REDD net

Networking for equity in forest climate policy

REDD+ and agriculture:

A cross-sectoral approach to REDD+ and implications for the poor

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Front cover image source: Sam Beebe and Ecotrust

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Key points and policy recommendations

- Agriculture is the most important driver of deforestation and forest degradation globally.
- National level REDD+ policies and programmes will need to address agriculture as a driver of deforestation and forest degradation, and ensure that local level food security is not compromised to ensure the long-term political and social sustainability of REDD+.
- To harmonise agricultural and REDD+ policy goals, agricultural intensification will be necessary, but not sufficient. In the absence of other policy and regulatory measures to reduce deforestation, intensification is very unlikely to reduce pressure on forests.
- Large scale land use planning will be essential in identifying areas for specific "place based" policies to support REDD+ objectives. The most appropriate and effective policy interventions to reduce the impact of agricultural expansion on forests are likely to differ depending on the type of agriculture driving deforestation.
- For commercial agriculture it may be appropriate to reduce support for extensive commercial agriculture in forest frontier areas, regulate agricultural expansion in forest areas, encourage intensification in areas away from forests and improve transport networks in areas away from forests.
- For small scale and subsistence farmers it will be necessary to maintain and build support and extension services in all areas to ensure that REDD+ does not contribute to local level food insecurity. This should include support to access PES schemes, assistance with access to technologies to enable intensification and agroforestry support.
- Implementation of agricultural policies as part of REDD+ is likely to have socio-economic impacts on more than just forest-dependent communities and Indigenous Peoples. This needs to be considered in the development of national REDD+ strategies and highlights the need for greater cross-sectoral coordination in this process.
- To maximise synergies between agriculture and REDD+, an adaptive governance framework will be necessary due to the uncertain impacts of climate change on carbon sequestration, the changing nature of land use pressures and the multiple objectives to be achieved in REDD+ countries e.g. agriculture and REDD+. These uncertainties mean that objectives for REDD+ and agriculture at the national level will be subject to change, and decisions will need to be able to adjust to these.

Introduction

REDD+ (Reduction of Emissions from Deforestation and forest Degradation, as well as conservation and enhancement of carbon stocks in forests and sustainable forest management) has been gaining international momentum as a climate change mitigation mechanism, demonstrated by agreement on some aspects of a REDD+ framework in at COP 16 of the UNFCCC in Cancun. The Cancun agreements outlined a phased approach for REDD+: Phase 1, where capacity is built and national plans and strategies are developed; Phase 2, where these plans, policies and measures are implemented; and Phase 3, where results based actions with full monitoring, reporting and verification are undertaken (FCCC/CP/2010/7/Add.1: Decision 1/CP.16).

As part of Phase 1, REDD+ countries are starting to develop national level REDD+ strategies and policies. This movement of REDD+ from pilot projects to national scale design and implementation means that the interlinkages between forests and other sectors is becoming increasingly important. Implementing REDD+ requires countries to effectively address the drivers of deforestation and forest degradation (DD), many of which are outside the forest sector, therefore national level REDD+ strategies and their implementation will need to be cross-sectoral in their approaches. The agriculture sector is the most important other sector driving DD, and the success of REDD+ will be heavily dependent on harmonisation of REDD+ and agricultural objectives.

Given the role of agriculture in driving DD, successful REDD+ strategies are likely to include actions and interventions in this key sector. This paper discusses the relationships between the agriculture sector and forests and what that might mean for the implementation of REDD+. It also examines a number of policy approaches (that may form part of a REDD+ strategy) to address DD caused by the agriculture sector. The paper then highlights some potential socio-economic impacts of these policies, to be considered and mitigated in the development of equitable REDD+ strategies, able to achieve desired sustainable development and poverty alleviation objectives. The paper draws principally on published literature, as well as from specific case study research undertaken through the REDD-net project. It is complemented by another REDD-net paper on energy, following the same framework.

1. Agriculture and forests

The agriculture[1] sector and forests are intrinsically linked, most obviously through their direct competition for land. The area used for agriculture globally is increasing (Smith et al. 2010), with much of this expansion occurring onto forested lands, making agriculture one of the leading drivers of deforestation (Geist and Lambin 2002; Pirard and Treyer 2010; Boucher et al. 2011; McKenzie 2011). Permanent cultivation and cattle ranching are among the leading proximate causes of deforestation (Geist and Lambin 2002) and broad consensus has emerged on three immediate causes of deforestation, all of which influence the profitability of farms and the economic opportunities for farmers. These are higher agricultural prices, more and better roads, and low wages and a shortage of off-farm employment opportunities (Angelsen 2010). Between 1980 and 2000, 83% of new cropland in tropical areas came from natural forested land (Pirard and Treyer 2010). Without concerted effort this is likely to continue: 38% of forested land is at high risk of conversion for agriculture, and forests have an agricultural conversion rate three times higher than the conversion of other natural landscapes (Creed et al. 2010).

On a regional basis agriculture is driving most deforestation in Latin America, with large scale expansion of crop and pasture land for cattle ranching driving deforestation. Cattle pastures expanded by 35 million ha in South America in the 1980s and 1990s, while cropland area increased 5 million ha during this time, most of this area being cleared from forests (Boucher et al. 2011; Gibbs et al 2010). In Asia large-scale agricultural and timber plantations drives most deforestation with palm oil, rubber, coconut and timber comprising the major crops. Palm oil alone was responsible for 80% of the expansion of plantations in Asia in the 1990s, and is a particularly important crop in Malaysia and Indonesia (Boucher et al. 2011). In Africa, although agriculture is still a primary driver of deforestation, given the small scale nature of most agricultural production in this region, large-scale commercial agriculture has not contributed as much as in the other regions (Boucher et al. 2011). This may be changing with increasing foreign investment in commercial agriculture in the region, and growing demand for products that have driven deforestation in other regions.

