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Agriculture and REDD+

The main driver of deforestation and a key sector for successful implementation of REDD+

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Contents

Key messages

Current knowledge surrounding REDD+ suggest most GHG emissions in tropical countries are related to direct and indirect drivers related to agriculture. This report highlights the potential of sustainable agricultural intensification and value chain efficiency to reduce pressure on forests when given the appropriate policy framework and good forest governance conditions.

While agricultural expansion has been the largest driver of tropical deforestation, global food production suffers from less than adequate corresponding growth. This suggests that agricultural value chains are still inefficient in many regions and there is large untapped sustainable intensification potential.

Synergies may exist between sustainable intensification of agricultural production, diversification of income options and climate mitigation through forest protection. The best mix of management options depends on regional and country-specific circumstances.

Clear policy and institutional frameworks are needed to enable synergetic opportunities. Agricultural intensification is not a standalone panacea. We recommend four pathways to delink agricultural production and deforestation:

1. Decouple agricultural growth from agricultural area expansion
2. Connect institutions and sectors for integrated rural development
3. Connect land users with information providers
4. Promote private sector engagement

Different levels of progress in countries engaged with REDD+ provide lessons for how to increase both agricultural production and forest protection along the four pathways described in this report. Brazil emerges as a well-documented and promising case, which provides examples for other tropical forest countries to follow.

Pineapple plantation and secondary forest, Costa Rica

German development cooperation should put a stronger focus on sustainable agricultural intensification and rural development in a holistic landscape approach in order to tackle the parallel challenges of forest protection and agricultural sector development. Entry points are suggested along the four presented pathways for further engagement in REDD+.

This study was commissioned by the GIZ International Forest Policy program (IWP) on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). As one of the world's leading enterprises for international development cooperation, GIZ implements forest-related capacity development programs in more than 30 countries and regions. Embedded in ongoing international and regional forest policy dialogues, the GIZ International Forest Policy program offers its partners holistic, process-oriented and values-led advisory services. Such inputs build on long-standing experience with and knowledge about partner organizations.
The views expressed in this report are those of the authors and do not necessarily reflect the views or policies of GIZ.

1 Introduction

The international community now faces the critical challenge of feeding an expected population of around 9 billion people by 2050 while simultaneously reducing greenhouse gas (GHG) emissions and adapting to climate change. Tropical landscapes lie at the nexus of these pressing concerns for a globally sustainable future. World food demand is projected to increase by roughly 70 percent by 2050 (EC SCAR 2011) in response to population growth combined with higher levels of per capita consumption and more animal-based diets. Sustainable agricultural intensification is critical to successfully implement REDD+ and to alleviate chronic food insecurity, which currently afflicts nearly 1 billion undernourished people. Moreover, as global GHG emissions continue unabated, climate change causes particularly negative effects on agricultural production, which then triggers increased deforestation.

The significant mitigation potential in the forestry and agricultural sectors has been recognized internationally. Agriculture as a driver of deforestation is on the agenda of the REDD+ negotiations in the framework of the United Nations Framework Convention on Climate Change (UNFCCC) in 2012. Since the UNFCCC Conference of the Parties in Durban (2011), agriculture is now considered its own sector in the climate negotiations.

Food production and the efforts to reduce deforestation are highly interconnected in tropical landscapes. Tropical forests and woodlands are the main remaining land areas available for agricultural expansion. Agriculture is the primary cause of deforestation, often preceded or accompanied by clear cutting and infrastructure development in and around forests. Furthermore, as forests are cleared to make room for croplands and pastures, burning and decay of biomass contribute to the accumulation of GHG in the atmosphere.

There are a number of publications that examine the drivers of tropical deforestation and focus on agriculture as a key sector for REDD+ implementation. The Center for International Forestry Research (CIFOR) has conducted a number of excellent studies addressing the topic at the national level, e.g. in Cameroon (Dkamela 2011), and globally (CIFOR in progress). A number of books and reports emphasize the multi-sectoral challenges surrounding REDD+ and agriculture (e.g. Angelsen et al. 2012; Chomitz 2007). The Union of Concerned Scientists published a review of the main economic drivers of deforestation, analyzing the most relevant sectors (agriculture, timber and paper industry, energy) and underlying factors in detail (Boucher et al. 2011). Much of the data for these publications and many other reports on REDD+ and agriculture are based on a series of scientific publications in the Proceedings of the National Academy of Sciences of the United States of America (PNAS 2010). Part of this analysis included an assessment of worldwide deforestation data, which concluded that “tropical forests were the primary source of new agricultural land in the 1980s and 1990s”(Gibbs et al. 2010).

This paper contributes to the international discourse by providing an overview and synthesizing current findings. We focus on agriculture as the main direct driver of deforestation, but it is important to keep in mind that other relevant sectors, such as mining, transport and charcoal industries, may also be important deforestation drivers. In some countries, these industries have strong negative impacts on standing forests, which are discussed in the respective case study chapters. We also recognize that agriculture as a sector responds to global megatrends such as a growing world population, changing diets and an increasingly globalized commodity market that replaces local demand as the primary driver of tropical forest conversion to agriculture (Macedo et al. 2012). However, these underlying causes of agricultural expansion and associated deforestation will not be analyzed here in detail.

Based on current literature, we develop an analytical framework to examine the interlinkages between forest conservation and sustainable agricultural intensification in order to identify concrete entry points for successful REDD+ implementation. The analysis is then carried out in four country case studies, where German development cooperation currently supports REDD+ implementation through technical and financial assistance. Brazil, Cameroon, Indonesia and Laos were chosen because they represent three major global deforestation hotspots while demonstrating different stages of forest transition and REDD+ implementation. Furthermore, Germany has signed bilateral agreements with these countries to support REDD+ activities.

Small-scale farmer with freshly cut oil-palm fruits, Thailand

We pose the following questions for our analysis:

1
How are forests and agriculture connected under the UNFCCC?
(Chapter 2)

2
What information regarding agriculture as a driver of deforestation exists and what are the specific regional differences in deforestation and forest degradation?
(Chapter 3)

3
How can we align agricultural production and forest protection objectives in tropical countries, given agriculture remains the main driver of deforestation, while paying specific attention to food security?
(Chapter 4)

4
What do country examples at different stages of forest transition tell us about decoupling agricultural production growth and forest loss?
(Chapter 5)

5
Which policy models for successfully addressing agriculture as a driver of deforestation emerge from the analysis of various case studies?
(Chapter 8)

2 REDD+ and agriculture in international climate negotiations

REDD+ has become the main tool for global forest conservation today (Angelsen et al. 2012) and is increasingly discussed in a cross-sectoral context, going beyond forest frontiers in order to more properly address the drivers of deforestation. The agricultural sector is not only discussed in direct relation to REDD+ under the UNFCCC, but also separately as a possible work program under the convention. The COP 17 in Durban was the first time negotiating parties agreed that agriculture is severely impacted but also considerably contributes to climate change and therefore should be discussed within the international climate change negotiations. This paper focuses solely on agriculture as part of the REDD+ discussion in the following chapters.

Political support for REDD+ in the international climate negotiations was built over more than a decade until a working group was formed in 2005. The breakthrough for REDD+ was in 2007 after the COP 13 in Bali, when the multilateral institutions of the World Bank's Forest Carbon Partnership Facility (FCPF) and the UN-REDD Programme were established for helping beneficiary countries become REDD+ ready (Pistorius 2012). The scope of the initiative widened consecutively in the following years and REDD+ gained significant importance throughout 2009, culminating in a COP decision (UNFCCC 2009). In 2010, the REDD+ Partnership Initiative was established as a global platform for organizing REDD+ activities in order to coordinate fast start finance for REDD+. At COP 16, countries agreed on REDD+ policy approaches and positive incentives, including guidance on activities and safeguards to be promoted and supported (Negra & Wollenberg 2011). In the meantime, REDD+ implementation capacity and readiness to address the multiple challenges has increased.

In addition, the Green Climate Fund was established to explore the financing options for a full implementation of results-based actions. In Durban, Parties agreed to explore new market mechanisms, which are also expected to be available for REDD+ implementation. Despite the agreement to establish the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) and the will to reach a globally binding agreement by 2015, there is still a long way to go for a robustly financed REDD+ mechanism.

Numerous questions regarding REDD+ remain, including how to effectively channel payments through national institutions to land users in order to incentivize and compensate for opportunity and transaction costs. One of the greatest remaining challenges in the continuously evolving REDD+ agenda is how to address the drivers of deforestation, which typically originate from outside forests.

Many UNFCCC submissions from governments and observer organizations concerning REDD+ have stressed the need to look beyond the forest sector in order to properly address the way other sectors drive deforestation. For example, the EU pointed out, "given the importance of rural development, food security, mitigation and adaptation in the agricultural sector and of agricultural expansion as a driver of deforestation, the implications of REDD+ implementation should be considered from a broad perspective" (EC 2012). It is crucial to understand the relationship between forests and the sectors that drive deforestation and forest degradation in order to reduce emissions and achieve development objectives. The current state of knowledge asserts that agriculture is the most important of these driving forces.

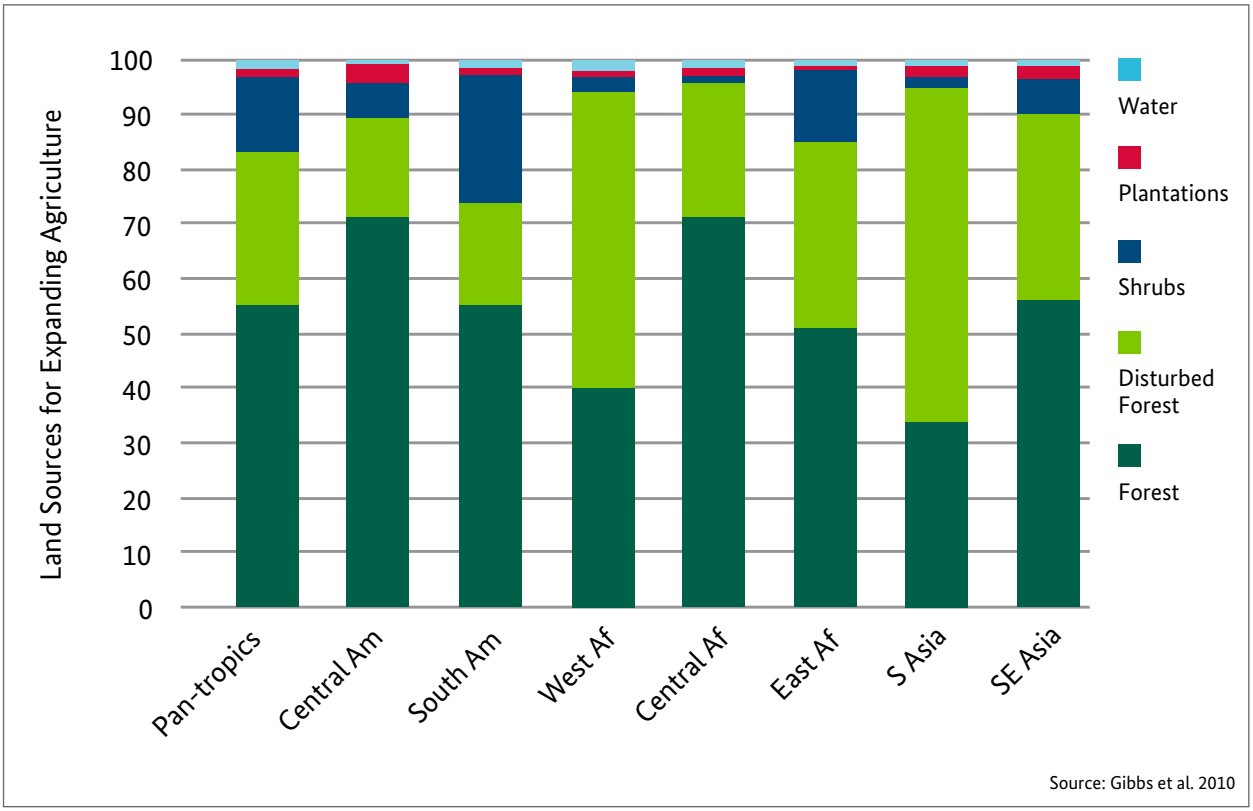
3 Agriculture as the main driver of deforestation

Around 31 percent of global GHG emissions originate from agriculture and forestry (IPCC 2007), with large variation across ecological zones. While land-use related fires constitute over 35 percent of all emissions in tropically forested countries, in the rest of the world they are below one percent. The same goes for methane (livestock and rice cultivation) and nitrous oxide (fires, fertilizer, manure) emissions, where shares in overall emissions of tropical countries are far above shares in the rest of the world (DeFries & Rosenzweig 2010). Despite low per capita emissions so far, developing country emissions are expected to grow at a more rapid rate than elsewhere.

In contrast to industrialized countries and temperate zones, where mitigation potential lies mostly in the energy sector, the substantial contributions from the tropics suggest that tropical landscapes have an enormous land use based mitigation potential.

Despite technical advancements in some regions, on a global scale, the most important direct driver of deforestation remains agricultural expansion for food and energy production (FAO 2010; Rademaekers et al. 2010). The origin of new agricultural land was predominantly primary and secondary forest in different ratios depending on the region up until 2000 (Gibbs et al. 2010, Figure 1). Agricultural subsectors with the largest impact vary between continents: cattle and soy are important only in Latin America, while the expansion of palm oil plantations, predominantly in Indonesia and Malaysia, drove much of the deforestation in South East Asia. In Sub-Saharan Africa, where deforestation rates remain low to medium, smallscale subsistence agriculture continues to be the dominant deforestation driver (Boucher et al. 2011).

