash activities are dominated by consolidated large companies with a powerful influence in their markets (e.g. timber, beef and corn). Ejidos and communities are in general poorly organised, nearly 70% of all ejidatarios may have not been receiving any recent capacity building and overall 60% of all ejidos may not be receiving any training at all according to the official censuses; this condition is more worrying in Yucatan. In the same context from 40 to 65% of the all ejidos do not report any form of productive collective organisation. Forest resources can suffer further degradation after a powerful hurricane particularly if the forest area is not properly managed. There are however successful cases of cooperatives for chewing gum and honey, and in some cases for timber. There is a higher potential for firewood and charcoal production in Yucatan since species and sizes are not commercially attractive.

5.3.2 Benefits of specific interventions to poor households

Considering the different studies reviewed in this work it is possible to obtain a reference of the expected benefits poor households can experience from specific improvements in local infrastructure, land access and education. Table 26 below presents for indicative purposes a list of such benefits.

Table 26. Expected benefits for poor households associated to specific interventions.

Intervention	Magnitude of Benefit ($MXP/month)	Per capita value ($USD/cap-day)*	Relative Weight	Temporality	Source
Education of one female in the household ending secondary level.	9,434	4.12	35.7%	Long term	Finan et al 2005**
Employment (pay of $250 per day)	5,500	2.40	20.8%	Short term	Own Estimate
Access to Forest Products (poorer households)	2,988	1.31	11.3%	Short-long term	Sheperd, 2015
Health Center in Locality	2,131	0.93	8.1%	Short-long term	Finan et al 2005
Access to Paved Road	1,950	0.85	7.4%	Short term	Finan et al 2005
Access to Land (1 ha)	1,946	0.85	7.4%	Short term	Finan et al 2005
Additional education of head of household (2 years)	1,654	0.72	6.3%	Mid term	Finan et al 2005
Household Improvement (reduction of two deprivation factors)	318	0.14	1.2%	Short term	CONEVAL, 2013**
Land access, 1000 m^2in *Solar* of house	195	0.09	0.7%	Short term	Finan et al 2005
Access to Social Security Services	159	0.07	0.6%	Short term	CONEVAL, 2013
Membership of a Productive Cooperative	124	0.05	0.5%	Short term	Finan et al 2005
Total of Interventions Considered	*26,399*	*11.54*	*100%*		

*Values per capita are estimated considering a household size of five and an exchange rate of $15 Mexican pesos per USD.
**Values from Finan et al 2005 and CONEVAL 2013 correspond to 1998 and 2015 prices; in this table values have been adjusted for inflation (121.1 and 8.3% correspondingly) (INEGI, 2015b); it is assumed that these values have increased with inflation.

Table 26 shows that the larger benefits for a household are related to education (at least up to secondary level particularly for women), employment, and access to forest products (provided clear

arrangements are set at local level), health services, paved road and land. The total values considered may be enough to grant benefits to households enough to cross the poverty line. It is important to highlight however that in the case of indigenous households they have a handicap of $6891 pesos ($3.01 USD/cap-day) that needs to be considered. These values can inform the design of benefit sharing schemes for REDD+ when non-cash direct transfers are considered; it will be important to provide a mix of incentives to provide short and long-term benefits and engage permanent collaboration. The value of an increased solar can be enhanced in combination with capacity building on best agroforestry practices and when any avoided transportation cost is taken into account. It is recommended to update these values to verify if these benefits have increased with inflation and adapt them to specific local conditions; it will also be important to explore the contributions of other potential interventions, as included in Table 25.

6 Conclusions

The potential contribution of REDD+ to poverty alleviation in the Yucatan Peninsula raises questions because in general it is not the local poor who are causing carbon emissions on a per capita or per hectare basis, but primarily better-off groups. Hence it is probable that compensation for reduced emissions would in first instance target the less poor, increasing income gaps. It is true that the rural poor do get some side benefits from the processes driving emissions and if these activities are halted, some benefits could be reduced. Additionally poorer groups are also immersed in processes reducing their productive assets (e.g. soil degradation, land sales). In this context REDD+ can promote the implementation of pro-poor activities and also including pro-poor considerations for the distribution of performance based carbon benefits.