1 In this paper agriculture includes both crop and livestock production.

Additionally there is pressure on international agricultural systems to produce more food for a growing global population with changing diets, and global food demand is predicted to double over the next 50 years (Tilman et al. 2002; DeFries and Rosenzweig 2010). For almost a billion people (CARE International 2011; Nellemann et al. 2009 in DeFries and Rosenzweig 2010) food insecurity is a major issue and agricultural productivity gains experienced during the green revolution are slowing. Climate change will also make agricultural production much more challenging in many areas (Tilman et al. 2002; Alston et al. 2009). Although most future increases in agricultural production will need to come from intensification (DeFries and Rosenzweig 2010) this set of circumstances provides additional impetus for agricultural expansion, making the competition for fertile land between forests and agriculture even more intense.

The close links between agriculture and forests, the fact that agriculture is the largest driver of deforestation in many areas, and the increasing global demand for food means that implementing REDD+ effectively will require policy interventions in the agriculture sector as well as the forest sector.

2. Factors behind the contribution of agriculture to deforestation

Different types of farmers have different models of production, constraints, risk management strategies and therefore different relationships with forests and deforestation. Because of these key differences, this paper will discuss the role of small-scale and subsistence agriculture in deforestation separately from commercial agriculture, and will also examine the impact on forests of intensification in both systems. This differing impact suggests that appropriate REDD+ policy options are likely to vary depending on the type of agriculture driving deforestation.

2.1 Small-scale and subsistence farmers

The main production goal of small-scale and subsistence (SSS) farmers is to secure their livelihoods and improve their economic situation, which affects how they make decisions about production and the introduction of agricultural technologies, and therefore their role in driving deforestation. SSS farmers tend to be more cash constrained and risk averse than large-scale commercial farmers (Angelsen and Kaimowitz 2001; Pichón et al. 2001). Capital constraints of these farmers generally limit their impact on forests (Chomitz 2007, Angelsen and Kaimowtiz 2001). For example in Ecuador poorer coffee farmers have no additional resources to clear land or raise cattle, and therefore have higher forest cover on their farms, while better-off farmers tend to clear all of their land to grow coffee, graze cattle or both (Pichón et al. 2001).

Shifting cultivation is one type of SSS production system often cited as a significant cause of deforestation (for example it was included as a significant driver of deforestation in the R-PPs[2] of the Democratic Republic of Congo, Tanzania, Lao PDR, Mexico and Peru). However, the evidence for this is thin (Geist and Lambin 2002; Angelsen 1995; Lawrence et al. 1998; Ickowitz 2006; Brown and Schreckenberg 1998) and there is growing evidence that SSS farmers do not cause significant amounts of deforestation (Geist and Lambin 2002), and that poverty constrains deforestation, while increasing profitability of the agriculture sector drives it (Angelsen and Kaimowitz 2001; PEN 2011).

2 Readiness Preparation Proposal prepared as part of the REDD readiness process under the World Bank Forest Carbon Partnership Facility.

Population growth, low agricultural productivity and poor technology are the main factors causing agricultural land expansion and deforestation by SSS farmers (Kaimowitz and Angelsen 1998, Angelsen and Kaimowitz 2001; Rosengren and Seeberg-Elverfeldt 2011). Small-scale farmers may also use deforestation as insurance against yield and price risk (Angelsen and Kaimowitz 2001).

2.1.1 Intensification

This relationship means that in response to increased agricultural productivity as a result of intensification, SSS farmers are likely to cultivate less land to fulfil subsistence needs, and therefore reduce pressure on forests, following the Land Sparing Hypothesis.

The "Land Sparing Hypothesis" states that intensification, and subsequent increases in agricultural yields, reduces the amount of agricultural land necessary for farmers to earn a living or make a certain level of profit, reducing the need to clear forests for additional agricultural land. On the macro scale, increased yields increase supply of the produce, driving down the price and consequently reducing the incentive for farmers to expand their area of production (Maertens et al. 2006; Pirard and Treyer 2010).

This theoretical relationship assumes that demand for agricultural products is fixed, or that individual farmers are unable to sell additional produce as they are isolated from markets (Ewers et al 2009). These assumptions are much more likely to hold for SSS farmers, as most commercial agricultural producers are well connected to markets. Agricultural subsidies and policies may also override the economic relationship described above, with increased yields resulting in surplus production rather than reductions in production and therefore reductions in total farmed area (Ewers et al. 2009).

The hypothesis also fails to take into account the diversified nature of the agricultural sector and the complex interactions made on the farm and market level between agricultural products (Pirard and Treyer 2010). This means that although the area of one particular crop may decrease as a result of yield increases, the area of other crops may increase, maintaining or increasing the total agricultural area.

There is limited evidence to support the hypothesis at a national level in developing countries, for example lower deforestation rates are seen in countries with high growth in agricultural yields (Barbier and Burgess 1997). Most evidence suggests that in practice, land sparing at the national level occurs only under specific conditions, unlikely to exist in developing countries for example where imports of staple food crops displace domestic production and strict environmental regulations are implemented and enforced (Rudel et al. 2009; Ewers et al. 2009).

At the local level land sparing has been demonstrated to occur in some shifting cultivation systems (for example where rubber was introduced) where forest regulations constrained additional forest clearing and in-migration was prevented. Although another type of intensification, the use of leguminous vines to improve crop yield, had unclear impacts on deforestation in Peru (Angelsen and Kaimowitz 2001).

This evidence suggests that land sparing is more likely to occur in small-scale and subsistence agricultural systems given their poor connection to markets and the underlying factors that drive deforestation in these production systems, for example to manage risk or in response to low agricultural productivity.

2.2 Commercial agriculture

Commercial agriculture is the production of agricultural produce for sale with the intention of making a profit. A number of characteristics of commercial agriculture influence its relationship with forests including its access to capital, the profit driven nature of the business, the large scale production systems and the links to international commodity markets as opposed to local markets.

The two major deforestation frontiers, the southern Amazon and south-east Asia, are currently driven by commercial agricultural expansion. It is likely that with greater international trade and increasing urbanisation, future deforestation will be similarly driven by commercial scale agriculture (DeFries and Rosenzweig 2010).