Figure 1: The origins of new agricultural land 1980-2000



There are some overarching factors that have driven deforestation and forest degradation in tropical regions worldwide. Until the late 1980, government policies incentivizing the colonization of forested land (e.g. through cheap land sales, infrastructure development) were the main force behind deforestation. These policies triggered new settlements and fostered shifting cultivation among smallholders in forested areas. A number of reinforcing loops then accelerated deforestation: further infrastructure developments provided better access to markets, high population densities and rising incomes boosted demand and capital accumulation (Angelsen et al. 2009). Since the turn of the century however, large commercial agricultural (and in some cases timber) enterprises – not subsistence farmers – are the principal agents of tropical deforestation (UCS 2010). Globalized demand for commodities such as palm oil, soy, beef and biofuels is increasingly replacing local demand as the primary driver of forest conversion (Macedo et al. 2012).

INFOBOX | **Bioenergy**

Although conclusive evidence regarding the direct impact of bioenergy development on global deforestation levels is not available, regional and hotspots assessments have demonstrated the link between expanding bioenergy production and deforestation (Gao et al. 2011). There is general consensus that biofuel production "can trigger a number of negative environmental and socio-economic impacts, for instance by putting pressure on key resources such as land and water," if not managed properly (FAO 2012a). The FAO has developed a set of indicators to assess the risk of negative impacts of bioenergy development on food security. The price and supply of a national food basket; land use and land-use change related to bioenergy production; allocation and tenure of land for new bioenergy production; and the development of energy infrastructure may have positive or negative effects on the four dimensions of food security: availability; access; utilization, and stability (ibid.). But they may also directly or indirectly influence forest conversion.

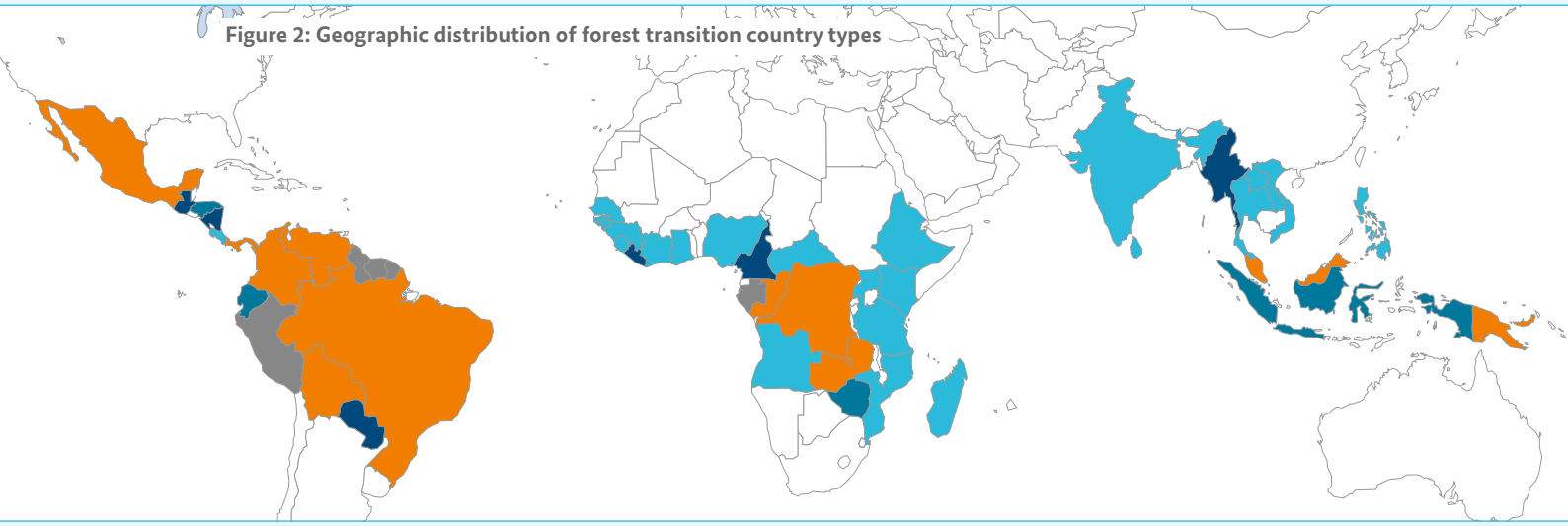
In this study, we treated bioenergy production as a subsector of agriculture with no separate analysis criteria. Crops for bioenergy, for instance, are included in the area expansion analyses of the case studies. The suggested pathways to delink agricultural production and deforestation also apply to the biofuel sector.

According to the forest transition theory (Mather 1992), two forces eventually stabilize forest cover. First, economic development leads to better paid, off-farm jobs and reduces the agricultural rent and the profitability of deforestation. In a second step, scarce forest cover increases forest rent (the value of forest products and environmental services) and slows down forest conversion (Rudel et al. 2005).

Figure 2 shows a categorization of tropical countries according to the five stages of forest transition (Angelsen et al. 2009):

- Stage 1: High forest cover, low deforestation rates (HFLD)
- Stage 2: High forest cover, high deforestation rates (HFHD)
- Stage 3: Low forest cover, high deforestation rates (LFHD)
- Stage 4: Low forest cover, low deforestation rates (LFLD)
- Stage 5: Low forest cover, negative deforestation rates (LFND)

Figure 2: Geographic distribution of forest transition country types



CLUSTER 1: HFLD

1 Belize
2 French Guiana
3 Gabon
4 Guyana
5 Peru
6 Suriname

CLUSTER 2: HFMD

7 Bolivia
8 Brazil
9 Colombia
10 Congo
11 Congo, DRC
12 Malaysia
13 Mexico
14 Panama
15 Papua New Guinea
16 Venezuela
17 Zambia

CLUSTER 3: HFHD

18 Cambodia
19 Ecuador
20 Honduras
21 Indonesia
22 Solomon Is.
23 Zimbabwe

CLUSTER 4: MFMD

24 Cameroon
25 Equatorial Guinea
26 Guatemala
27 Liberia
28 Myanmar
29 Nicaragua
30 Paraguay

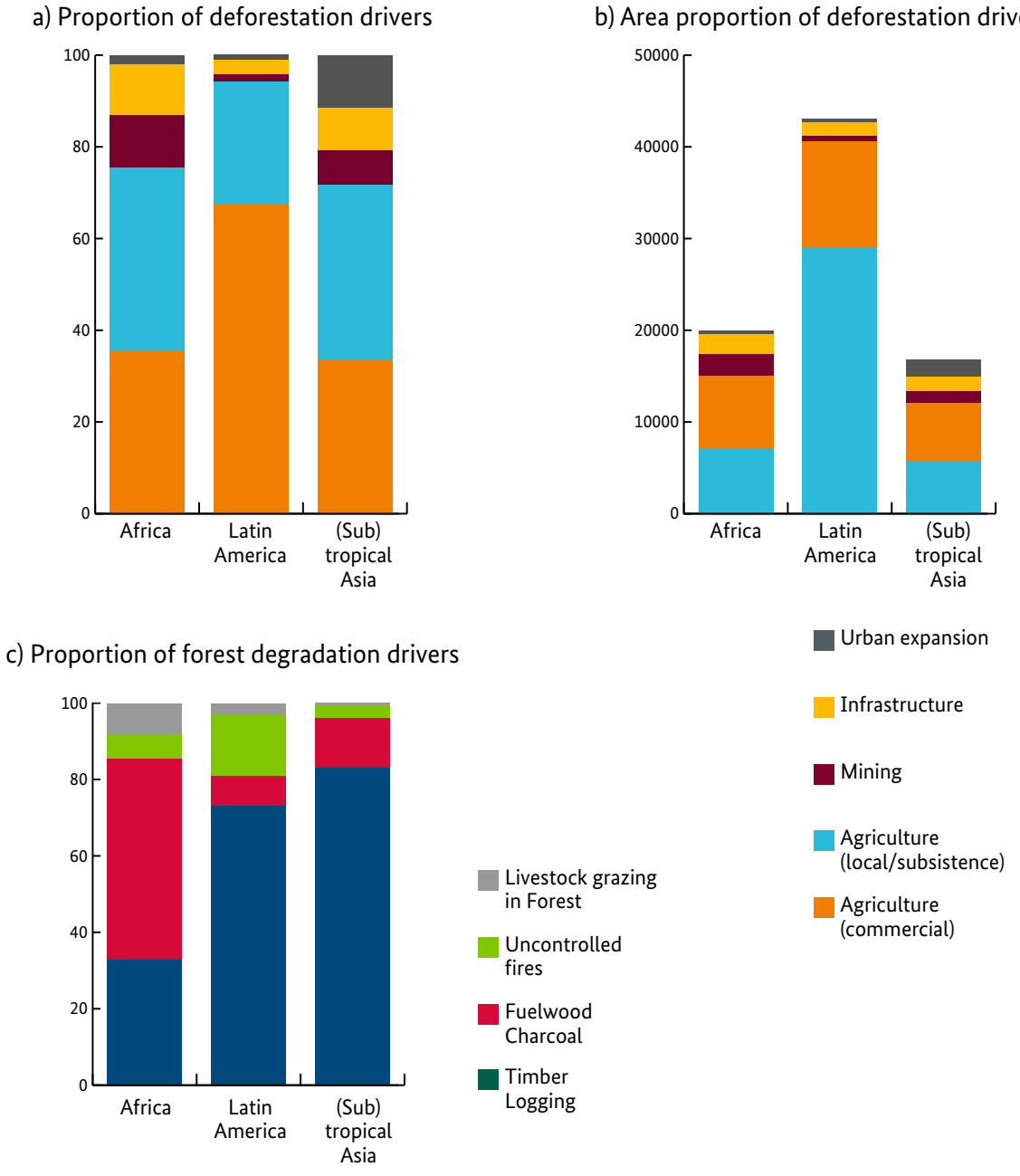
CLUSTER 5: LFLD

31 Angola
32 Central African Republic
33 Costa Rica
34 Cote d'Ivoire
35 Cuba
36 Dominican Republic
37 El Salvador
38 Ethopia
39 Ghana
40 Guinea
41 Guinea-Bissau
42 Haiti
43 India
44 Kenya
45 Laos
46 Madagascar
47 Mozambique
48 Nigeria
49 Philippines
50 Senegal
51 Sierra Leone
52 Sri Lanka
53 Tanzania
54 Thailand
55 Uganda
56 Vietnam

Source: Griscom et al. 2009

Given these differences and the fact that some regions are endowed with more biologically-diverse forest ecosystems than others, current deforestation levels are usually analyzed in three hotspot (Rademaekers et al. 2010): Latin America and the Caribbean, Sub-Saharan Africa and Pacific Asia (see Figure 3).

Figure 3: Continental-level estimations of the importance of deforestation drivers



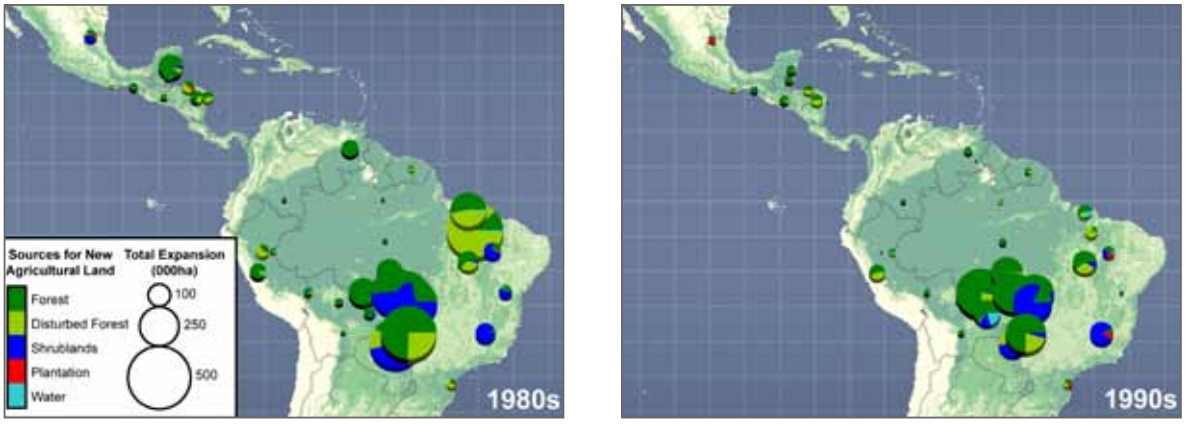
Source: Hosonuma et al. 2012; drivers as reported by 46 countries (a), the same data shown in terms of absolute net forest area change (km2/y, (FAO 2010) for the period 2000-2010 (b), and for continental estimations of relative importance of degradation drivers (c).

Latin America

Latin America has the largest tropical forest area in the world, and has also been the world leader in terms of forest clearing over the last 30 years, with about 22 million hectares cleared between 2000 and 2005. It thus holds just under half of all tropical deforestation during that period (Rademaekers et al. 2010). While tropical forests stretch from Mexico in the north to Paraguay in the south, the vast majority of Latin American forests are located in the Amazon Basin, mostly in Brazil. This country is such a dominant player that from 2000 to 2005, it accounted for three-fourths of deforested areas across all of Latin America (ibid).

To a large extent, forest conversion has been caused by the expansion of large-scale pasture lands, which increased by 35 million hectares and contributed to 80 percent of deforestation in the Amazon, while cropland expanded by 5 million hectares (FAOSTAT 2012). Sugarcane and soybeans were responsible for the majority of the cropland expansion. The largest amount of additional agricultural land throughout Latin America came from intact tropical forests and disturbed forests, with the area taken from intact forests increasing by 13 percent from the 1980s to the 1990s (Gibbs et al. 2010, Figure 4).