If REDD+ activities are to be pro-poor they would have to promote the productivity, technology transfer and access to markets of poorer groups. Activities increasing the productivity of subsistence farming without increasing forest degradation could benefit a large number of the relatively poor, and enhanced local management and governance would benefit all, including the poor. These actions can also help to add economic value to sustainable practices allowing reinvestment and recapitalisation. In the long run, activities improving land access could be important for reduction of poverty but this is a complex area of intervention under current REDD+ plans.

The preparation of climate effective land-use plans can be particularly beneficial for the poor if they receive access to land, if collective parcels are defined or if they are included in economic activities (e.g. employment and other benefits in plans for managing forest, NTFP and wildlife). As part of this process, landless groups can be recognized as *avecindados*, or even as *ejidatarios/comuneros* by assemblies, this additionally will give them legal personality. Subsidies focusing on individuals and most importantly around family level needs, (rather than on local authorities) and not requiring holding land rights (as is the case with many agricultural subsidies) can benefit poorer groups. However, the process of re-distribution of land (i.e. titling landless people) is complex, since it may raise conflicts locally and may not be easily promoted as a pro-poor solution in the short term. Additionally to enhanced land access, improvements in agricultural activities might help to reduce alimentary problems and prevent forest degradation while better links to markets can be promoted. It should be noted that possibly the largest source of emissions is the expansion of commercial farming; it seems that this sector cannot be addressed through voluntary approaches and clear controls to impede and in any case regularize land use changes and offset these through existing compensation schemes will need to be implemented.

The household is the fundamental economic organization unit in rural economies where decisions on how to allocate labour and other resources are made; it is also the primary institution and safety network in rural economies particularly for the poor. However it has been largely forgotten by public development programs, so far it has not been formally included as part of the strategy for rural sustainable development in Mexico, the objective to which REDD+ aims to contribute.

Most of the potential REDD+ activities focus on aspects related to the natural, social and human capitals (e.g. forests, local rules, health and education). Cash compensation can take place in the form of subsidies, temporary employment or payment for environmental services (financial capital). Productive activities are promoted via capacity building, better governance and transfer of know-how (best practices), but there is little focus on the transfer/formation of physical assets (productive capital) and on improved financial access (financial capital).

There are different processes identified which reduce the productive prospects of rural actors, these are: low levels of economic value-added; poor market access; low investment; long-term de-capitalization due to land sales; reduced productivity of subsistence activities (fallow cycle and soil productivity); and hurricanes. At local level prospects for development are linked to land access firstly because it allows actors to engage in subsistence activities and later to trade surpluses and other goods; and secondly, because it entitles them to other benefits. The most vulnerable groups are usually landless, and as a result they usually make only very small contributions to carbon emissions. Thus as we have already noted as the first conclusion, if REDD+ payments mostly target the groups which are responsible for the majority of the emissions, local income gaps might increase.

The magnitude and permanence of carbon-based payments in REDD+ cannot be determined at the moment. In this context REDD+ can give an initial impulse for the adoption of management practices producing local benefits while reducing emissions. This opportunity can be used to build new assets and conditions for sustainable management. In Mexico REDD+ is being implemented under the national effort to promote rural sustainable development (CONAFOR 2010; CONAFOR, 2014). Thus, it is important to consider REDD+ interventions which are able to target poorer groups and if possibly, reduce, stop or even revert processes de-capitalising or eroding their productive assets while addressing drivers of emissions.

It will be difficult for REDD+ to prevent long-term de-capitalization linked to land sales. However strengthening local social capital and financing local rural sustainable development plans may reduce this process; particularly if REDD+ is able to promote the inclusion of social and environmental values and costs in supply chains and industries, the financial sector and in consumer behaviour.

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Appendices

7.1 Evaluation of main assets and benefits of poorer social groups, identified in the description of drivers of emissions.