Increased profitability of commercial agriculture will generally increase deforestation. Many factors may affect profitability such as technical improvements, farmgate prices and the prices of inputs themselves affected by tariffs, subsidies, transport costs and exchange rate policies (Kaimowitz and Angelsen 1998; Chomitz 2007).

2.2.1 Intensification

Intensification of commercial agricultural systems is therefore most likely to result in increased deforestation as a result of the profit driven nature of commercial agriculture, the greater access to capital, the nature of and access to international commodity markets and the diversification of products in most agribusinesses, following the alternative "No Land Sparing Hypothesis".

The "No Land Sparing Hypothesis" states that increased yields make agriculture more profitable, therefore promoting agricultural expansion and deforestation (Maertens et al. 2006; Shivley and Martinez 2001; Meyfroidt and Lambin 2008; Kaimowitz and Smith 2001; Coxhead et al. 2001; Rudel 2009). Increased profitability may also make clearing of previously marginal lands more profitable and induce additional deforestation by migrants attracted by better economic conditions (Pagiola and Holden, 2001).

This theoretical relationship assumes that farmers are well connected to markets and are able to sell additional produce if they expand their activities. In reality this may not be case for all farmers however is likely to be true for commercial agriculture. Other factors likely to affect expansion by farmers include capital or labour constraints and risk, which influence investment or loan decisions (Pirard and Treyer 2010).

This hypothesis has greater evidential support at the global level (Ewers et al. 2009; Angelsen 2010; Rudel 2009) and at the national level, particularly when diversified agricultural systems are considered, for example in Tanzania (Angelsen et al. 1999) and Indonesia (Angelsen 2010). Intensification of extensive cattle grazing systems in Latin America also suggests that land is not spared when intensification improves the profitability of agriculture (Kaimowitz and Angelsen 2008).

At the local level, support for the No Land Sparing Hypothesis has been demonstrated in the state of Matto Grosso, Brazil, where the area cleared for cropland, and its contribution to large deforestation events was directly correlated with the price of soybeans in the year of clearing (Morton et al. 2006).

The evidence suggests that land sparing is very unlikely to occur if commercial agricultural production systems are intensified. This is largely because intensification is likely to increase profitability of commercial agriculture which in turn stimulates deforestation.

Impact of land tenure policies and enforcement on deforestation; the case of Latin America

Conversion of forest lands for agricultural production, particularly low input agriculture such as cattle grazing, has been used as a risk management strategy in areas with insecure property rights e.g. Brazilian Amazon. In these areas forests are converted to pasturelands to generate immediate returns and to assert the productive use of the land, which often leads to the grant of formal property titles, as well as reducing the risk of expropriation (Araujo et al. 2009; Jaramillo and Kelly, 1997). Removal of forest cover in many parts of Latin America has been a requirement for land titling and has been documented to be a major factor in frontier agriculture conversion in Costa Rica, Ecuador, Honduras and Panama (Jaramillo and Kelly 1997; Southgate et al. 1991).

Since 2009 the Brazilian Government has been trying to regularise the titling of land in the Amazon region under the Programa Terra Legal. This involves a simplification of the titling process for 296 800 small properties occupied since December 2004, in the 43 municipalities with the highest rates of deforestation (Government of Brazil 2010). Land holdings of 100 ha or less are exempt from payment and larger holdings will require payment, but this is likely to be below market rates (Miotto 2010). Regularisation follows a 4 stage process of registration, georeferencing, field inspection and then titling. It aims to regularise 300,000 land holdings in 3 years, over a potential area of 670,000 km (Oliviera 2011). As of January 2011 a total of 86 397 individuals have registered 10,116,715 ha of land but there has been little progress made in field inspections or titling, with only 516 titles processed so far (Brito and Barreto 2010). There are concerns however that the programme will not address deforestation and illegal logging undertaken in much of the Amazon, as properties under 400 ha are exempt from inspections, so illegal logging undertaken during their occupation will not be reported or penalised (Oliviera 2011).

Clarification and strengthening of resource tenure will be essential to effective management of agricultural impacts on forests. Even in Brazil, which when compared to many other countries is well advanced in its recognition of individual and communal property rights over forests, there are still large areas where tenure 'chaos' exists (Wollenberg et al. 2011).

2.3 Government regulations, policies and incentives

The agricultural sector is an important sector for rural growth, poverty reduction and development, and has therefore been provided with significant policy support and incentives in many countries (IFAD 2010). This support influences the profitability of agriculture, and therefore has corresponding impacts on agricultural expansion, and deforestation.

The connection between commercial agriculture and international agricultural commodity markets mean that international trade policies and the movement of global commodity markets will also affect profitability and therefore production decisions. This will have corresponding impacts on agricultural expansion and deforestation, however given the complexity of international trade systems, national agricultural sectors and production decisions, these impacts are difficult to generalise. The influence of these international systems and markets on the commercial agriculture sector and their potential to influence national policy objectives for the agriculture sector should be recognised, for example a spike in international grain prices may mean that domestic grain production becomes more of a priority to reduce reliance on imported grain. This highlights the need for adaptive governance of REDD+ (discussed further in text box: The need for multi-sectoral and adaptive governance of REDD+).

Government policies on land tenure and land use planning, and the capacity to implement and enforce these also affects the relationship between forests and agriculture, as demonstrated by the text box: The impact of land tenure policies and enforcement on deforestation; the case of Latin America. Land tenure systems which view forests as 'unproductive' or 'unclaimed' have been the underlying cause of much of the deforestation in Brazil (Araujo et al. 2009) and other parts of Latin America (Jaramillo and Kelly 1997; Southgate et al. 1991).

Although the authors acknowledge the important role that property rights and land tenure systems play in driving deforestation implementing REDD+ (Sunderlin et al. 2009), detailed discussion of these are beyond the scope of this paper.