Figure 4: Sources of newly expanded agricultural land in tropical South America



Source: Gibbs et al. 2010

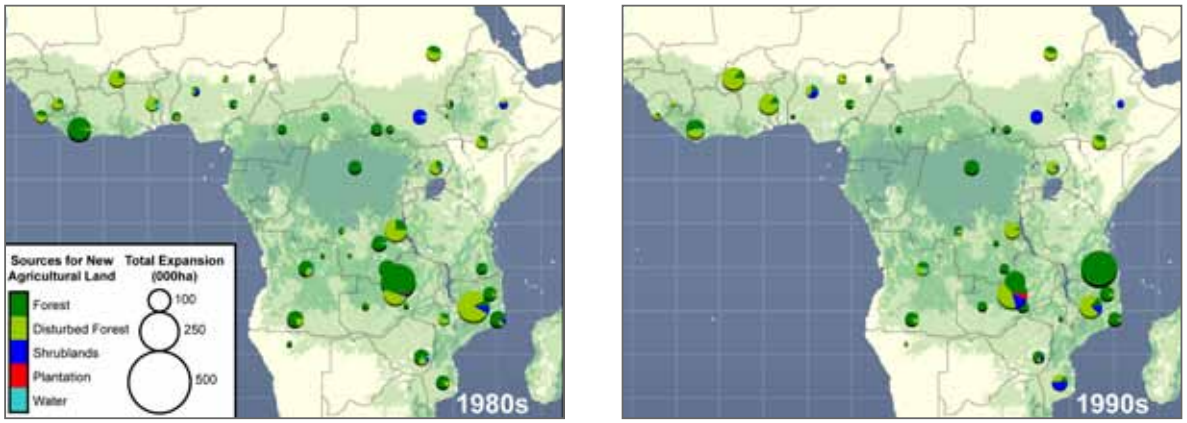
Sub-Saharan Africa

Africa has the second largest expanse of tropical forests, and some of the lowest deforestation rates. From 2000 to 2005, about 11.5 million hectares of forest were cleared in tropical Africa (Hansen et al. 2010). Sudan, Zambia, Tanzania, Nigeria, and the Democratic Republic of Congo (DRC) had the largest areas of deforestation (Rademaekers et al. 2010). However, most of these countries are covered by dry forest and savanna (DRC is the exception). Due to the lower carbon density, they contribute relatively little to global warming.

Africa has less cropland than the other regions, comprising only 13 percent of the global harvested area. In East and West Africa however, cropland area increased by approximately 50 and 25 percent respectively during the last 30 years. In Central Africa, the total cropland area declined during this period despite favorable biophysical conditions for large-scale expansion. The most important staple crops are often produced in subsistence farming systems with small plots, including sorghum, maize, millet, cassava, groundnuts, rice, and yams (Gibbs et al. 2010).

Unlike Asia and Latin America, African deforestation remains dominated by smallscale processes, not by large-scale globalized agriculture (DeFries & Rosenzweig 2010; Fisher 2010). This is due to in part weak governance and limited infrastructure, as well as the low level of industrialization in agriculture (Rudel et al. 2005). Throughout Africa, nearly 60 percent of new agricultural land was derived from intact forests, and another 35 percent came from disturbed forests. However, land sources varied considerably across the continent (Gibbs et al. 2010, Figure 5).

Figure 5: Sources of newly expanded agricultural land in tropical Africa



Source: Gibbs et al. 2010

Given that demand continues to grow for products that have driven deforestation in other regions, there is particular concern that deforestation rates will significantly increase in African countries where deforestation remains low and forest cover is relatively vast (i.e. HFLD countries).

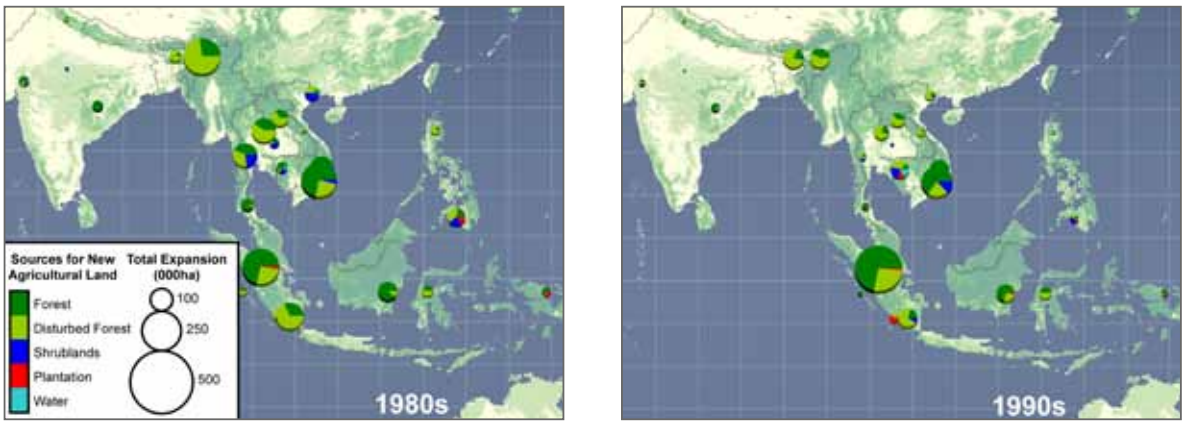
Pacific Asia

While Asia has the smallest extent of tropical forest, it has the highest population densities in forested areas and some of the world's highest deforestation rates (Chomitz 2007). From 2000 to 2005, it had the highest percentage of its tropical forests cleared of any region at around 2.9 percent per year (Hansen et al. 2008). The largest share of current deforestation in Asia is occurring in Indonesia, which cleared about 3.5 million hectares of forest between 2000 and 2005 (Hansen et. al 2010). In fact, Indonesia and Brazil combined made up about 60 percent of the forest cleared throughout the humid tropics over that period (Hansen et al. 2008). Malaysia, Cambodia, and the Philippines also experienced large amounts of deforestation during that time (Rademaekers et al. 2010).

Southeast Asia relied on intact forests for nearly 60 percent of new agricultural land and on disturbed forests for more than 30 percent. Southern Asia depended on disturbed forests for 60 percent of new land and on intact forests for only 35 percent (Figure 6). However, geographic patterns of land conversion were highly variable throughout the region, with new agricultural land coming from several sources in most locations (Gibbs et al. 2010).

Much of the forest conversion across tropical Asia was driven by large-scale agricultural and timber plantations. The area of tree plantations in Southeast Asia grew from roughly 11 million to over 17 million hectares between 1980 and 2000 (FAOSTAT 2012). These plantations include palm oil, rubber, coconut, and pulp fiber and timber. While rice and rubber still dominate continental Southeast Asia, palm oil and timber are the prevailing types of plantations on the Southeast Asian islands (Gibbs et al. 2010). Palm oil, rubber, and coconut accounted for 20 to 30 percent of all cultivated land, and palm oil was responsible for 80 percent of expansion of Asian plantations in the 1990s (Rademaekers et al. 2010). Indonesia and Malaysia are the world's largest producers of palm oil, producing around $5 billion each year (UCS 2010).

Figure 6: Sources of newly expanded agricultural land in tropical Asia



Source: Gibbs et al. 2010

Oil-palm plantation, Indonesia

4 Key principles to align food security and forest protection in tropical countries

As agriculture increasingly is recognized as the main driver of deforestation, REDD strategies must properly account for food security. Commercial agriculture feeds urban and globalized demand, while at the national level, food security in the REDD context is particularly important for smallholders at the forest frontier, who depend on local production. Strategies for sustainable agricultural intensification should take these differences into account.

Forest protection and efforts to reduce agricultural expansion may lead to increases in food prices and therefore exacerbate national and global problems of food security. Addressing agricultural drivers may have negative impacts on national and local populations unless the differences between smallholders and commercial agriculture are properly taken into account.

Moreover, increases in agricultural outputs do not necessarily imply an equitable distribution of these goods. Therefore, a focus on food security, which assesses the various dimensions of agricultural production, is employed in this analysis. The FAO defines food security as follows:

> *"Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."*
>
> -1996 World Food Summit (FAO 1996)

From this definition, four main dimensions of food security can be identified:

INFOBOX | **The four dimensions of food security**

Availability	supply side of food security determined by level of food production, stock levels and net trade
Access	household level food security determined by incomes, expenditure, markets and prices
Utilization	sufficient energy and nutrient intake by individuals determined by good care and feeding practices, food preparation, diversity of diet and intra-household food distribution
Stability	Stability of other three dimensions over time Determined by weather conditions, political circumstances, economic factors (employment, food prices)

Source: FAO 2008

Increasing agricultural production addresses only two of the dimensions of food security: food availability and to some extent stability and this report's focus is limited to these two dimensions. Increased agricultural output and production efficiency might be preconditions of food security in many countries. But it is important to keep in mind that individual food security, especially in marginalized parts of society, will not be guaranteed per se without accompanying measures that ensure all above dimensions. Particularly in the context of REDD+ countries, smallscale subsistence farmers operating at the forest frontier often live on the margins of food security and efforts to reduce deforestation without providing extension services adapted to their needs could have immediate negative impacts on their livelihoods.

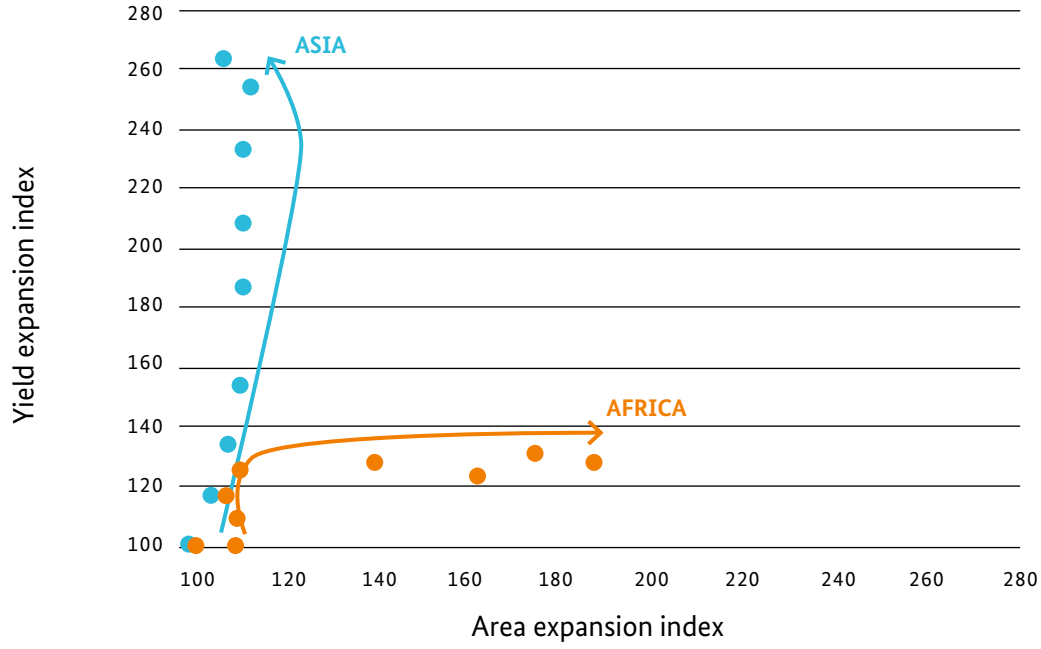
Although deforestation, i.e. the conversion of tropical forests to agricultural land, continues globally, positive developments in many developing and transitioning countries have recently come to light. Both Brazil and Indonesia, which had the highest net loss of forest in the 1990s, have significantly reduced their deforestation rates. The amount of forest converted to other land uses was around 13 million hectares each year in the last decade compared to 16 million hectares per year in the 1990s (FAO 2010).

Some overarching patterns become evident when observing the promising cases of economic development reconciled with natural resource protection. State-of-the-art scientific findings and practical experiences can be boiled down to four interlinked principles of successfully addressing agriculture as the main driver of deforestation and implementing REDD+ in light of this. These four principles are described below and will further serve as the analytical framework for assessing the progress towards aligning food security and forest protection in the four selected case study countries (Chapter 6).

4.1 Decouple agricultural growth from agricultural area expansion

Increasing agricultural outputs often correlates with agriculture area expansion and the trade-offs between agricultural intensification and forest protection highly depend on political commitment and effectiveness of policy implementation. With the political will of governments and effective governance, agricultural intensification can even stimulate expansion and increase deforestation. The correlation between growth in agricultural outputs and area expansion is highly context dependent. For example, increasing local profits may stimulate deforestation (Angelsen 2010); demand elasticity may prevent reduced level of deforestation (DeFries & Rosenzweig 2010). Figure 7 below shows how the so-called "Green Revolution" in Asia resulted in yield increases mainly induced by more fertilizer use, whereas in Africa the small increases in food staples were largely achieved by expanding the cultivated area. However, the Green Revolution in Asia was also associated with many unsustainable land use practices, such as overuse of synthetic fertilizer and ground water reduction, and it is important to keep in mind that intensification also results in fertilizer-related emissions (ibid.).

Figure 7: Evolution of cereal production in Asia and Sub-Saharan Africa



Source: FAOSTAT as cited in World Bank 2007

Sustainable agricultural intensification techniques, including certain conservation agricultural practices, often exist but financial and knowledge-related barriers prevent their wide-scale adoption. In REDD+ countries, there is considerable intensification potential in both commercial large-scale enterprises and smallscale family agriculture. However, this intensification must be sustainable and should prioritize strategies that ensure intensification without expansion into forest areas. Considerable differences exist between smallscale subsistence and large-scale commercial agriculture, which are outlined below.

Commercial farms should be directed to intensify in areas outside the forest, applying labor intensive methods that enhance productivity and provide employment in agricultural processing and value-adding. Especially in the context of large-scale agriculture, the following sustainability criteria should be considered:

- reclamation of marginal and degraded land or land with low carbon stocks
- soil improvement programs
- moving away from the forest frontier
- sustainable intensification of extensive land uses

Subsistence farmers on the other hand can increase and diversify their incomes and to be more food secure through measures such as agroforestry, which is likely to compensate for restricted area expansion, especially if they dwell in forest frontiers.

Sustainable intensification options do not stop at the farm gate. Agricultural value chains from input production all the way to the final consumer provide intervention points to increase production efficiency and lower emissions per unit of agricultural output. Global nitrogen-use efficiency for example is generally below 50 percent and can be increased by better fertilizer types, placement and timing (Reay et al. 2012). After leaving the farm gate, a lot of resources in developing countries are wasted in the form of food losses, mostly during the early and middle stages of the food supply chain. While per capita wastage is a lot higher in industrialized countries, the causes of food loss in low-income countries are mainly connected to limitations in harvesting techniques, storage and cooling facilities in difficult climatic conditions, infrastructure, packaging and marketing systems (Gustavsson et al. 2011).