Assets and Benefits	Characteristics						Capital/Dimension of Livelihood							Value Total	Critical Decapitalisation
	Relative	Tradable	Liquid/Cash	Renewable	Subsistence	Sub-Total	Natural	Social	Human	Productive	Financial	Power, Political	Combined Value		
Off-land work	High		X	X	X	6		X	X	X	X	X	83%	5.0	0
Knowledge of/Organisation for, labour intensive cash oriented agricultural practices	Medium	X		X	X	5	X	X		X	X	X	83%	4.2	0
Participation of ejido activity (membership as ejidatario)	Medium	X	X		X	5	X	X		X	X	X	83%	4.2	1
Formal access to land (ownership) (posesionario, comunero)	High	X	X		X	6	X			X	X	X	67%	4.0	1
Subsidies (poverty, agricultural)	High		X	X	X	6		X	X	X	X		67%	4.0	0
Institutional presence	High				X	4	X	X	X	X	X	X	100%	4.0	0
Private parcel (freehold)	High	X			X	5	X	X			X	X	67%	3.3	1
Empowerment, motivation	High			X	X	5		X	X	X		X	67%	3.3	0
Links to markets and intermediaries	Medium		X	X	X	5		X		X	X	X	67%	3.3	0
Use and access to resources (timber, NTFP)	Medium	X		X	X	5	X		X	X		X	67%	3.3	0
Social rules for resource access (Firewood, timber, land rental)	High				X	4	X	X	X	X		X	83%	3.3	0
Water and irrigation	High	X		X		5	X			X	X	X	67%	3.3	0
Formal education	High	X		X	X	6		X	X			X	50%	3.0	0
Emigration	High		X	X	X	6		X		X	X		50%	3.0	0
Access to transport services	Medium			X	X	4		X		X	X	X	67%	2.7	0
Fallow Age	Medium			X	X	4	X		X	X	X		67%	2.7	0
Family (nuclear and extended)	High		X		X	5		X		X	X		50%	2.5	0
Food and crops (perennial)	Medium	X		X	X	5	X		X	X			50%	2.5	1
Cattle (small scale)	Medium	X		X	X	5			X	X	X		50%	2.5	0
Remittances	Medium		X	X	X	5		X	X		X		50%	2.5	0
Social provision services (retirement)	High		X		X	5		X	X		X		50%	2.5	0
Collective grain driers and silos (commercial practices)	High	X				4		X		X		X	50%	2.0	0
Agricultural machinery	High	X				4				X	X	X	50%	2.0	0
Financial access	High		X			4				X	X	X	50%	2.0	0
Certification of products	High	X				4				X	X	X	50%	2.0	0
Institutional formal power, in managing affairs of ejido and enterprises	High					3		X		X	X	X	67%	2.0	0
Citizenship (legal recognition, agrarian subject)	High				X	4		X		X		X	50%	2.0	0
Experience in productive activities	High				X	4			X	X		X	50%	2.0	0
Honey, Bee hives	Low	X		X	X	4	X		X	X			50%	2.0	0
Chewing gum extraction	Medium	X		X		4	X		X	X			50%	2.0	0
Access to land (rented, borrowed)	High				X	4	X	X		X			50%	2.0	0
Inside information	Medium	X				3		X		X	X	X	67%	2.0	0
Cattle rearing (large-scale)	High	X		X	X	6				X	X		33%	2.0	0

Assets and Benefits	Characteristics						Capital/Dimension of Livelihood							Value Total	Critical Decapitalisation
	Relative	Tradable	Liquid/Cash	Renewable	Subsistence	Sub-Total	Natural	Social	Human	Productive	Financial	Power, Political	Combined Value		
Access to Firewood	Low	X		X	X	4	X			X	X		50%	2.0	0
Presence of meliferous species	Medium			X	X	4	X		X	X			50%	2.0	0
Charcoal production (individual)	Low	X		X	X	4	X			X	X		50%	2.0	0
Membership of collective organisations (chewing-gum, honey, other	Medium				X	3		X		X		X	50%	1.5	0
Food and Crops (Seasonal)	Medium	X			X	4	X			X			33%	1.3	1
Social, political and economic networks	Medium					2		X		X	X	X	67%	1.3	0
Access to agrochemicals	Medium	X			X	4				X	X		33%	1.3	1
Access to veterinary services	Medium				X	3				X	X		33%	1.0	0
Kilns for charcoal production	Low	X			X	3				X	X		33%	1.0	1
Home and solar	High	X			X	5				X			17%	0.8	1
Access to maintenance services (agricultural machinery)	Medium					2				X	X		33%	0.7	0
Non-motorised vehicles	Low	X			X	3				X			17%	0.5	1
Stables	Low	X			X	3				X			17%	0.5	1
Hand tools	Low	X			X	3				X			17%	0.5	1
Barns	Low	X			X	3				X			17%	0.5	1
Motor vehicles	Medium	X				3				X			17%	0.5	0
Agrochemical products	Medium	X				3				X			17%	0.5	0
Motor vehicles	Medium	X				3				X			17%	0.5	0
Chainsaws	Low	X				2				X			17%	0.3	0