3. REDD+ policy options to address agriculture as a driver of deforestation

Given the complex relationships between changes in agricultural policy, agricultural technology and deforestation, as well as the dependence of the rural poor on the agricultural sector, policy options being considered to address agriculture as a driver of deforestation need to clearly consider the tradeoffs involved. These include the socio-economic impacts of various policy options, particularly on the rural poor. The location in which various policy options are implemented will also influence their effectiveness in achieving REDD+ goals, and overall climate change mitigation. Landscape scale land-use planning will therefore be essential to underpin these decisions and identify areas that are appropriate for agricultural intensification, REDD+ and other land uses (e.g. mining, infrastructure development, urban expansion, nature conservation of non-forest ecosystems). The need for legislative and policy reform to enable the implementation of many of these policies is recognised, for example regularisation and reform of land tenure (Sunderlin et al. 2009), however discussion of these is beyond the scope of this paper. The range of appropriate policy options are summarised in Table 1.

3.1 Large scale land-use planning

This will be essential in taking a whole landscape view of climate change mitigation options and meeting the many competing uses for land. Studies have shown that even if REDD+ halts deforestation, without specific policies to manage agricultural expansion, expansion in other natural areas will cancel out up to 50% of avoided deforestation emissions reductions (Creed et al. 2010).

Land-use planning should clearly identify areas for new agricultural production, preferably on previously cleared or degraded land, as well as areas that will be targeted for intensification. It will be important that these areas are located away from forest areas and are well connected with markets, something which may also be improved through policy intervention, for example targeted road network enhancement. In combination with this, land-use planning should identify priority areas for REDD+ and this will then form the basis for the location specific policies necessary to discourage agricultural production, and particularly

The need for multi-sectoral and adaptive governance of REDD+

Although there are likely to be significant changes in the drivers of DD and in the priorities and outcomes of REDD+ strategies over time, the adaptability of REDD+ policy regimes has not been widely explored (Corbera and Schroeder 2011). Given the linkages discussed in this paper between forests and agriculture, agricultural policy options will have various synergies and tradeoffs with REDD+, and policy choices made in this sector will strongly affect the implementation of REDD+ (Contreras-Hermosilla 2011).

While the objective of REDD+ is to reduce greenhouse gas emissions from the forest sector, the objective of the agriculture sector is in most countries to maintain or increase economic development from the sector, and contribute to local and national level food security. There are a number of synergies between REDD+ and agricultural sector objectives as are identified in this section of the paper, and ideally the forest and agricultural sector will be able to coordinate their actions to build on these synergies and to avoid the existing tradeoffs between economic development, agricultural production and deforestation and forest degradation.

In order to maximise these synergies an adaptive governance framework will be necessary because of the uncertain impacts of climate change on carbon sequestration (e.g. vegetation die-back, fires, pests), the changing nature of land use pressures (e.g. commodity markets altering the opportunity costs of REDD+) and the multiple objectives to be achieved in REDD+ countries (e.g. increasing agricultural productivity and REDD+). The uncertainties mean that objectives for REDD+ and agriculture at the national level will be subject to change, and decisions will need to be able to adjust to these.

Adaptive governance requires the updating of decisions to reflect updated information and will require organisations to facilitate this process through the provision and exchange of updated information between sectors, as well as the facilitation of multi-stakeholder groups (Cash et al. 2003; Duit and Gala, 2008). For adaptive governance to work in the context of REDD+ it will also be important that monitoring and evaluation systems involve organisations and institutions (not only in the forest sector) that are able to monitor how national REDD+ policies interact at the local level with other economic activities and the socio-economic impacts of these interactions. An adaptive governance framework will enable this information to be fed into REDD+ strategy evaluation and redevelopment.

expansion, in priority areas for REDD+. These could include: no new road building, no support to commercial agriculture in these areas, land swap opportunities for farmers, PES schemes and regulations which impose bans on land clearing for agriculture. Moreover, land-use planning could also be used to promote synergies between climate change mitigation and adaptation such as ensuring the conservation of ecosystem services necessary for ecosystem-based adaptation to climate change (Vignola et al. 2009).

It is important that national level land-use planning is a multi-stakeholder process, and also has strong political support. Lack of political support and poor government coordination have made the implementation of land-use plans difficult even where they have been done (e.g. in Mozambique, see Nhantumbo and Salomao 2009) and the politics involved in land-use decision making should not be underestimated. Land use planning will involve a number of tradeoffs and policy decisions and in order to build political support for the land use planning process it will be important that these are made transparently and explicitly. This has proven exceedingly difficult in most developing countries and whether REDD+ will provide enough of an incentive to do this effectively remains to be seen.

How competing land uses are balanced will also depend on many country specific factors, including existing levels of forest cover and the scale of opportunity that REDD+ provides. As many agricultural products are traded on global markets, forest rich countries may choose to reduce tariffs to encourage the import of staple food crops, keeping food prices low and discouraging expansion of agricultural areas (Rudel 2009). Forest poor countries may choose to focus on agricultural production, in conjunction with restoration of degraded forests and agroforestry to take advantage of REDD+, as well as increased global demand for agricultural products (Rudel 2009).

Once the strategic direction and land use planning framework has been established for a country, the details of location-specific policy approaches for various areas can be determined. Whether the land-use planning process enables REDD+ and agriculture

Land use planning in practice

In Brazil, land use planning has been undertaken to direct biofuel feedstock production to certain areas. For example agroecological zoning laws adopted in 2009 mean that sugarcane is unable to be grown in 92.5% of the country in order to protect ecologically significant biomes (Shoneveld et al 2010).

Malaysia also has in place a ban on forest clearing for oil palm, with oil palm expansion only permitted on land zoned as agricultural (Shoneveld et al. 2010). It is the weak implementation of these plans and laws that makes them ineffective in many areas.

In Indonesia, decentralisation has resulted in a reform of spatial planning which now occurs at the Provincial level. This has been seen as an opportunity to better link local government spatial planning to the knowledge, experience and aspirations of local people, however in some areas (e.g. East Kalimantan Province) the transparency of decision making has not been enhanced by decentralisation of land-use planning (Wollenberg et al. 2008).

to co-exist in order to ensure food security at the local and national levels will depend on the outcome of the process, however without such a process it will be much more difficult to ensure these synergies.