Roughly one-third of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tons per year (Gustavsson et al. 2011). This means huge amounts of food production resources are used in vain and that GHG emissions caused by food production have significant mitigation potential (ibid.). Along with interventions in early and medium sections of agricultural values chains, reductions in food loss and waste at the consumption stage can reduce avoidable emissions. One example is the dairy sector, which constitutes a large proportion of avoidable food waste. Studies suggest that interventions in industrialized countries with the goal of altering consumer behavior (e.g. smaller purchasing units, servings, consumption volumes) have the potential to lower agricultural emissions (Reay et al. 2012). Furthermore, very substantial global emissions reductions seem possible by addressing distribution and consumer-phase wastage (Gustavsson et al. 2011).

In summary, agricultural output can be enhanced by efficiency increases in the following areas:

- **Sustainable crop- and pastureland management (sustainable land management and nutrient applications):** The most promising cropland mitigation practices are input-based; using a combination of organic and/or synthetic fertilizer, soil and water conservation or irrigation, extending crop rotations including cover crops, green manure and agroforestry and increased cropping intensity by introducing more than one crop per year and/or yields on existing agricultural land. Better pastureland management and advanced livestock management practices to increase grazing productivity and soil carbon sequestration may involve seeding fodder grasses and legumes and often require temporary de-stocking to align the quantity of animals with the grassland carrying capacity. Livestock management includes better feeding practices (e.g. food additives), animal breeding, marketing and value-adding activities, and veterinary services.
- **Reducing losses along the value chains:** Investments with the goal of moving actors dispersed along value chains closer together usually reduce losses that occur between harvesting and final consumption. Collective marketing and storage facilities for farmer groups, processing structures, such as cooling chains, infrastructure development and transport networks connect the two ends more efficiently.

- **Demand-side measures:** Regulatory interventions, such as removing subsidies or tariffs can de-incentivize unsustainable agricultural production and the consumption of unhealthy commodities. Sustainable procurement policies, possibly linked to voluntary certification schemes, can also influence consumption. Unsustainable consumer behavior can be addressed by promoting educational campaigns, school feeding programs and better consumer information.

Table 1: Analytical criteria for agricultural efficiency

Criteria	Sources and scores	Rationale for inclusion
Forest loss and agricultural expansion How has the deforestation rate developed in comparison to agricultural area expansion and output? How efficient is production in main agri-subsectors?	• Literature review • Statistical analysis of forest cover decline, cereal production and area development (FAOSTAT 2012)[1]	Cereal production and area development as a proxy for overall agricultural production efficiency. Cereal chosen due to global data availability not because it is regarded major driver of deforestation.
Value chain efficiency How have post-harvest losses and food waste developed?	No country specific data was available here; regional estimates used (Gustavsson et al. 2011)	Value chains contribute a high share of overall production efficiency; efficient value chains can increase available amount of food dramatically.
Food Security What is the availability of food?	EIU's food security index	This assesses the sufficiency of supply, agricultural infrastructure, volatility of production and political stability.

4.2 Connect institutions and sectors for integrated rural development

Di Gregorio et al. (2012) analyzed the political context in which REDD+ strategies evolve in seven different countries and this study concluded that factors constraining transformational change are determined by the interplay of the institutional arrangements, past policies and consolidated interests in sectors driving deforestation and forest degradation. Since agriculture is the major driver of deforestation in most tropical countries, one first needs to identify the policies enabling or hindering REDD+ objectives in the forestry and agricultural sectors.

Adverse policies that support drivers of deforestation and related institutional arrangements include tax regimes, such as tax breaks for biofuels and plantation development in Indonesia and rural credit provisions for cattle ranching in Brazil. Research shows that supported intensification, lower access costs to new lands through public funding for infrastructure development and other incentives, such as agricultural subsidies, may increase deforestation (Angelsen 1999).

1 We use cereal production as a proxy considering that related data is relatively robust other indices that can be used are crop production index, food production index, livestock production index (http://data.worldbank.org/indicator/AG.PRD.CROP.XD/countries) all based on FAO data.

Enabling REDD+ policies, on the other hand, include payments for environmental services; forest regulations that foster sustainable forest management; conservation, reforestation and afforestation initiatives; and government expenditures that aim to increase energy efficiency and provide alternatives to forest products (di Gregorio et al. 2012). More generally, intersectoral policies are needed at national and local levels in order to address climate change in both agriculture and forestry using a landscape approach. This can only happen by strengthening the often-weak coordination and collaboration between various ministries and implementing bodies. National climate change adaptation measures, mitigation strategies and action plans are one way to build linkages between REDD+ and agriculture. Landscape development approaches should include food security, livelihood improvement and forest protection measures beyond the farm gate and forest frontier.

The European Commission, for example, is stressing the concept of land as a scarce resource in its latest bioeconomy strategy (EC 2012). In order to account for land-based ecosystem services, which range from crops to fresh water to climate change mitigation and adaptation, and properly take landscape level effects and connectivity into account, trade-offs between different land uses, such as food and biofuel production need to be better balanced in the future. The provision of alternative employment and income opportunities reduces pressure at the forest frontier (Angelsen 1999), as does the inclusion of trees in agricultural landscapes. Trees outside forests deliver ecosystem and livelihood services that are significant at the global scale, predominantly in areas where forests and farmland meet (Zomer et al. 2009). These results suggest landscape planning must aim to achieve a spatial delinking of remaining forests and intensive production areas (Angelsen 2010), mixed systems in transition zones and integrated sectors for off-farm and out-of-forest employment across geographic boundaries.

The key for translating policy frameworks into implementation is an integrated land-use planning approach. To achieve conservation and development goals simultaneously, the principles of ecological-economic zoning should be taken into account. This means policy makers should consider socio-economic factors (as opposed to only physical factors and crop production) and a wider range of land uses when designating areas for agricultural production, development activities, protected areas or buffer zones.

In order to get all relevant actors on board, the planning process needs to be inclusive, integrated and informative. Inclusivity involves the participation of multiple stakeholders during the entire planning process and must incorporate consultations before the final stages of planning. Local community participation begins with tenure systems that formally recognize customary use rights and traditional ownership, which can be further secured by including them in the REDD+ design and forest-zoning processes. Unless the perspective of forest-dwelling communities (which are most likely to be disproportionately impacted by deforestation) is properly taken into account, any REDD+ policy will be inadequate to address the full spectrum of deforestation and degradation drivers. The more inclusive policy processes are, the more likely REDD+ policies will include considerations about equity and the less likely potential tensions and open conflicts will occur among policy actors and stakeholders later on. Inclusiveness in policy processes is affected by the type of political regime and by its degree of centralization. Di Gregorio et al. (2012) use democracy indices and the degree of centralization of the political system as proxies for inclusiveness, assuming that the inclusiveness of political regimes will likely impact the inclusiveness of specific policy processes, including REDD+.

Another issue is land tenure. Eighty percent of forests worldwide are in public hands (FAO 2010), whereas the situation of farmland ownership is reverse in most countries. This discrepancy is an indicator for ownership transitions that occur when forests are cleared for agricultural expansion and are therefore transferred from the public to the private domain. Converting forests is often the only means to acquire productive land for agricultural uses on a subsistence or commercial level.

Pasture, Costa Rica

INFOBOX | **The role of subsistence farmers in land transitions**

Experience from Indonesia exemplifies the multiple roles that smallscale farmers may play at forest frontiers in global deforestation hotspots. In a community forest area in Central Kalimantan, village dwellers depend on dry rice cultivation and derive much of their protein sources, as well as other non-timber forest products, from the surrounding communally-protected forest. A large palm oil plantation developer now plans to expand into the agricultural areas used by villagers. Although this step is legal under current legislation (because the agribusiness is not deforesting), the villagers would have to move their current cultivation area into surrounding forests, thus increasing deforestation rates all the same.

In similar processes worldwide, farmers on forest edges are forced by large-scale agricultural expansion to move subsistence production into woodlands, unintentionally becoming direct drivers of deforestation. On the other hand, smallholders may take advantage of such situations by selling already cleared areas to businesses for short-term income gains.

Source: Lang & Dotzauer 2012

Once land is converted to an agricultural area, it is exposed to different dynamics as regards ownership distribution. In Brazil for example, an estimated 1 percent of the population owns 45 percent of all land and nearly five million families are landless. At the same time, there are about one million square kilometers of uncultivated land in the country (USAID 2012). Policies need to recognize and address this issue, first to ensure the land rights of communities living in or in close proximity to forest areas, potentially reducing the need to deforest; and second to assure that each agriculture-dependent family has secure land tenure and the right to food security.

In order to provide incentive structures for REDD+, it is essential that the state not only offers enabling policies and ensures inclusivity of the policy process, but also holds a sufficient level of autonomy from the economic actors driving deforestation (di Gregorio et al. 2012). Many countries face challenges in the application of forestry laws, in particular at the local level where patron–client networks dominate, e.g. in Cameroon (Dkamela 2011). In other cases, powerful agribusinesses, private landowners and companies constantly put pressure on governments to protect their sources of rents. This is exemplified by the attack from business interests on the Brazil Forest Code and the Indonesian Forest Moratorium.

Table 2: Analytical criteria for agricultural efficiency

Criteria	Sources and scores	Rationale for inclusion
Hindering and enabling policies Which policies clash with REDD+ aims? (e.g. do tax regimes, agricultural development plans, etc. favor unsustainable agricultural production?)	• Literature review • Expert interviews in case study countries	General overview of the policy environment enabling REDD+
Which policies support REDD? (e.g. does the country have a cross-sectoral climate change strategy or action plan? Are there cross-sectoral land use planning processes in place?)	• Literature review • Expert interviews in case study countries	General overview of the policy environment hindering REDD+
Horizontal/Sectoral inclusion Which ministries are involved in the REDD+ process? Which ministries are involved in the agricultural sector development plans?	• Expert interviews in case study countries • Revision of R-PPs or UN-REDD National Programme Documents	Ministry involvement in REDD+ and agriculture as a proxy indicator for cross-sectoral cooperation.
Vertical inclusion How inclusive is the overall policy regime?	• Democracy index from 0=authoritarian regime to 10=full democracy (The Economist 2011) • Level of centralization (di Gregorio et al. 2012)	Democracy index and level of centralization as a proxy for REDD+ process inclusivity; the more advanced a democracy and the more decentralized a state, the higher is the likelihood for an inclusive policy process.
Equity How is forest and agricultural property divided?	• Percentage of forest under public ownership (FAO 2010); • Gini concentration index of agricultural holdings from 0=equal to 1= totally unequal (USAID 2012) • Arable land per capita in ha	Forest and land distribution as proxies for equity and degree of property transformation from forest to agricultural land.
Food Security How affordable is food?	• EIU's food security index	This includes food consumption as a share of household expenditure, proportion of population under global poverty line and the presence of food safety nets

4.3 Connect land users and information providers

TResearch and extension are the prerequisites for sustainable intensification. However, information is either lacking or not well-distributed to actors in both the agriculture and forest domains, with large variations across commodities and regions. Bottom-up information flow (that includes stakeholders in policy processes and recognizes them as knowledge providers rather than recipients) remains in infant stages in many countries. Although investments in agricultural research and development demonstrate very high rates of return, agricultural science remains grossly underfunded, especially in developing

countries (World Bank 2007). This is due to the fact that funding for research mainly comes from the public sector. Spielman & Birner (2008) provide an overview of public spending on extension services (p.30). These authors point out that not only the quantity, but also the quality of extension services must be taken into account, e.g. whether sustainability concerns are included in extension services.

Private funding is limited due to a lack of financing opportunities and incentives for private research, as well as uncertain returns to investments. Privately financed research usually focuses on soya, palm oil and other highly profitable commodities with very limited knowledge transfer to smallscale farmers.

The lack of private sector engagement in research and development (R&D) often results in the non-commercialization and up-scaling of innovations. A fund could fill this void by attracting private sector capital to invest in agricultural mitigation and adaptation innovations designed to meet multiple social and environmental objectives. These include smallscale irrigation technology to increase biomass production and soil carbon sequestration, precision farming technology that enables more efficient fertilizer application, and carbon monitoring systems that are simple, cost-effective and locally managed by private sector entrepreneurs.

Experience shows that targeted agricultural research efforts are needed to generate knowledge and technological spillover to farmers, which in turn increases production efficiency. But science-driven, linear research-extension-farmer approaches cannot do it alone. To improve the efficiency and effectiveness of agricultural R&D, sources of innovation need to be interlinked with developers, disseminators and users of technology in non-linear knowledge networks, ideally including private sector players. New kinds of extension systems can make use of international and regional R&D partnerships such as CGIAR or FONTAGRO (regional funds for agricultural technology development in Latin America), which competitively allocate grants to research and extension organizations of participating countries. These large networks create economies of scale for the research sector, which typically implies high fixed costs, putting small countries at a disadvantage. Public-private partnerships are another option. Worldwide, catalytic funds are evolving that trigger private finance to invest in agricultural value chains and link producers to high-value supply chains with knowledge, technology and infrastructure development generated by agribusinesses (Palmer 2011).

In the forestry sector, government leadership in data provision and dissemination might be more feasible and necessary in order to monitor, coordinate and control actors of deforestation. Methods for improving the detection and quantification of deforestation, forest degradation and the associated GHG emissions in critical areas should be tested, refined and institutionalized. Modern remote-sensing technologies and geospatial approaches should be used, balancing cost-effectiveness and precision. A further focus of interventions should be national-level capacity building for supporting forest monitoring and carbon accounting agency that can then make this information freely available.

Information provision strongly correlates with the inclusion of various actors in the policy process (see 5.1.). The case of Tanzania shows how information on REDD+ can successfully channel both bottom-up and top-down process, engaging a wide range of stakeholders (Rantala 2012). In this case, the government-led REDD+ Task Force has welcomed contributions by civil society, research institutions, local governments and international partners to support national REDD+ strategy development. While formal workshops and training were included, the most successful policy-influencing entry points were advocacy coalition-building within and outside of government as well as subtle diplomacy with individuals high up in the line of command across different sectors. There was also considerable consensus regarding the need to showcase real local success stories in order to convince policy makers.