7.2 Evaluation of the effect of the drivers of emissions on poor groups.

Drivers	Main Benefits			Main Costs			Capital/ Livelihood						Poor groups											Total
	Description	Scale	Permanence	Description	Scale	Permanence	Natural	Social	Human	Productive	Financial	Power	Immigrant	Milpero	Carbonero	Resident	Avecindado	Women	Young	Elder	Posesionario	Smallholder (private)	Ejidatario	
Hurricanes	Increase in dead biomass (bioenergy and timber)	Small	Short term	Loss of Natural Capital/ES, tension on social capital, loss of livelihoods (crops and activities), poor communication, unemployment, debts and decapitalisation, powerlessness	Large	Long term	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	88.0
Urbanisation and land speculation	Large cash income	Large	Short term	Loss of Natural Capital/ES, loss of productive assets, power asymmetry	Large	Long term	X	X		X	X	X						X		X	X	X	X	25.0
Shifting Cultivation	Subsistence activities (crops)	Small	Short term	Loss of natural capital and ecosystem services (ES), diminishing production yields, increasing production costs.	Moderate	Mid term	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	22.0
Firewood collection	Subsistence activities (energy and income)	Small	Short term	Loss of Natural Capital/ES	Moderate	Mid term	X		X		X		X	X	X	X	X	X	X	X	X	X	X	16.5
Charcoal production	Subsistence activities (income)	Small	Short term	Loss of Natural Capital/ES	Moderate	Mid term	X		X		X		X	X	X	X	X	X	X	X	X	X	X	16.5
Public programs and subsidies	Cash, income	Small	Short term	Loss of Natural Capital/ES, powerlessness	Moderate	Mid term	X			X	X			X			X	X	X	X	X	X	X	12.0
Pastureland	Capital accumulation in cattle, cash activities (cattle and land rental)	Moderate	Short term	Loss of Natural Capital/ES	Moderate	Mid term	X			X	X		X	X				X		X	X	X	X	7.0
Barriers SFM	Direct use, employment and cash activities	Moderate	Short term	Loss of Natural Capital/ES, problems for organised management	Moderate	Mid term	X	X		X	X								X		X		X	4.0
Governance and environmental management regimes	That from unsustainable activities implemented due to poor enforcement (see above, cash and subsistence)	Moderate	Short term	Loss of Natural Capital/ES, problems for organised management, power asymmetry	Moderate	Mid term	X	X				X									X	X	X	3.0
Commercial agriculture	Organised, mechanised production, cash activities and capital accumulation, employment	Large	Short term	Loss of Natural Capital/ES	Moderate	Mid term	X	X		X	X										X	X	X	2.0