3.1.1 Potential socio-economic impacts:

There may be broad ranging socio-economic impacts associated with the implementation of land-use plans. Economic development is likely to be generated in areas targeted for intensification, with potential declines in employment and growth in areas where agricultural expansion is curtailed. Facilitating migration to new growth areas in order to take advantage of new employment opportunities will be needed to ameliorate these impacts, as will support for alternative income generating enterprises that do not involve deforestation (e.g. NTFPs and ecotourism). The scale of these potential impacts makes an inclusive, participatory process for land use planning even more of an imperative.

If a country with high levels of forest cover chooses to pursue a strategy which reduces internal agricultural production and increases reliance on the import of staple foods, this will reduce opportunities for the rural poor, usually the poorest segment of the population. To counteract this impact, REDD+ revenue distribution will need to specifically target these groups and alternative income generation opportunities be developed (Rudel 2009).

3.2 Intensification

Where and how intensification occurs, including the labour intensity of the new technology, markedly influences its effectiveness in reducing pressure on forests. Intensification of extensive grazing systems has been demonstrated not to reduce pressure on forests in Latin America (Angelsen and Kaimowitz 2001) and the following discussion will be focussed on intensification of crop production systems. The method of intensification is also important as greater use of inputs can result in higher total greenhouse gas emissions in the long-term, cancelling out the effects of mitigation from reduced forest DD (Wollenberg et al. 2011). It is therefore essential that agricultural intensification is undertaken in a way that is 'climate smart' (Grieg – Gran 2010; Wollenberg et al. 2011).

Although growth in agricultural productivity will be essential to reduce pressures on tropical forests from agricultural expansion, this is not sufficient to prevent deforestation in the absence of specific policies to do this (Thomson et al. 2010; Wise et al. 2009; Angelsen and Kaimowitz 2001), so support for intensification of both commercial and SSS agriculture will need to be accompanied by effectively enforced regulation of agricultural expansion into forest areas.

3.2.1 Commercial Agriculture

Intensification of commercial agriculture has the potential to contribute to REDD+ if it is undertaken in areas away from forests (e.g. lowland areas in South-East Asia or peri-urban areas) and involves adoption of labour intensive technologies or stimulates non-farm employment (e.g. in transport or agricultural processing industries) thereby providing an alternative source of off-farm income for those currently engaged in deforestation, drawing labour out of forested areas (Angelsen, 2010; Angelsen and Kaimowitz 2001; Chomitz 2007).

The method of intensification should focus on low emission intensification technologies, for example restoring cultivated organic soils, restoring degraded lands and improving livestock management, as summarised in Table 2.

3.2.2 Small scale and subsistence agriculture

Intensification for smallholders and farmers involved in subsistence agriculture is important to enhance food security for these farmers, particularly if REDD+ policies will restrict further extensification. It is also likely to be essential in attaining ongoing political support for REDD+ by contributing to the dual objectives of local level food security and REDD+.

In the case of shifting cultivation, intensification can prompt farmers to become more sedentary, thereby reducing deforestation (Angelsen 2010). Development of technologies that facilitate intensification and consequently alleviate yield risk for smallholders may also help to reduce deforestation by small scale farmers, given their use of natural resources as a form of insurance against these risks (Angelsen and Kaimowitz 2001).

3.2.3 Potential socio-economic impacts

The adoption of effective and appropriate technologies which result in increased agricultural productivity for smallholder farmers will be essential to ensure that reduced agricultural land availability, likely under REDD+, does not create local level food insecurity. Targeted investment and extension will also be required to ensure SSS farmers are able to integrate these technologies into production systems.

In order to reduce the impact of food price increases on poor urban or rural consumers, effective intensification of commercial agriculture is also needed, particularly in highly productive areas which have the greatest potential for further increases in productivity. In combination with this incentives may be needed to ensure that local markets are adequately supplied (e.g. through export taxes), so that at least some of the benefits of higher agricultural productivity remain within the country.

3.3 Agroforestry

Facilitating widespread adoption of agroforesty (including managing trees for agricultural production (perennial tree crops), using trees for improved fallow cycles and silvopastoral systems) is one way to achieve multiple benefits of ecosystem services and food production from agricultural systems, achieving food security and livelihood objectives (Akinnifesi et al. 2009; Neufeldt et al. 2009; DeFries and Rosenzweig 2010). This is particularly important in SSS farming systems, allowing multiple benefits to be achieved from limited agricultural land. Uptake of agroforestry has been mixed, with some studies demonstrating significant levels of adoption (Ajayi et al. 2006), although adoption and diffusion has generally lagged behind the scientific and technological advances in this area (Mercer 2004). Adoption of agroforestry is quite different to other agricultural crops and a range of factors influence it

Table 2: Low emissions agricultural techniques for 'Climate-Smart Agriculture'

Strategy	Example methods
Restore cultivated organic soils	Increased vegetation cover, reduced tillage, use of crop residues or manure or compost
Improve cropland management	Agronomy, nutrient management, reduced tillage, water management (including irrigation and drainage), set-aside land, agroforestry
Improve grazing land management	Increased cover of high-productivity grasses and overall grazing intensity, nutrient management, fire management and species introduction
Restore degraded lands	Erosion control and organic and nutrient changes
Improve rice cultivation	Techniques to reduce methane emissions such as periodic drainage, intermittent irrigation and shallow flooding
Improve livestock management	Better feeding practices, dietary additives, breeding and other structural changes, improved manure management.
Agroforestry	Tree crops, integrating trees into fallow cycles, forest fragments and trees integrated into agricultural systems (e.g. silvopastoral systems).

Source: adapted from Grieg-Gran 2010

Impacts on different ethnic groups

The restriction of agricultural expansion in forest frontier areas, as may be the outcome of large scale land use planning, may have different socio-economic impacts on different ethnic groups. In the BOSAWAS reserve in north-eastern Nicaragua, research has suggested that the mestizo population would be more affected by any restriction on agricultural expansion because their livelihood and culture is more closely linked to agricultural production than other groups. In contrast, indigenous populations in the area (Miskito and Mayagnas) have traditionally relied on non-timber forest resources such as fish, meat and fruits, and have a more holistic view of the services provided by forests (MARENA 2007), making them less affected by any restriction of agricultural land use.