Public awareness of the REDD+ policy process and agricultural planning procedures are also key elements of effective information flow. Di Gregorio et al. (2012) did a media analysis in order to assess the extent to which national state and non-state actors are active in shaping the REDD+ policy discourse. They argue that media participation may reflect the degree of ownership of the REDD+ policy process by different stakeholders. This analysis is used in this study.

Table 3: Analytical criteria for information provision

Criteria	Sources and scores	Rationale for inclusion
Agriculture		
Public expenditure on agricultural R&D Total expenditure and expenditure as share of agricultural GDP; if number not available: public expenditure on agriculture as share of GDP	Statistical analysis of Agricultural Science and Technology Indicator database (ASTI 2012)	Public expenditure on R&D as proxy indicator for the significance of agricultural research and extension.
Key trends in agricultural research Information on the research system, staff, funding, etc.	Literature review	Efficient R&D is seen as a prerequisite for sustainable intensification.
Foresty		
Information provision and transparency Is there real-time land-use change surveillance in place? Is deforestation data publicly available?	Literature review	Information provision is seen as a prerequisite for forest law enforcement.
Stakeholder participation Which stakeholders have a voice in the REDD+ process, which are absent? Who "owns" the process?	Media discourse analysis (di Gregorio et al. 2012)	Representation of stakeholders in the national media on REDD+ as a proxy for overall participation.

4.4 Promote private sector engagement

The private sector remains one of the most logical and influential partners, whose potential has yet to be maximized for climate change adaptation and mitigation efforts in the land use sector worldwide (La Viña et al. 2012). The business argument for private sector engagement is still not as strong as it needs to be. New multilateral agreements at the national level must contribute to the development of business models that maximize private sector involvement in food security and forest conservation.

Agriculture, including its value chains, is projected to be a growing sector in many developing countries and the private sector is expected to play an important role in this process. Agriculture is the backbone of many developing countries' economy as well as the livelihood base for most of these countries' inhabitants, especially in rural areas. Green economic growth based on sustainable agricultural intensification is therefore critical to improve living standards and reduce the need to deforest (World Bank 2012b). Although agriculture is an important economic sector, agricultural production, in particular on smallscale farms and in small and medium size enterprises (SMEs) operating in the agricultural sector is far below its potential. Furthermore, there is evidence that agricultural growth has a high poverty reduction pay-off. Investment in agriculture is 2.5 to 3.0 times more effective in increasing the income of the poor than is nonagricultural investment (Cleaver 2012).

INFOBOX | **Who is the private sector in agriculture?**

In the present study, we define private actors in agriculture as the whole continuum of producers from smallscale subsistence farmers to large-scale agribusinesses. Their roles and needs obviously differ widely, but their common objective is to make a living from agriculture. While small farmers and the agricultural sector as a whole are often seen by cooperation partners and national governments as mere recipients of development aid, numerous capacity assessments in the agricultural sectors of developing countries emphasize the urgent need of a paradigm shift towards redefining "agriculture as a business" (e.g. Lundgren & Lundgren 2012 for Kenya). Operating a small farm as a business can have multiple benefits, including: increasing incomes through better management choices, better access to credit and supportive instruments resulting from formal recognition by authorities, etc.

Policy options outlined below and concrete examples from case study countries highlight opportunities for engaging both small and large actors.

Market-oriented incentives for direct investments (referring to Climate Focus et al. 2011)

Risk management: Risk management, with an appropriate level of government or public guarantees or risk-sharing, could unlock more large-scale investment in agriculture and REDD+ from domestic and international institutional investors now deterred by today's political and technical uncertainties. High or unmanageable risk deters many investors who otherwise may finance improved agricultural or forestry practices. Risk sharing mechanisms can be deployed by banks and multilateral institutions in coordination with governments or development agencies in order to unlock investment in agriculture.

Monetizing ecosystem services revenue streams: Fixed income instruments linked to climate-related assets are a promising option for agricultural mitigation. Traditionally, climate investment has focused on higher-risk private and public equity or debt. Fixed-income instruments monetize revenue or credits from climate-related projects, thus allowing institutional investors to finance ecosystem services (as well as programs meeting specific performance standards) at a lower risk level than either equity or debt investors in projects. Several so-called green bonds or fixed income products have been issued since 2007 by the World Bank and the European Investment Bank. Potential investors include the State of California, Swedish national pension funds, UN pension funds, and others, including institutions who have not traditionally invested in bonds from these organizations.

Direct purchase: Global carbon markets represent a potential source of finance for improved agriculture in the future. Upfront finance is needed to invest in inputs or more efficient technology that will subsequently reduce emissions or sequester GHG. Carbon finance can bridge the time gap between implementation costs and the materialization of benefits/revenues. The ability of carbon finance to provide bridge financing is contingent upon investors or donors offering upfront payments against credits delivered during the first two to five years, which is also the most critical period for farmers to overcome initial cost hurdles.

Transition cost subsidies: An industry or government-financed fund set up to reimburse transaction costs for adopting climate change mitigating activities could address a major barrier preventing large-scale implementation of agricultural mitigation and adaptation. Models are being developed that draw on industry taxes or public finance to create a way for individual businesses to cover the upfront capital costs of certification, improving agricultural methods or other program costs.

Regulatory reforms

The massive scale of agricultural subsidies, market interventions and trade barriers in the agricultural sector will limit the effectiveness of any market-based scheme that does not consider how these issues shape incentives for famers and agribusinesses (ibid.). Institutional reforms, such as the implementation and enforcement of

regulatory mandates for adoption of improved land use practices, minimum standards and investments in the regulatory infrastructure lowering the transition costs of adopting improved management practices, is needed. Other regulatory reforms include actions that address the consumer side and aim to reduce the demand for unsustainably grown, harvested or produced products, or increase premiums for sustainable products. A potential area of regulatory reform in the agricultural sector is to support smallholders in registering their farms as businesses coupled with capacity building for business plan development, access to and management of credits and service provision for future business-relevant tasks.

The country-specific policy context, which incorporates domestic low carbon developments and green economy strategies as well as the evolving international climate policy under the UNFCCC, may define the appropriate mix of market-oriented and regulatory instruments in order to better align food security and forest protection. Apart from the policy context, private sector activity depends on many factors and can be measured by the "ease of doing business" index developed by the World Bank (2012a). It is not specific to agriculture, but is used in our analysis as a proxy indicator for the environment in which a private investor in agriculture finds him or herself in the case study countries. Country economies are ranked from 1 to 183. A high ranking means the regulatory environment is more conducive to the starting and operation of a local firm as regards: the number of regulations for starting a business, construction permit and property registration requirements, investor protection, taxes, international commerce, contract enforcement, employee relations and closing a business— as they apply to domestic small and medium-size enterprises.

Foreign direct investment (FDI) in agriculture is used in our analysis as another proxy indicator for the attractiveness of private investments in the sector overall. FDI may only comprise a small fraction of domestic private sector investment.

Table 4: Analytical criteria for private sector engagement

Criteria	Sources and scores	Rationale for inclusion
Overall business environment How easy is it to establish, run and end a business?	Ease of doing business indicator World Bank (2012a)	Overall ease of doing business as a proxy for the business environment in the agricultural sector.
Foreign direct investment How high is FDI in the agricultural sector?	Statistical analysis of FDI data (FAO 2012b)	FDI as a proxy indicator for overall investments/business activity in the agricultural sector.
Incentives and regulations What kind of market-oriented incentives and regulatory mechanisms are in place in the agriculture and forestry sectors which enhance sustainable production and resource use (e.g. certification schemes, roundtables, funds)?	• Literature review • Expert interviews in case study countries	Overview of initiatives to involve the private sector in forest protection and sustainable agricultural production.

5 Case studies

Brazil

Latin America

Forest cover: 62%

Deforestation rate 2005-2010: -0.42%

Main agricultural drivers of deforestation: cattle, soy and sugarcane

Brazil is a country of superlatives when it comes to land use potential. On the one hand, Brazil is the world's second largest producer of both beef and soy; these industries were worth $18 billion and $13 billion respectively in 2008 (FAOSTAT 2012). Cattle, soy and sugar production are the main causes of deforestation and account for around 60 percent of Brazil's agricultural gross domestic product. On the other hand, 62 percent or 5.2 million square kilometers of the country remains forested.

Within Brazil there are large regional variations in deforestation patterns. Eastern Pará and Northern Tocantins in the Amazon basin converted notably more disturbed forests and shrubland than other Brazilian states. Conversely, dramatic increases in soybean production and pasture land expansion have driven the relatively higher rate of intact forest clearing in Mato Grosso and Rondônia along the "arc of deforestation" in southeastern Brazil. Soy is the principle crop in this deforestation hotspot and a much higher proportion of forest was cleared in this soy producing area than elsewhere (Gibbs et al. 2010).

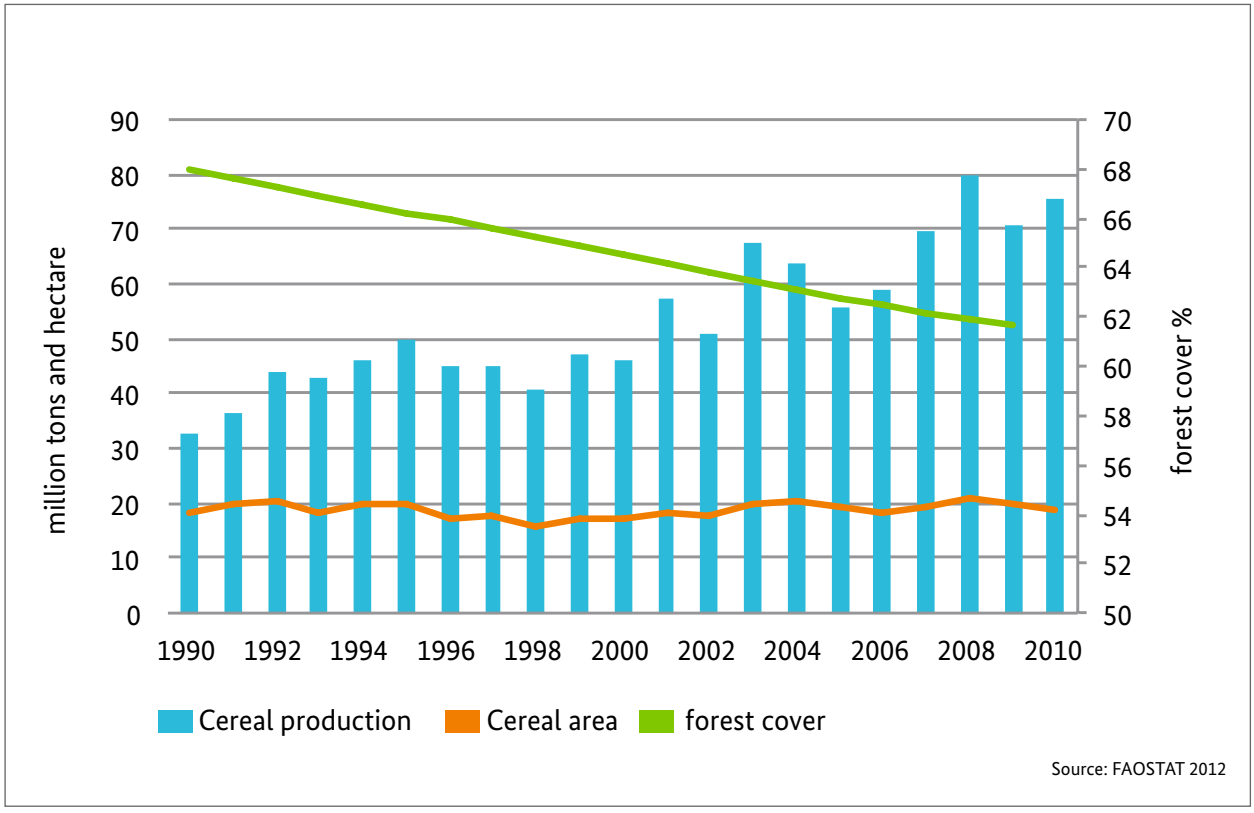
Decouple agricultural growth from agricultural area expansion

Production efficiency increased tremendously in various agricultural subsectors of Brazil during the past decades. Improved production techniques triggered a 240 percent increase in grain and oilseed (including soy) production for example. While yields more than doubled, cultivated areas only increased by 32 percent (Pereira et al. 2012). The figure exemplifies a stagnating cereal production area (excluding perennial crops like sugarcane) with increasing outputs over time.

Pasture expansion remains by far the largest driver of deforestation in the Amazon. Nevertheless, scientific findings provide evidence that technological change has led to productivity increases in the beef sector (Martha et al. 2012). While growth in beef production was based on the expansion of extensive pastures until 1975, productivity gains explained 79 percent of growth in the overall period from 1950 to 2006. An increase in animal performance (average weight per head) further contributed to lower methane emissions per kg of produced meat (ibid.).

Children of traditional small-scale farmers in the Amazon region, Brazil

Productivity development in cereal production vs. forest loss 1990-2010



Source: FAOSTAT 2012

National data is not available on value chain efficiency, but regional estimates can paint a realistic picture. Following global trends, the highest losses occur in the fruits and vegetable commodity categories (over 50 percent of production lost on the way from production to consumption) and roots and tubers (around 40 percent loss), although this may not be applicable for soy bean and sugar cane.

Perishable produce is wasted mainly in the early stages of the value chain (i.e. production and postharvest activities) mainly due to climatic conditions and grading for quality standards. Regarding meat production however, Latin America has one of the lowest loss rates worldwide, amounting to roughly 20 percent losses distributed evenly along the value chain (Gustavsson et al. 2011).