7.3 Pro-poor evaluation of potential REDD+ interventions

REDD+ Intervention	Capital Dimension/ Livelihood							Characteristics of Intervention							Poor Social Groups												Pro Poor Potential
	Natural	Social	Human	Productive	Financial	Power	Combined Capital Index	Scale	Temporality	Tradable	New Jobs	Liquid	Subsistence	Total	Immigrant	Milpero	Carbonero	Resident	Avecindado	Women	Young	Elder	Posesionario	Small-holder (private)	Ejidatario	Social Groups (Poor)	
Harmonise, Simplify and align subsidies and public programs for rural development, Coordination across and within governmental levels	X	X	X	X	X	X	100%	Large	Mid Term		X	X	X	8	X	X	X	X	X	X	X	X	X	X	X	11	88.0
Articulate rural sustainable development strategies around needs at family level.	X	X	X	X	X	X	100%	Large	Long Term		X		X	8	X	X	X	X	X	X	X	X	X	X	X	11	88.0
Micro-insurance schemes for housing, *milpa*, CFM, honey production, cattle, chewing gum.		X	X	X	X	X	83%	Large	Long Term			X	X	8	X	X	X	X	X	X	X	X	X	X	X	11	73.3
Increase size of solares in *ejido* population centres (community land use plans).		X	X	X	X	X	83%	Large	Long Term	X			X	8	X	X	X	X	X	X	X	X	X	X	X	11	73.3
Improve CFM in small *ejidos* (control extraction fronts, small scale plantations, agroforestry).	X	X		X		X	67%	Large	Long Term	X	X		X	9	X	X	X	X	X	X	X	X	X	X	X	11	66.0
Develop local industry and workshops around the timber industry to add value to local products.		X	X	X		X	67%	Large	Long Term	X	X	X		9	X	X	X	X	X	X	X	X	X	X	X	11	66.0
Technology transfer for forest based, farm and non-farm activities.	X		X	X		X	67%	Large	Long Term	X	X		X	9	X	X	X	X	X	X	X	X	X	X	X	11	66.0
Support for transport services and better links to markets.		X	X	X	X	X	83%	Large	Long Term		X			7	X	X	X	X	X	X	X	X	X	X	X	11	64.2
Earmark contribution to NFF to offset land use changes within same jurisdictions.	X	X		X	X	X	83%	Moderate	Mid Term		X	X	X	7	X	X	X	X	X	X	X	X	X	X	X	11	64.2
Simplify regulations (i.e. timber, charcoal, firewood, chewing gum, production and transportation; consider small-scale practices).	X	X		X	X	X	83%	Large	Long Term		X			7	X	X	X	X	X	X	X	X	X	X	X	11	64.2
Promote voluntary carbon market for sequestration practices (restoration, reforestation, afforestation).	X	X		X	X	X	83%	Moderate	Mid Term		X	X	X	7	X	X	X	X	X	X	X	X	X	X	X	11	64.2
Regularisation of land access (recognise avecindados, posesionarios).	X	X		X	X	X	83%	Large	Long Term	X			X	8	X	X	X	X	X	X	X	X	X			9	60.0
Allow the division of ejido holdings among heirs.	X	X		X	X	X	83%	Large	Long Term	X			X	8	X	X	X	X	X	X	X	X	X			9	60.0
Best practices for *milpa* production to increase productivity (fallow, soil, water management).	X		X	X	X		67%	Large	Long Term		X		X	8	X	X	X	X	X	X	X	X	X	X	X	11	58.7
Strengthen the APDT (negotiation skills, strong technical authoritative opinion, budget).	X	X		X		X	67%	Large	Mid Term		X	X	X	8	X	X	X	X	X	X	X	X	X	X	X	11	58.7