A reduction in agricultural production in this area may also affect the urban population as there is a relatively large informal labour sector involved in the purchase and sale of agricultural products (e.g. grain and milk products).

Local community members have suggested that in order to reduce the impacts of any potential agricultural expansion, alternative livelihood strategies that take into account the cultures of different ethnic groups are needed. Possible suggestions from indigenous communities have included greater community involvement in natural resource management, and strengthening enforcement of existing forest laws. The need to generate income from forest resources (e.g. through a PES type system) has also been highlighted as a way to diversify livelihoods while maintaining provision of other forest based services such as water and wood fuel.

This demonstrates the need to disaggregate socio-economic impacts of REDD+ strategy option by cultural groups and highlights the need for broad stakeholder participation in identifying potential impacts which may occur outside of forest areas.
Source: Olivas and Vignola (2011)

including: household specific factors (e.g. education, access to capital), technological factors (e.g. lag time between investment and realising benefits), institutional and policy factors (e.g. land tenure systems, agricultural subsidies), geographical factors (which determine suitability of technology, location relative to institutions promoting agroforestry) and how farmers respond to risk and uncertainty (Mercer 2004; Ajayi et al 2006).

3.3.1 Potential socio-economic impacts:

The socio-economic impacts of agroforestry will depend on;

i. what type of agroforestry is pursued
ii. how multiple objectives are balanced
iii. the extent to which local benefits (derived from products and services provided by this land use) for development and adaptation to climate change are achieved.

In order to maximise benefits, agroforestry systems will need to reflect unique local needs. For example in Ethiopia tree species that provide fuel wood as a bi-product are preferred (Arnold et al. 2006) and in Kenya nitrogen fixing trees and shrubs used to improve fallow cycles have demonstrated win-win outcomes of increased crop productivity and provision of fuel wood (Jama et al. 2008).

3.4 Payments for Ecosystem Services (PES)

Payments for Ecosystem Services (PES) is likely to be a useful policy instrument for areas that have been identified as REDD+ priority areas and in which agricultural expansion is to be discouraged or limited by regulation. In these areas PES may provide the necessary incentive for farmers to retain forest cover, or, if additional forest clearing is prohibited in these areas, it can be used as a way of compensating farmers for restricting their land-use options, as the Costa Rican PES scheme was (Pagiola 2008). PES schemes could also provide income to farmers to fund their adoption of new technologies that enable intensification (Pirard and Treyer 2010).

How these schemes are structured and the governance procedures used in their design will be important to ensure socially equitable and environmentally effective initiatives to conserve forests. Indeed, it is important that smallholders and subsistence farmers are able to access them, as high transaction costs and short run capital constraints have been demonstrated to preclude smallholders or poor communities participating in PES and CDM projects (Coomes et al. 2008; Miranda et al. 2003; Zbinden and Lee 2005).

3.4.1 Potential socio-economic impacts

PES schemes have the potential to create additional income streams for farmers, however their ability to benefit the rural poor will depend on the distribution of land within a country, the level of payments provided and whether they are able to fully compensate the opportunity costs of participating, and the design (including eligibility criteria) of the scheme. The contribution of PES to household income is variable, depending on the scheme and the participants, although can be substantial (e.g. for poor PES scheme participants in the Osa Peninsula of Costa Rica, PES income was the primary household cash income source in 44% of cases)(Wunder 2008; Wunder et al. 2005). PES may also create employment opportunities for people in the area in which it operates if it requires rehabilitation of degraded land or other labour intensive land management practices. Requiring retention of existing forests would however be more likely to reduce employment opportunities in PES areas (Lee and Mahanty 2009).

There are a number of ways to increase the participation of smallholders in PES schemes including bundling of contracts and targeting extension and support services (Zbinden and Lee 2005; Miranda et al. 2003). Support and extension services also build knowledge and capacity in forest or agricultural land management for participants (Lee and Mahanty 2009), providing an additional benefit of participation.

Equity in the Costa Rican PES scheme

The Costa Rican PES scheme is being adopted as a tool to implement the National REDD+ strategy. Some limitations, such as guaranteeing additionality (Sanchez-Azofeifa et al. 2007) and the effectiveness of the scheme in providing locally-relevant ecosystem services (Wunscher et al., 2008) have been raised for the Costa Rican scheme. It does however provides a useful tool for implementing REDD+, enabling conservation of globally important forest carbon stocks, as well as enhancing the provision of locally relevant ecosystem services such as water regulation and quality. Governance procedures for design of the PES and its adaptation under REDD+ demonstrate the increased inclusivity of design processes, necessary to maximise the socio-economic benefits of the scheme.

The initial stages of the design process of the PES system in Costa Rica involved a limited number of actors represented in the governance structure for the scheme, mainly associated with the central Government*. Participation in the design and adaptation of the scheme, including in the procedural and distributional aspects, has since been evolving towards a more consultative approach with broader representation. This more participatory approach has also been a result of the REDD+ readiness processes in Costa Rica.

The law establishing the PES scheme clearly outlines its equity objectives through the objective of FONAFIFO to provide incentives mainly to small and medium landowners (Art. 46, Law 7575, the Government of Costa Rica, 1996). A recent consultation as part of the FCPF process (MINAET-FONAFIFO, 2011) provided the opportunity for other stakeholders such as indigenous and peasants groups to highlight different concerns. These groups have been historically under-represented in the procedural steps as well as in the distributional outcomes of the design and functioning of the current PES system#. Their main concerns referred to tenure clarity, and distributional and procedural improvements that are required if the PES is to be adopted as a REDD+ tool in Costa Rica. For example, small and medium peasant communities highlighted the high transaction costs and lack of clear land tenure hindering the participation of peasant communities under the IDA land assignation scheme. The indigenous communities highlighted the need to include indigenous representatives in decision making processes defining criteria for the use rights of forest resources. They also indicated distributional concerns, referring to the unfair provision of incentives to non-indigenous landowners within their territories.