Connect sectors and institutions for integrated rural development

Category	Country situation
REDD+ related polices	
Enabling	• law on reducing deforestation; • Brazilian Forest Code: conservation requirement on private land; • Action Plan for Protection and Control of Deforestation in the Amazon (PPCDAM): improved enforcement of land use policies including protected areas, land regularization process, demarcation of indigenous land • economic and ecological zoning; • efforts to certify producer legality in value chains (beef, soy); • real-time monitoring of deforestation
Hindering	• rural credit for cattle ranching (although more limited than in the past) or infrastructure development (roads and dams); • poor enforcement of land tenure and environmental laws and collection of fines
Overall policy environment	
Policy inclusiveness	• The Economist Intelligence Unit's democracy category score is almost in the highest category with 7.12 out of 10 points, meaning it is a flawed democracy. • Level of centralization: Decentralized (Federal State)
Sectoral integration	• Ministries involved in REDD+: no REDD+ framework on national level so far; Ministry of the Environment (MMA) in coordination with the presidential office in the context of the National Climate Change Policy (PNMC) involves Ministry of Agriculture (MAPA), Ministry of Agricultural Development (MDA), Ministry of Exterior, Ministry of Mines and Energy, Ministry of Science and Technology (MCTI) and others; strong involvement by forested states • Ministries involved in agricultural development: MAPA, MDA (focus on small-holders and agrarian reform)
Equity	• Percentage of forest under public ownership: 81%, slightly above regional average • Gini concentration of agricultural holdings: 0.85, meaning highly unequal land distribution. An estimated 1% of the population owns 45% of all land. Nevertheless, Brazil has granted land tenure/land use rights to indigenous and traditional communities to a higher degree than most other tropical countries (Rights and Resource Initiative 2009). • Per capita arable land: 0.32 ha, slightly decreasing

Sources: Di Grigorio et al. 2012, FAO 2012b, USAID 2012, The REDD Desk 2012, World Bank 2012a

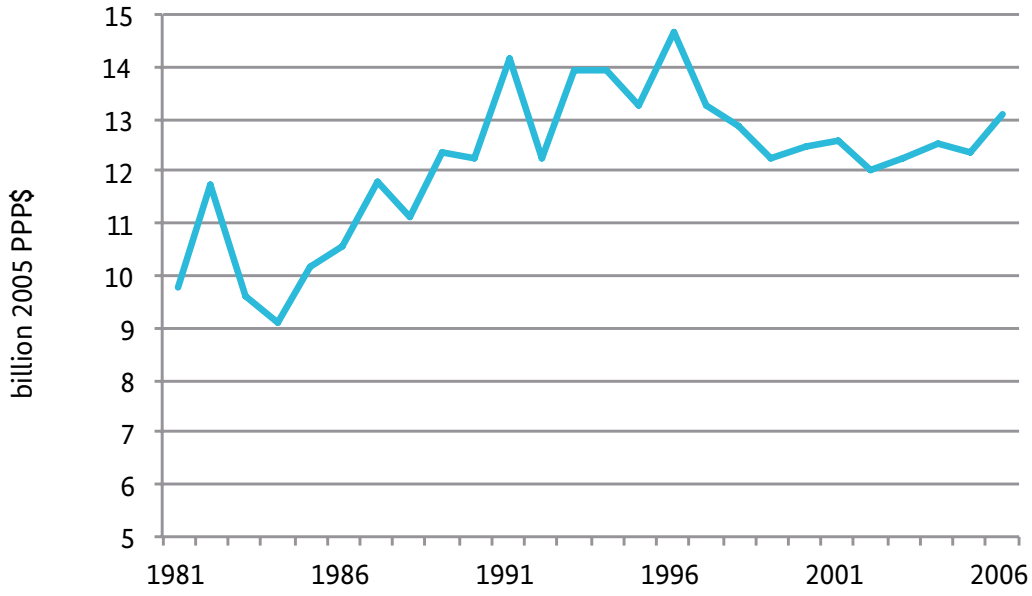
Connect land users with information providers

Total agricultural R&D spending in Brazil grew dramatically in the 1980s, but has stagnated ever since and constituted 1.66 percent of agricultural GDP in 2006 (ASTI 2012).[2] The Brazilian public agricultural research corporation EMBRAPA is often cited as an outstanding example of successful institutional reform, having created an autonomous agency that effectively assesses and responds to farmer demands and is engaged in long-term capacity building (World Bank 2007). Apart from EMBRAPA, Brazil has introduced competitive funding mechanisms for agricultural research institutions and gives 30-50 percent of its grants to universities (World Bank 2005).

According to ASTI (2012), further key trends since 2000 are:

- In 2006, Brazil employed 5,400 full-time equivalent agricultural researchers, more than any other country in Latin America.
- Brazil operates a two-tier system of federal and state-based government agencies. As a semiautonomous federal agency, EMBRAPA is the largest agricultural R&D agency in Latin America in terms of staff and total expenditures.
- In addition, 16 of Brazil's 26 states operate agricultural research agencies, although most state-level activities are carried out in São Paulo. Brazil also has a substantial number of (mostly federal and state) universities that conduct research at more than 100 faculties or schools specialized in agricultural sciences.
- In 2006, 64 percent of the combined research staff employed at EMBRAPA and APTA were trained to PhD level.
- Agricultural R&D in Brazil is largely government-funded. Other sources of funding, including internally-generated resources, have increased in recent years but still represent a small share of total agricultural R&D funding in Brazil.

Public expenditure on agricultural research and development 1981-2006



Source: ASTI 2012

2 As a comparison, the average share in developed countries was 2.36 percent in 2000 (World Bank 2007).

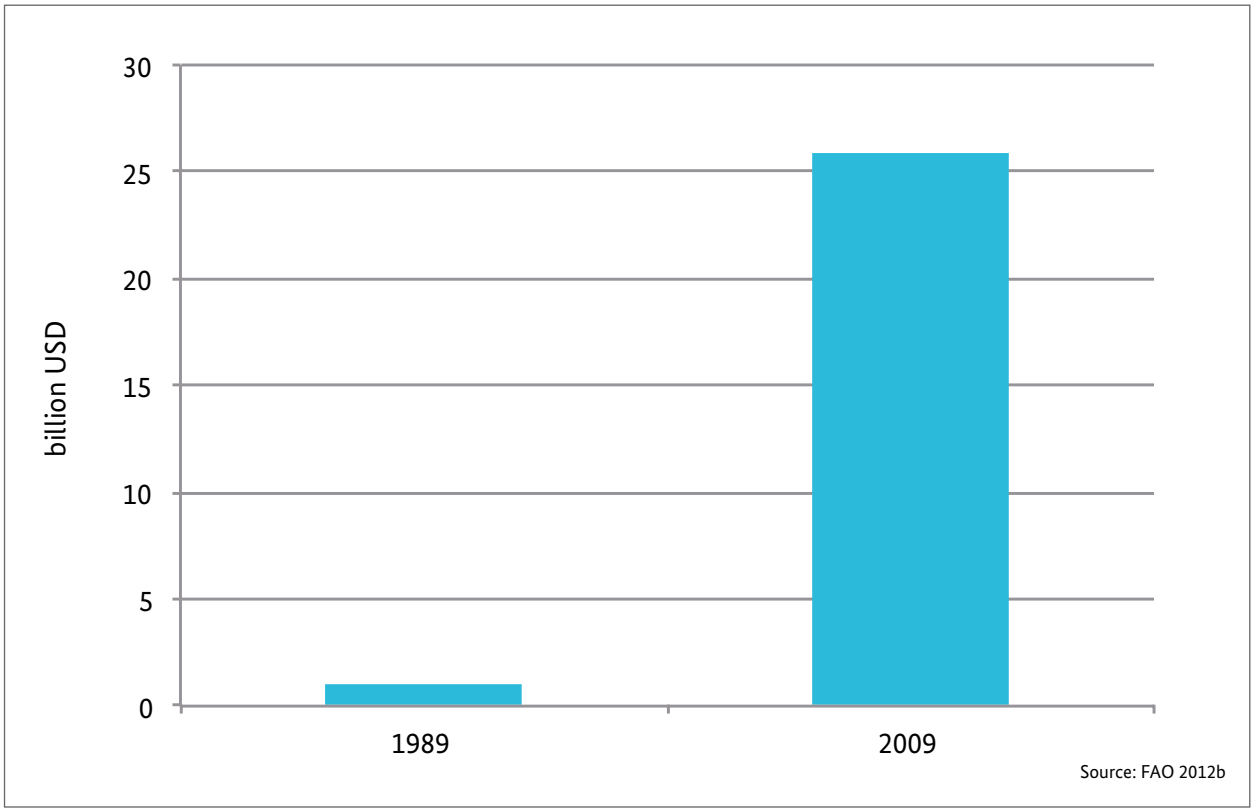
Brazil's National Institute for Space Research (INPE) has published the Amazonian Deforestation Real Time Detection Program Data online since 2005, securing transparent and spatially explicit information on deforestation activities all over the country. Institutions like IPAM and IMAZON are independent research bodies and publish monthly deforestation and forest degradation updates and other analyses covering the Amazon Basin, where Mato Grosso and Rondônia, the two states with systematically highest deforestation rates, are located.

The REDD+ policy discourse in Brazil is dominated by national-level state actors, but a high diversity of stakeholders is also present in the media, notably international NGOs, research institutes and domestic civil society actors, as well as sub-national actors. Private sector perceptions and business–state relations regarding REDD+ are barely explored in the media even here, although the role of the corporate sector is quite significant in Brazil. (di Grigorio et al. 2012).

Promote private sector engagement

Brazil ranked 126th in the ease of doing business index in 2011, with a slight setback in almost all areas compared to the year before. This low rank, even when compared to other countries in Latin America, is apparently due to time-consuming and costly regulatory processes (World Bank 2012a). Nevertheless, FDI in the agricultural sector has increased dramatically in the past two decades, indicating substantial agribusiness activity overall. This impression is supported by the fact that 80 percent of forest clearings in the Amazon are above 20 hectares (Chomitz 2007).

Foreign direct investment in Brazilian agriculture, net inflows 1989 and 2009 (BoP, current US$)



Source: FAO 2012b

Brazil's proposed REDD+ approach combines regulatory enforcement with compensatory payments for environmental services (Börner & Wunder 2012). The Brazilian Forest Code, a regulatory mechanism, mandates the conservation of 80 percent of on-farm forests. But compliance is low and rigid enforcement would be of substantial cost for land owners. Moreover, Brazil's forests are under considerable threat from expansion of commercial palm oil. The production of this commodity is rising fast to reply to rapidly increasing global demand. Consequently, the Forest Valuation Pact is a scheme to compensate farmers for not deforesting. This will be funded primarily with state treasury resources. However, this scheme led to criticism in that Brazilian taxpayers were paying for services benefitting global society, especially when the beneficiaries would be large commercial landowners with a history of aggressive land grabbing and clearing. Again, the divergence between large-scale commercial agriculture and small-holders must be taken into consideration. Further initiatives to engage private actors in the forestry and agriculture sectors are listed below.

Connect sectors and institutions for integrated rural development

Name	Financing approach	Description	Results
Amazon Fund	• Non-reimbursable direct financing • Performance payments from Governments such as Norway and Germany and Petrobras	• Performance-based support of projects in sustainable management and production; science, technology and institutional development; and improvement of control mechanisms such as real time deforestation control linked with law enforcement. • Governance board consists of three members representing government, private sector and civil society.	• As of 2012, the Fund's portfolio comprises 21 contracted projects with a total support of US$ 134.9 million and 7 approved projects with a total support of US$ 8.2 million. • Supported entities include state governments, municipalities, research institutions and NGOs.
Action Plan for Protection and Control of Deforestation in the Amazon (PPCDAM)	Over 200 initiatives involving territorial planning in forest areas, land tenure, monitoring and inspection, and promotion of sustainable forest management.	One scheme is the suspension of rural credits to deforesting municipalities. Credits can be regained by reducing deforestation and enforcing the cadastral registration of land and environmental data.	• PPCDAM strongly stimulated value chain certifications of beef and soy.
Global Roundtable for Sustainable Beef, Round Table on Responsible Soy Association (RTRS), Bonsucro	Value chain certification for various commodities	The roundtables reflect a balance of interest groups and global representation, guaranteeing the fulfillment of minimum environmental and social standards for production.	• RTRS aims to certify about 1 megatons of soy by end of 2012, RSPO (palm oil, see Indonesia) has certified around 13% of world production
RT-REDD initiative	Exploring financial mechanisms for delivering forest carbon-based incentives to farmers	Alliance of commodity roundtables, NGOs and Unilever	• Proof of concept pilot projects under way, funding from Government of Norway secured

Regulatory reforms and forest law enforcement on the ground combined with targeted research efforts in agricultural production efficiency and information provision on deforestation have slowed Brazilian forest loss dramatically. The groundbreaking financing initiative Amazon Fund has facilitated this process. Although the challenges of continuing competition for land by the agro-industry and rising demand for resource-inefficient products remain, Brazil is a front-runner in the attempt to reconcile food security with forest protection.

Cameroon

Sub-Saharan Africa

Forest cover: ~42% (see below for clarification)

Deforestation rate 2005-2010: ~-1.07%

Main agricultural deforestation drivers: shifting cultivation, expanding agro-industrial business interests and cash cropping

Cameroon's official forest cover and deforestation rate is debated amongst scholars and research institutes due to the lack of reliable data. According to a recent country study of REDD+, deforestation estimates range from -0.9 percent to -0.2 percent annually, which is the second highest rate among Congo Basin countries (Dkamela 2011). Eighty to ninety-five percent of agricultural deforestation is attributable to shifting cultivation, where the potential to increase efficiency is substantial (Essama-Nssah & Gockowski 2000), and a smaller but quickly increasing portion to large-scale industrial plantations such as rubber and palm oil (FAO 2010). National forest loss is coupled with additional deforestation in neighboring countries through migration of deforestation agents and trade in timber and agricultural products. This can be explained by a form of economic dualism in two seemingly disconnected sectors: smallholders engaged in slash-and-burn cultivation for subsistence needs; and a rapidly growing urban population with nonfarm income sources who is increasingly importing foreign land use based commodities such as animal and wood products (Lambin and Meyfroidt 2011).