REDD+ Intervention	Capital Dimension/ Livelihood							Characteristics of Intervention							Poor Social Groups												Pro Poor Potential
	Natural	Social	Human	Productive	Financial	Power	Combined Capital Index	Scale	Temporality	Tradable	New Jobs	Liquid	Subsistence	Total	Immigrant	Milpero	Carbonero	Resident	Avecindado	Women	Young	Elder	Posesionario	Small-holder (private)	Ejidatario	Social Groups (Poor)	
Local health and education services.			X	X	X	X	67%	Large	Long Term			X	X	8	X	X	X	X	X	X	X	X	X	X	X	11	58.7
Innovate education and research programs to increase sustainable productivity of rural groups	X		X	X		X	67%	Large	Long Term		X		X	8	X	X	X	X	X	X	X	X	X	X	X	11	58.7
Human and social development project to empower local population in alliance with local groups		X	X	X		X	67%	Large	Long Term		X		X	8	X	X	X	X	X	X	X	X	X	X	X	11	58.7
Formalise commercial firewood market in cities.	X	X		X		X	67%	Large	Long Term		X		X	8	X	X	X	X	X	X	X	X	X	X	X	11	58.7
Silvopastoral management.	X	X		X	X		67%	Large	Long Term		X		X	8	X	X	X	X	X	X	X	X	X	X	X	11	58.7
Saving and investment strategies compatible with sustainable practices.	X		X	X	X		67%	Large	Long Term		X	X		8	X	X	X	X	X	X	X	X	X	X	X	11	58.7
Micro-credits/finance.			X	X	X	X	67%	Large	Long Term		X	X		8	X	X	X	X	X	X	X	X	X	X	X	11	58.7
Participation in the voluntary carbon market.	X	X		X	X		67%	Moderate	Long Term		X	X	X	8	X	X	X	X	X	X	X	X	X	X	X	11	58.7
Effective management and budget for NPA.	X	X		X		X	67%	Moderate	Long Term		X	X		7	X	X	X	X	X	X	X	X	X	X	X	11	51.3
Conflict management with intermediaries.	X	X		X		X	67%	Large	Long Term		X			7	X	X	X	X	X	X	X	X	X	X	X	11	51.3
Allow some low impact forest management in areas receiving PES	X			X	X	X	67%	Moderate	Mid Term	X	X		X	7	X	X	X	X	X	X	X	X	X	X	X	11	51.3
Intensive production of cattle.	X	X		X	X		67%	Large	Long Term		X			7	X	X	X	X	X	X	X	X	X	X	X	11	51.3
Promote community enterprises/cooperatives managed by specialised groups.		X	X	X	X	X	83%	Moderate	Short Term		X	X		5	X	X	X	X	X	X	X	X	X	X	X	11	45.8
Agroforestry practices in parcels and solares.	X		X	X	X		67%	Moderate	Long Term				X	6	X	X	X	X	X	X	X	X	X	X	X	11	44.0
Install improved cook stoves.	X	X	X		X		67%	Small	Long Term		X		X	6	X	X	X	X	X	X	X	X	X	X	X	11	44.0
Community management plan for commercial firewood (including small-scale participation).	X	X		X		X	67%	Moderate	Long Term		X			6	X	X	X	X	X	X	X	X	X	X	X	11	44.0
Community management plan for commercial charcoal (including small-scale participation).	X	X		X		X	67%	Moderate	Long Term		X			6	X	X	X	X	X	X	X	X	X	X	X	11	44.0
Contingency considerations for timber and NTFP management.	X			X		X	50%	Large	Long Term			X	X	8	X	X	X	X	X	X	X	X	X	X	X	11	44.0
Strengthen development and enforcement of internal rules at *ejido* community level.	X	X		X		X	67%	Large	Mid Term				X	6	X	X	X	X	X	X	X	X	X	X	X	11	44.0

REDD+ Intervention	Capital Dimension/ Livelihood							Characteristics of Intervention							Poor Social Groups												Pro Poor Potential
	Natural	Social	Human	Productive	Financial	Power	Combined Capital Index	Scale	Temporality	Tradable	New Jobs	Liquid	Subsistence	Total	Immigrant	Milpero	Carbonero	Resident	Avecindado	Women	Young	Elder	Posesionario	Small-holder (private)	Ejidatario	Social Groups (Poor)	
Community land use plans (including, areas for charcoal and firewood production; reforestation, restoration; communal parcels).	X	X		X		X	67%	Large	Mid Term				X	6	X	X	X	X	X	X	X	X	X	X	X	11	44.0
Increase technical presence of forest management institutions on the ground.	X			X		X	50%	Large	Long Term		X		X	8	X	X	X	X	X	X	X	X	X	X	X	11	44.0
Greening financing (producers, inputs and services, value chains, consumers).	X			X	X		50%	Large	Long Term		X	X		8	X	X	X	X	X	X	X	X	X	X	X	11	44.0
Bioenergy plantations (firewood, charcoal).	X			X	X		50%	Moder ate	Long Term	X	X		X	8	X		X	X	X	X	X	X	X	X	X	10	40.0
Enrichment plantations of chewing gum and melliferous species.	X			X	X		50%	Moder ate	Long Term		X		X	7	X	X	X	X	X	X	X	X	X	X	X	11	38.5
Contingency plans and shelters.		X	X			X	50%	Large	Long Term				X	7	X	X	X	X	X	X	X	X	X	X	X	11	38.5
Technical support for different steps in production chain (local small scale industry, family workshops).		X	X	X	X	X	83%	Moder ate	Short Term		X			4	X	X	X	X	X	X	X	X	X	X	X	11	36.7
Technical scholarships (professionalization of functions under CFM).			X	X		X	50%	Moder ate	Long Term		X			6	X	X	X	X	X	X	X	X	X	X	X	11	33.0
Increase coverage of PES (Including private funds).	X				X	X	50%	Moder ate	Mid Term		X	X		6	X	X	X	X	X	X	X	X	X	X	X	11	33.0
Low emissions commercial agriculture (e.g. zero tillage, organic agriculture, agroforestry, fire management practices).	X			X	X		50%	Large	Mid Term		X			6	X	X	X	X	X	X	X	X	X	X	X	11	33.0
Fund young landless groups to develop productive non-farm activities.	X		X	X		X	67%	Large	Mid Term		X	X		7	X				X	X	X		X		X	6	28.0
Waste management to protect mangroves in coastal areas.	X			X		X	50%	Large	Long Term		X		X	8					X	X	X	X	X	X	X	7	28.0
Poverty alleviation subsidies.			X		X		33%	Large	Mid Term			X	X	7	X	X	X	X	X	X	X	X	X	X	X	11	25.7
Certifications schemes (Timber, NTFP, crops, beef, honey) to provide information to final *consumers*.	X	X	X	X	X	X	100%	Moder ate	Mid Term		X			5		X	X						X	X	X	5	25.0
Control of road, urban and touristic development to protect mangroves in coastal areas.	X			X		X	50%	Large	Long Term				X	7					X	X	X	X	X	X	X	7	24.5
Engage with the *secondary sector* adding value to local production (greening *supply chains*).	X	X		X		X	67%	Large	Long Term		X			7		X	X						X	X	X	5	23.3
Fire management practices.	X	X		X			50%	Large	Short Term					4	X	X	X	X	X	X	X	X	X	X	X	11	22.0
Crop diversification, technological			X	X	X		50%	Small	Short		X		X	4	X	X	X	X	X	X	X	X	X	X	X	11	22.0