Source: Vignola and Morales-Aymerich 2011

* The founding law 7575 states that the FONAFIFO board will be composed by: two representatives of the private sector nominated by the Board of the National Forestry Office (a consultation platform for private sector forestry, one of the two members represents the small and medium actors), three representatives of the public sectors nominated by the Ministry of Environment, Ministry of Agriculture and the National Banking System.

\# These actors are not mentioned in the FONAFIFO founding Article 8 of Law 7575 (1996) indicating who sits in the FONAFIFO Board.

3.5 Public sector agricultural research and development

Organised public and private investment in agricultural research and development was a primary driver of the high agricultural productivity growth seen in the latter half of 20th Century. However this investment has since slowed down, despite a number of cost-benefit analyses demonstrating its value (Alston et al. 2009). As private sector investment is unlikely to provide significant improvements in livelihoods for SSS farmers (Evensen and Gollin 2003), public sector funded research and development, and extension services will be needed to do this. These will be essential to ensure that agricultural productivity grows at a rate commensurate with population growth, enabling REDD+ to be a politically feasible and realistic land use option within countries, particularly many countries in Africa where food security is already a particularly important and politically charged issue.

3.5.1 Potential socio-economic impacts:

Analysis of the Green Revolution demonstrates that although productivity gains occurred on the macro-scale, many small farmers, or those living in less favourable agro-ecological zones did not benefit and in some cases were harmed by the Green Revolution as a result of lower product prices and higher input costs (Evensen and Gollin 2003; Hazell 2002).

To ensure that future productivity gains reach SSS farmers, and that the negative socio-economic impacts experienced in some areas during the Green Revolution are avoided, concerted efforts will need to be made in public sector agricultural research and development to ensure that technologies are scale neutral i.e. that they can profitably adopted on farms of all sizes. Countries will also need to ensure that their policies do not discriminate against small farms and that farms of all sizes have access to modern farm inputs and information (Hazell 2002), likely to require targeted support and extension services.

3.6 Reform of trade and other policies that encourage agricultural production on forested land

In order to create international incentives for countries to undertake the national level land-use planning process and to provide strong national government leadership in the identification of areas for appropriate agricultural development, international trade rules which promote those products produced in 'forest friendly' areas would be beneficial. These types of trade rules or standards have occurred in the EU and US for biofuel feedstock production (discussed further in the complementary REDD-net paper on Energy and REDD+), and could potentially be expanded to include a greater portion of agricultural production. The sustainability criteria for biofuels require importers to certify the origin of biofuel feedstocks, which are not allowed to be grown on recently deforested land. A reform of agricultural subsidies, trade policy and taxation of agricultural inputs could also be used to harmonise the incentives to direct agricultural development to identified areas away from forests.

3.6.1 Potential socio-economic impacts:

As with other targeted policies that identify areas for agricultural intensification and development, in areas that are not identified as appropriate for agricultural development (e.g. forest frontier areas), agricultural employment and agricultural development opportunities will be limited by these types of policies. As the agricultural sector is a key driver of rural development in many developing countries, active stimulation of employment and growth opportunities able to co-exist with REDD+ (e.g. forest monitoring, agroforestry, forest management, NTFP, ecotourism) will be needed to mitigate the negative impacts of these policies on opportunities and livelihoods of people living in these areas.

3.7 Agricultural extension services and support

The focus for agricultural extension services will differ depending on the area and the priorities identified for that area under the national land-use planning process. In order to support REDD+ objectives it should also differ for different types of agricultural producers.

3.7.1 Commercial agriculture

To support REDD+, extension services and support (including subsidies, tax concessions, grants) should be eliminated for commercial agriculture operating in forest and forest frontier areas. This would provide a direct incentive for commercial agriculture to move or expand in areas away from forests, and would also reduce the opportunity costs of implementing REDD+ in these areas.

Support should instead be directed to assist commercial agriculture to adopt technologies that will intensify production and increase labour requirements in areas identified for this under the national land-use planning process.

3.7.2 Small scale and subsistence agriculture

Support and extension services should be maintained for SSS farmers in forest and forest frontier areas to ensure that they have to access appropriate technologies necessary for intensification and therefore ensure their food security, while also contributing to REDD+. For those smallholders who are better connected to markets, support and extension services will enable farmers to take advantage of new agricultural techniques such as agroforestry, contributing both to REDD+ as well as agricultural productivity.

Support for smallholder and subsistence farmers should also focus on assisting farmers to access PES and other support for low emissions agricultural practices e.g. climate finance, which will provide an additional income stream for them. Small and poor farmers are often not well represented in these schemes due to high transaction costs and lack of knowledge about the opportunities (Zbinden and Lee 2005; Miranda et al. 2003).

3.7.3 Potential socio-economic impacts

Agricultural extension services and support, particularly when targeted to SSS farmers is a good way to increase the uptake of new technology, improving profitability and food security of these farmers as well as overcoming capital constraints. In the absence of targeted services it is unlikely that these types of farmers will be able to access technologies to improve their productivity, and therefore would continue to rely on extensification to meet their food needs.

Targeted extension and support services are therefore vital to mitigate the socio-economic impact of potential REDD+ policies e.g. restricting agricultural expansion in forest areas, on SSS farmers and will be important for the social and political sustainability of REDD+.

3.8 Targeted transport networks

Roads and transport networks are one of the most powerful agents of deforestation, as they open up new areas, reducing transport costs and providing market access, thereby making deforesting activities more profitable (Angelsen 2010). Improving road transport in more densely populated areas away from the forest frontier can assist in intensification, contribute to economic growth in these areas and therefore also reduce outward migration to forest frontier areas (i.e. the Land Sparing Hypothesis of Maertens et al. 2006). Policies which limit road expansion in forest frontier areas, while improving transport links in those areas identified for intensification are the most supportive of REDD+.

3.8.1 Potential socio-economic impacts

Rural roads are generally argued to raise rural incomes and alleviate poverty, as they

i. increase the profitability of rural industry, the same reason that they promote deforestation as suggested by the No Land Sparing Hypothesis, and
ii. facilitate access to nonfarm employment in towns, which is often crucial to poverty alleviation in rural areas (Chomitz 2007).