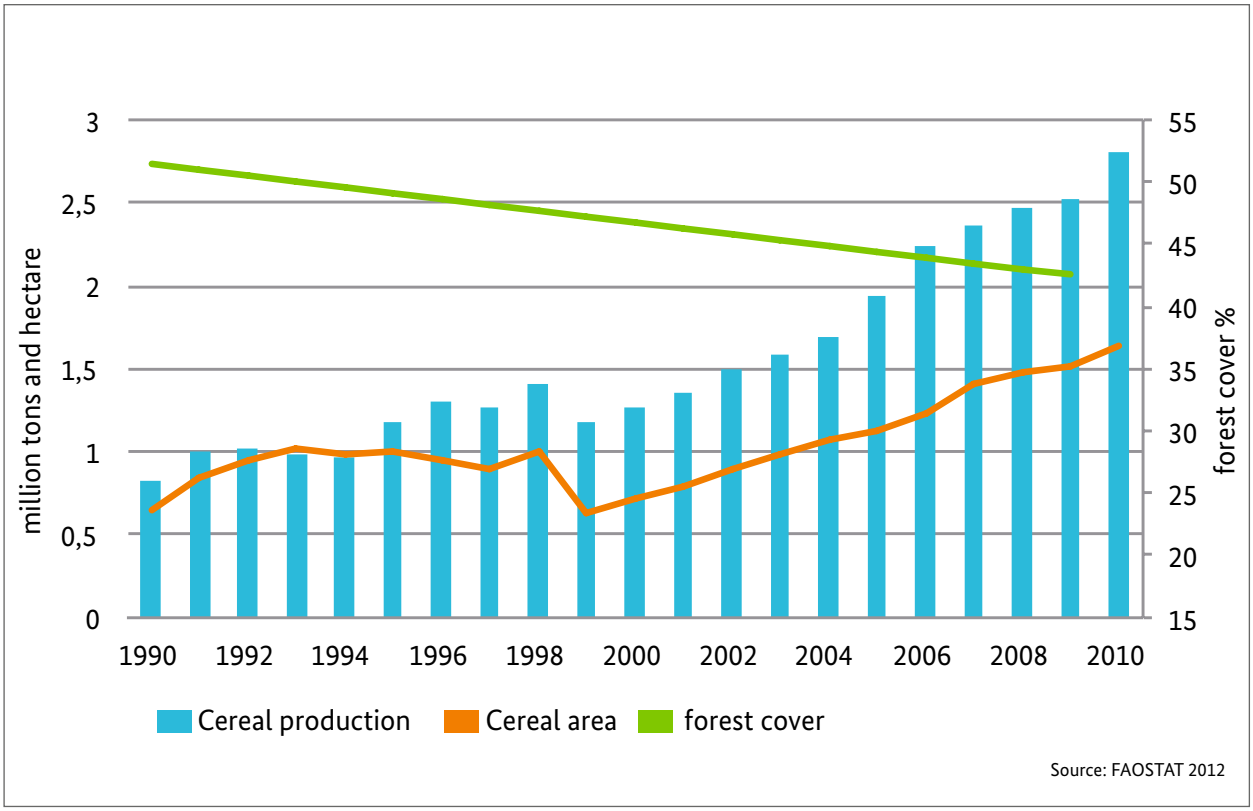
Vision Cameroon 2035 outlines the country's development objectives of becoming an emerging economy primarily through industrial development and an ambitious trade policy. The Vision's measures include through investments in infrastructure, improvements in industrial technology, increased productivity and more processing of local commodities. At the same time, Cameroon's recently submitted draft R-PP emphasizes that REDD+ must be a tool for sustainable agricultural development and recognizes the country's opportunities for decreasing agriculture's pressure on the forest while optimizing production (FCPF R-PP 2012).

Decouple agricultural growth from agricultural area expansion

Growth in agricultural production resulted mainly from increases in the area of land cultivated, not from increases in yields or gains in factor productivity up to the mid-1980s. Since then, however, increased cereal production has been sustained by a combination of increased yields and area cultivated (Dewbre & de Battisti 2008). The high poverty rate, a large workforce dependent on agriculture and the overall low economic performance of the country are factors used to justify the massive expansion plans under the Rural Sector Development Strategy issued in 2006 (MINADER 2006). The plan is to achieve a 50 percent increase in agricultural production by 2015 through increasing cropping areas in forested regions by 25 percent.

Given this situation, the window of opportunity to design a low carbon development strategy is wide open at the moment in Cameroon. Economic development led by the agricultural sector and climate change mitigation can both be achieved if agricultural growth happens through efficiency gains along the value chain. Such a strategy includes decision-making tools for carbon-sensitive agricultural expansion and strategic investment in low-carbon sectors and climate smart businesses.

Productivity development in cereal production vs. forest loss 1990-2010



National data is not available for value chain efficiency, but regional estimates can paint a realistic picture. In stark contrast to food losses in industrialized countries, almost all of the food losses take place during production and post-harvest in Sub-Saharan Africa. Although this trend prevails in all developing regions and for all commodity categories, the numbers are especially daunting for meat production. Fifteen percent of the overall output is lost during animal production. This can be explained by high animal mortality caused by frequent diseases such as pneumonia, digestive diseases and parasites in livestock breeding. For dairy products, Sub-Saharan Africa is also the region with highest loss rates during processing and transport, amounting to more than 20 percent before even reaching end consumers (Gustavsson et al. 2011).

Connect institutions and sectors for integrated rural development

The Ministry of Environmental Protection and Sustainable Development (MINEPDED) is charged with the coordination of REDD+ and new structures dedicated specifically to REDD+ will be created within this Ministry. Although the Forest and Agriculture Ministries are invited to participate in REDD+ meetings and committees, REDD+ ownership largely remains in the MINEPDED and there is a risk that the inclusion of other sectors (i.e. agriculture, energy, transportation) will not be optimal. REDD+ does not achieve the same level of priority in Ministries other than MINEPDED and increased efforts to share the responsibility for the mechanism is required.

Category	Country situation
REDD+ related polices	
Enabling	• Law No 2011/08 on Guidelines for Territorial Planning and Sustainable Development in Cameroon • Forest and Environment Sector Programme (2004), although suffers from low enforcement • Governance partnerships with the Ministry of Forests and Wildlife, e.g. EU-FLEGT, that are developing or will soon enter into force
Hindering	• Devaluations boosting logging exports • Infrastructure (roads, rails and dams) and mining development • Vision Cameroon 2035 • The Rural Sector Development Strategy (RSDS 2006) foresees 25% agricultural area expansion in forested areas for cocoa, coffee, rubber, oil palm and others
Overall policy environment	
Policy inclusiveness	• The democracy index according to the Economist Intelligence Unit is at 2.96 out of 10 points, which is in the lowest "authoritarian state" category • Level of centralization: Decentralized but with limits
Sectoral integration	• Ministries involved in REDD+: low participation in general, including Ministry of Forestry and Wildlife
Equity	• High percentage of forest under public ownership • Gini concentration of agricultural holdings: 0.40 on a scale from 0 to 1, meaning relatively equal land distribution. This is a good value compared to other developing countries. • Arable land per capita: 0.31, slightly decreasing

Sources: Di Grigorio et al. 2012, FAO 2012b, USAID 2012, World Bank 2012a

Connect land users with information providers

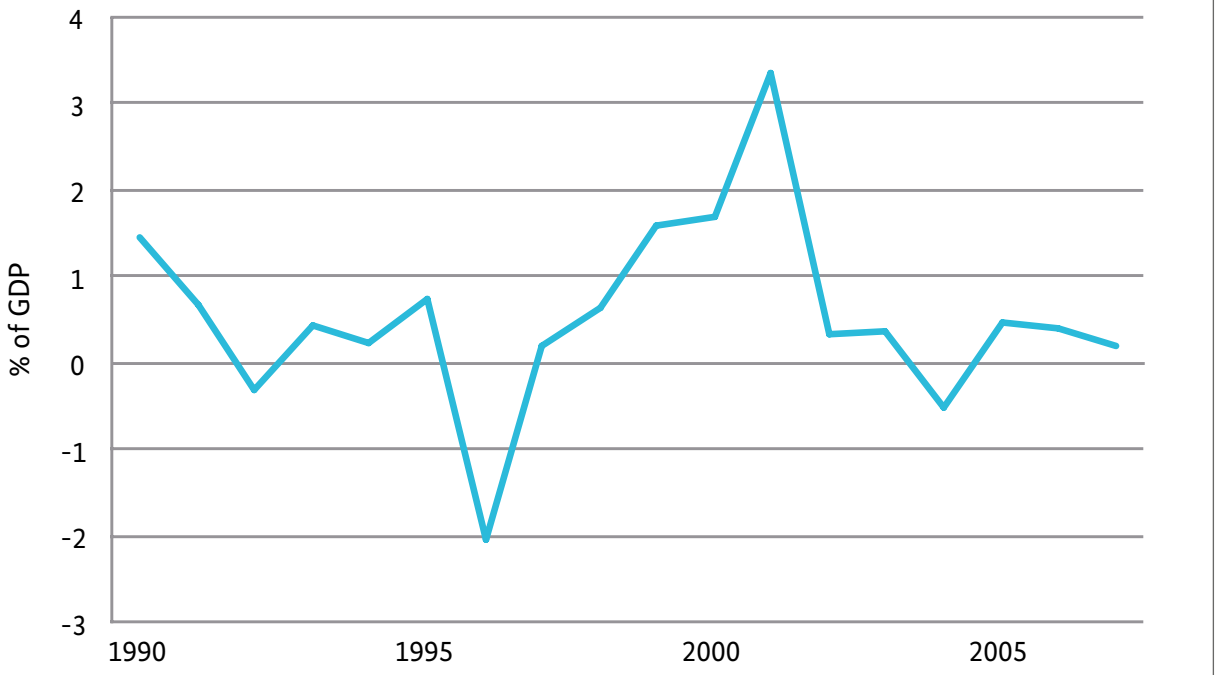
The research and development-specific spending was not available to the authors, but most African countries do not meet the target set by the African Union's New Partnership for Africa's Development (NEPAD), which is one percent of GDP dedicated to agriculture (Flaherty 2011). In most African countries, public expenditure on agriculture remains below the pledge to increase agricultural investments to at least 10 percent of the national budget, as stated in the 2003 Maputo Declaration directed at all member countries of the African Union. However, Cameroon is planning to engage in NEPAD's Comprehensive Africa Agriculture Development Programme (CAADP) and is expected to formally launch implementation this year. Agricultural research and technology dissemination is one of the key pillars of the investment program and support is likely to increase as implementation begins.

There are no Agricultural Science and Technology Indicator (ASTI) data for Cameroon, but agricultural research and development trends from Sub-Saharan Africa are likely to be representative for the country as well (World Bank 2007):

- Public R&D spending as share of GDP was 0.72 percent in 2000, slightly above the developing country average (0.52%) and considerably below developed countries (2.36%).
- The large extent of heterogeneous smallscale production reduces technological spillover and slows down the diffusion of agricultural innovation in the region.
- Agricultural research systems are highly fragmented with nearly 400 institutions in the region- almost four times the number in India and eight times that in the US.

- Funding per scientist is especially low throughout Sub-Saharan Africa. While there are 50 percent more scientists than in India and a third more than in the US, annual spending is about half of what India spends and less than a third of US funds.
- On average, only 25 percent of scientific employees are trained to the PhD level.

Public expenditure on agriculture as share of GDP 1987-2007



Source: FAO 2012b

In the forestry sector, independent observer bodies assess and publicly display the quality of forest operations and update a register on law violations, contributing to transparency in the sector (Dkamela 2011). Although third-party observers have been in place for decades, their contribution to transparency continues to face many barriers, including donor dependence (Cerutti & Fomété 2008). The Congo Basin Forest Fund has recently started funding a regional initiative to help Cameroon and other Central African countries set up advanced national forest monitoring systems in close collaboration with the Brazilian National Institute for Space Research (INPE). The initiative will focus on providing technical support to countries, enabling them to use remote sensing technologies to estimate forest cover and forest cover changes, as well as to estimate the amount of carbon stocks contained in forests in the region (FAO 2012c).

Forest policy reform has further introduced mandatory consultations with stakeholders on land use decisions, but the actual influence of this change remains to be assessed. For example, NGOs remain absent from key bodies, such as the interministerial commission overseeing concession allocation (Dkamela 2011). Some say the REDD+ policy discourse in Cameroon is dominated by intergovernmental bodies and international research institutes, while the voice of state actors is almost absent in the media (e.g. di Grigorio et al. 2012). However, the recently submitted

draft R-PP was written by national experts and national ownership of the REDD+ process seems to be gaining strength.