REDD+ Intervention	Capital Dimension/ Livelihood							Characteristics of Intervention							Poor Social Groups												Pro Poor Potential
	Natural	Social	Human	Productive	Financial	Power	Combined Capital Index	Scale	Temporality	Tradable	New Jobs	Liquid	Subsistence	Total	Immigrant	Milpero	Carbonero	Resident	Avecindado	Women	Young	Elder	Posesionario	Small-holder (private)	Ejidatario	Social Groups (Poor)	
change and sanitary measures to reduce vulnerability									Term																		
Explore opportunities for rural tourism services	X	X		X			50%	Moder ate	Short Term		X			4	X	X	X	X	X	X	X	X	X	X	X	11	22.0
Increase green areas in urban and touristic areas.	X			X			33%	Small	Long Term		X		X	6	X	X	X	X	X		X	X	X	X	X	10	20.0
Address illegal traffic of permits (timber, charcoal).	X			X	X	X	67%	Small	Short Term	X	X			4		X	X					X	X	X	X	6	16.0
Voluntary compliance programs.	X			X		X	50%	Moder ate	Mid Term		X			5		X	X						X	X	X	5	12.5
Support for CFM (e.g. Management plans, inventories, brigades, technical offices -GIS, computer-, demarcation of areas -forest permanent areas, yearly extraction area-, paths, maintenance and renovation of machinery).	X			X	X	X	67%	Large	Long Term	X	X	X		9											X	1	6.0
Capacity building and support to managerial bodies for management, commercialisation, certification, added value, social services and professionalization.		X	X	X		X	67%	Large	Long Term		X			7											X	1	4.7
Financial access for CFM practices (e.g. Revolving fund for extraction practices).	X			X	X		50%	Large	Mid Term		X	X		7											X	1	3.5
Install improved kilns.	X			X	X		50%	Small	Mid Term	X	X			5			X									1	2.5
Provide social security benefits to old ejidatarios who transfer their land rights earlier.		X	X				33%	Moder ate	Long Term			X	X	7							X					1	2.3
Promote natural regeneration/enrichment of managed forests.	X			X			33%	Moder ate	Long Term		X			6											X	1	2.0
Effective land use change control, enforcement and monitoring (address illegal deforestation).	X					X	33%	Large	Short Term		X			5												0	0.0
Fines and contributions to National Forest Fund (NFF).					X	X	33%	Large	Short Term			X		5												0	0.0