A strategy which reduced investment in roads in forest frontier areas would reduce the economic development opportunities available in these areas similarly to previously discussed location-targeted policies. This could be mitigated through targeting of REDD+ revenues and active stimulation of employment and growth opportunities able to co-exist with REDD+.

Table 1: Summary of policy options with high potential to meet dual objectives of REDD+ and agriculture

Policy	Description	Potential socio-economic impacts	Political feasibility	Other policies necessary for improved effectiveness
Large-scale land use planning	Country level identification of priority areas for forests for REDD+, forests for other uses, agriculture and other land uses. Land-use plan then underpins the location specific policies described below.	Depends on the area and the outcome of the plans. Plan provides greater certainty on national land use priorities which should stimulate investment in appropriate areas.	Moderate but will need strong participation/ownership from regional levels of government for effective implementation	Inclusive and participatory process essential for community ownership of final plan.
Land tenure reform[1]	Securing property rights and tenure claims in forest and agricultural areas. This underpins other policy measures.	If customary use of land not recognised, further marginalisation of some forest users.	Moderate but will depend on political power of various interest groups.	
Intensification (Commercial agriculture)	Increasing agricultural productivity in ways that are 'climate smart' in areas away from forests. Should use labour-intensive technologies.	Rising food prices for urban consumer if intensification can't meet rising demand.	High in areas identified for intensification. Generally higher if employment opportunities are created.	Improving connections to markets in intensification areas e.g. road improvements. Restriction of extensification in forest areas.
Intensification (Small scale and subsistence agriculture)	Increasing agricultural productivity in ways that are 'climate smart' for all smallholders.	Benefits to smallholders.	High	Restriction of extensification into forest areas. Investment in public sector agricultural research and development.
Agroforestry	Use of trees in agricultural production systems	Additional bi-products which may be particularly beneficial for smallholders.	High	Support and extension services.
Payment for ecosystem services	Payments to landholders for maintenance of existing forests	Only landowners are able to benefit. Provides an additional income stream to farmers, however will not be competitive in all areas.	High	
Public sector agricultural research and development	Research and development to increase productivity of agriculture sector	If it doesn't occur, intensification technologies are unlikely to benefit smallholders	Moderate	Extension services and support for smallholders to enable uptake of new techniques.

Policy	Description	Potential socio-economic impacts	Political feasibility	Other policies necessary for improved effectiveness
Reform of trade and other policies	A reform of subsidies, taxation and trade policies to harmonise incentives to direct agricultural development to non-forest areas	Will reduce agricultural employment opportunities in forest areas.	Moderate although will depend on how much current producers are affected.	Maintenance of support for agriculture in areas identified for intensification i.e. away from forests
Extension services and support (Commercial agriculture)	Eliminate extension services and support for operations in forest and forest frontier areas	May reduce rural employment opportunities in areas where support is discontinued.	Low	Restriction of extensification in forest areas, support to commercial agriculture operating in identified intensification priority areas.
Extension services and support (Small scale and subsistence agriculture)	Services in all areas to ensure access to technologies for intensification and to assist farmers to access PES schemes or new agricultural techniques e.g. agroforesty	Benefits to smallholder farmers. Without support for these farmers the impact of REDD+ on food security is likely to be greater.	High	Restriction of extensification in forest areas e.g. access to support could be made contingent on no further extensification.
Targeted transport links	Improving transport links in areas away from forests that have been indentified for intensification and limiting road expansion in forest frontier areas	Reduce development opportunities for forest frontier areas. Increase opportunities in areas away from forests. Negative impacts could be mitigated by targeting of REDD+ revenues.	Moderate	
Extension services and support	Services in all areas to ensure access to technologies for intensification and to assist farmers to access PES schemes or new agricultural techniques e.g. agroforesty	Benefits to smallholder farmers. Without support for these farmers the impact of REDD+ on food security is likely to be greater.	High	Restriction of extensification in forest areas e.g. access to support could be made contingent on no further extensification.

1 Although land tenure reform is not discussed in this paper see Sunderlin et al. 2009 for further information on this as an underpinning policy for REDD+.

4. The way forward for REDD+ and agriculture

The importance of a nationally based, land-use planning process which is used to inform and harmonise REDD+ and agricultural policies and develop location-specific agricultural policies that are able to support the implementation of REDD+ cannot be overstated. Contrary to the optimistic view held by some agronomists, intensification will be necessary, but not sufficient, to reduce agricultural pressure on forests and assist in the implementation of REDD+. A combination of policies will be necessary for the successful harmonisation of countries' REDD+ and agriculture priorities, including the regulation of forest clearing for agricultural expansion, the reform of agricultural tariffs and subsidies, targeted support for intensification in appropriate areas, targeted support for smallholder farmers, PES and the promotion of agroforestry, as have been discussed in this paper.

The range of policy approaches that will be necessary highlights the need for extra-sectoral coordination and ownership of national level REDD+ strategies however this is occurring in very few national level REDD+ strategy development processes (Kissinger 2011), despite having been highlighted as being important for long-term effectiveness of REDD+. This paper demonstrates how important this cross-sectoral coordination is not only for effectiveness, but for considering equity in national level REDD+ policies. The harmonisation of agricultural and forest sector policies will have implications for a much larger group of people than just forest dependent communities and Indigenous Peoples, the current focus under the UNFCCC safeguards for REDD+ activities.

This paper therefore encourages countries to implement REDD+ in a much more coordinated and holistic way in order to more effectively address the drivers of deforestation, however also highlights the potential socio-economic impacts of doing this and encourages policy makers to think more broadly than the forest dependent poor when thinking about equity in REDD+.

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ABOUT REDD-NET

REDD-net is an international knowledge forum for southern civil society organizations through which they can access information about efforts to Reduce Emissions from Deforestation and forest Degradation, share their own experiences and help to build pro-poor REDD projects and policies. REDD-net is a partnership between Centro Agrononómico Tropical de Investigación y Enseñanza (CATIE), the Overseas Development Institute, RECOFTC – The Center for People and Forests and Uganda Coalition for Sustainable Development. REDD-net is funded by Norad.

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