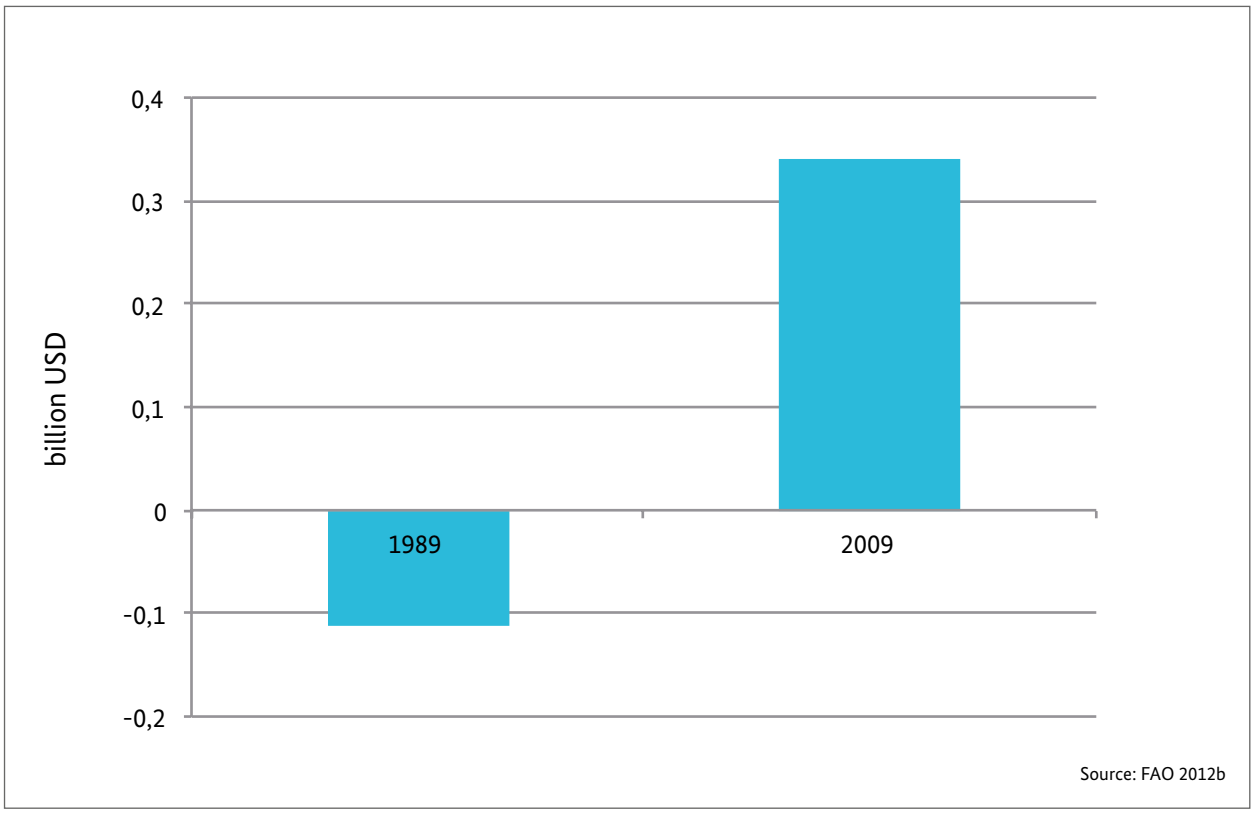
Promote private sector engagement

Cameroon's R-PP recognizes the need for more involvement from the private sector. The lack of private sector engagement is most likely due to the uncertainty of REDD+, both in terms of funding and strategy. Given the breadth of private sector interests in agro-industrial developments in the country, the potential for avoiding deforestation or reducing agricultural emissions through increased efficiency is significant.

Cameroon must find alternative funding sources beyond that provided by the FCPF. The private sector can foster technological innovation and provide the necessary investment in R&D needed to decouple deforestation from increased agricultural yields.

Cameroon ranked 161st out of 183 in the ease of doing business list in 2011, with a slight improvement compared to the year before, especially in the category of access to credit. This dramatically low rank is apparently due to time consuming and costly regulatory processes with registering property, enforcing contracts and other business processes (World Bank 2012a). Net agricultural outflows exceeded net inflows in 1989, but since then FDI in the agricultural sector has increased dramatically and is projected to grow further. Cameroon is becoming a target country for large-scale oil palm and other commodity development by international investors due to the availability of cheap land, relative political stability and the willingness of the Cameroonian government to develop its agricultural sector. This has resulted in expanding agricultural areas often at the cost of forests especially in the southern forested zone (WWF 2012).

Foreign direct investment in Cameroonian agriculture, net inflows 1989 and 2009 (BoP, current US$)



Source: FAO 2012b

At present, the preferred funding mechanism for REDD+ in Cameroon seems to be subsidies, which are supposed to be allocated as start-up funds in the overall context of REDD+ preparations. Some conservation activities, especially in protected areas, have achieved sustainable financing through trust funds. The *Fondation Tri-National de la Sangha* is a success story that is inspiring other initiatives. Clearly, these initiatives aim to eventually be financed through market based instruments, but there is still a long way to go. No performance-based payments have yet been made for carbon, although a project by the Center for Environment and Development (CED Cameroun) based on payments for community ecosystem services is in the process of becoming part of a voluntary market (Dkamela 2011).

Further initiatives to engage private actors in the forestry and agriculture sectors are listed below.

Name	Financing approach	Description	Results
Congo Basin Forest Fund (CBFF)	• Fund set up by the Climate Change Funds of Great Britain and Norway, with the support of ministries responsible for forestry in the Central African Forest Commission (COMIFAC) member states	• Fund managed by AfDB • Disbursement of grants with a minimum volume of €80,000 measured against performance indicators • Thematic areas: sustainable forest management, livelihoods and economic development, MRV, Benefits from REDD and PES, capacity building	• 41 projects valued at €84 million, two-third of proposals by NGOs, one third by national governments. Private sector forestry operators can also apply, but have not done so so far.
Fondation Tri-Nationale de la Sangha	• Endowment fund set up by various multi- and bilateral cooperation partners and managed by a registered charity.	• Independent conservation trust fund set up to finance the protection and management of a trans-boundary forest complex called Sangha Tri-National. • Priority expenditures are defined and approved in the management and business plans of the three national parks. • Independent and mixed Board of Directors with a majority of representatives from the private sector.	• Operational since 2007, the TNS Foundation has received €11.5 million in endowment commitments from public and private donors such as KfW, the French Development Agency (AFD), WWF and the Regenwald Stiftung.
Roundtable on Sustainable Palm Oil (RSPO)	• Sustainability standard to lower the uncertainty and risk of investments in the sector (e.g. for loan preparations from World Bank)	• Supported and adopted by many international producers investing in Cameroon and civil society	• The share of RSPO certified palm oil has risen to 11 percent of the total market. • Impact on forest protection in Cameroon: not quantified; one investor rejected a site offered to them by the Government – an intact primary forest – due to its high conservation value (WWF 2012).

In Cameroon, the direct drivers of deforestation have so far not been successfully addressed seeing as REDD+ at the national level has yet to be implemented. Forest loss caused by agricultural area expansion, to an increasing extent by large-scale cash crop producers, continues at a fast pace and is further fueled by poor governance and weak law enforcement. Past political commitments such as the creation of a National Climate Change Observatory suggest the case of Cameroon provides a wide window of opportunity to design a low carbon development strategy that reconciles food security and forest protection with economic development, catalyzed by an efficient agricultural sector. However, proper implementation and close monitoring of these promising initiatives is required.

Indonesia

Pacific Asia

Forest cover: 52%

Deforestation rate 2005-2010: -0.71%

Main agricultural deforestation drivers: oil palm and other plantations

Indonesia is among the ten countries with the largest forest areas. Although absolute deforestation remains very high, the rate of forest loss has been significantly reduced and is now less than half the rate in the late 1980s and 1990s (FAO 2010). The country has recently overtaken Malaysia as the world's largest producer of palm oil, a national business worth around US$5 billion each year (UCS 2010). Annual production grew from 3.3 million tons of crude palm oil in 1992 to roughly 21.5 million tons in 2010 (FAOSTAT 2012). More than half of oil palm expansion since 1990 has come at the expense of forests (Koh & Wilcove 2008). The industry is expected to grow further, as Indonesia has announced its aims to increase the production of fifteen major crops by 2020, including the doubling of palm oil production. Achieving these goals will require more land, regardless of yield and efficiency increases (Austin et al. 2012). Forest clearing is even more problematic on peat land, which is the dominant soil type in one of the country's deforestation hotspots, Sumatra.

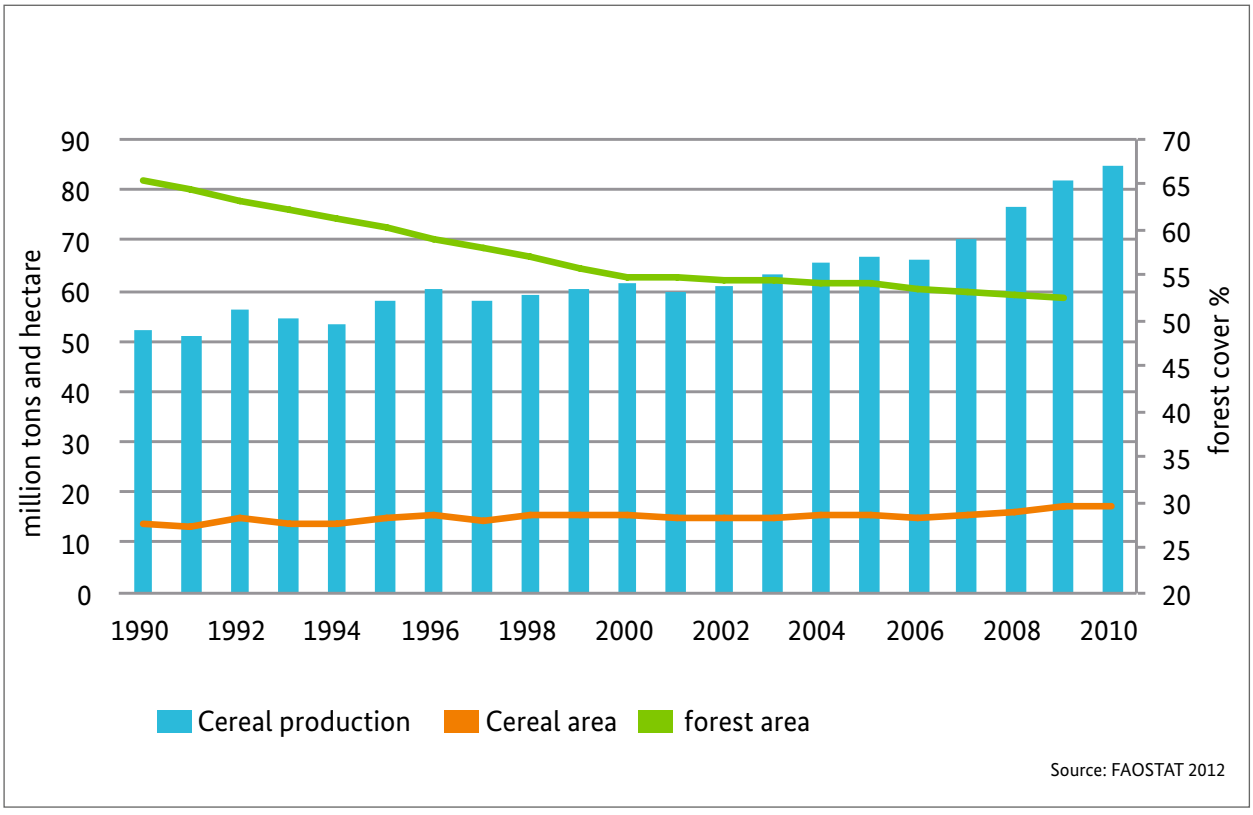
Decouple agricultural growth from agricultural area expansion

Since the 1980s, Indonesia recorded one of the fastest agricultural transformations in history. The agricultural sector underwent some realignment in response to policy changes that shifted the focus from food crop production to an industrial, export-oriented development strategy. As the country transitioned rapidly from self-sufficiency to supplying export markets, the agricultural sector responded by diversifying production to include cash crops.

Total agricultural output in Indonesia grew through land expansion, increased labor and capital investments, and intensified use of intermediate inputs such as fertilizer. Average annual agricultural output growth in Indonesia increased 3.6 percent between 1961 and 2006, with roughly half accounted for by farms increasing input usage (Fuglie 2010). The remaining portion of output growth is attributed to total factor productivity growth—that is, growth from improved technologies and a more efficient allocation of farm resources (USDA, 2010). The figure exemplarily shows a stagnating cereal production area (excluding perennial crops like sugarcane and oil palm) with increasing outputs over time.

Stabilization pond of palm oil mill, Indonesia

Productivity development in cereal production vs. forest loss 1990-2010



Source: FAOSTAT 2012

National data is not available on value chain efficiency, but regional estimates can paint a realistic picture of the country. The region of Southeast Asia boasts the lowest per capita food loss of only around 6 kg/year worldwide, and comparatively low loss rates in meat and cereal production. Along with the global trend however, the highest losses is expected in fruit and vegetable commodities (over 50 percent of production is lost on the way from production to consumption) and roots and tubers (around 40 percent loss). Perishable produce is wasted mainly in the early stages of the value chain – production and postharvest activities – mainly due to climatic conditions and grading for quality standards (Gustavsson et al. 2011).

Category	Country situation
REDD+ related polices	
Enabling	• Letter of Intent with Norway which put a moratorium on the granting of new licenses for forest clearing and seeks to improve primary forest and peat land governance (criticized as a weak policy due to the influence of business on government) • Agriculture Sector Climate Change Road Map sets targets area for forest protection in part through agricultural land optimization
Hindering	• Tax dependence on forest, mining and palm oil industries • Tax breaks for forest products, farming produce, pulp and paper • Mining permits in protected areas • Fiscal and non-fiscal concessions for food estate and energy estate development • Biofuel development • Land allocation for oil palm plantations
Overall policy environment	
Policy inclusiveness	• The democracy category score according to the Economist Intelligence Unit is in the intermediate category with 6.53 out of 10 possible points, which equals a flawed democracy • Level of centralization: Decentralized with regional tensions
Sectoral integration	• Ministries involved in REDD+: REDD+ task force; Ministries of Mining, Agriculture, and Finance are not involved in implementation of Forest Moratorium; Ministry of Forestry drafted several regulations for REDD+ before Moratorium • Ministries involved in agricultural development: the Agriculture Sector Climate Change Road Map outlines sectoral emissions reduction targets aligned with the Ministry of National Development Planning
Equity	• Percentage of forest under public ownership: 91%, slightly above regional average • Gini concentration of agricultural holdings: 0.56, meaning relatively unequal land distribution (range: 0-1, 0=equal distribution). Conflicts over access to land are frequent in the world's fourth most densely populated nation • Arable land per capita: 0.10, slightly increasing

Sources: Di Grigorio et al. 2012, FAO 2012b, USAID 2012, World Bank 2012a

Connect land users with information providers

Figures on total agricultural R&D spending in Indonesia are only available 1994-2003 and show a slight decline in this period. In 2003, the expenditure amounted to 0.2 percent of agricultural GDP, which is very low (ASTI 2012).[3] Due to the Asian financial crisis, total agricultural R&D spending has been severely cut since 1997 and the country's level of agricultural R&D investments was recently recorded as still being below pre-crisis levels.

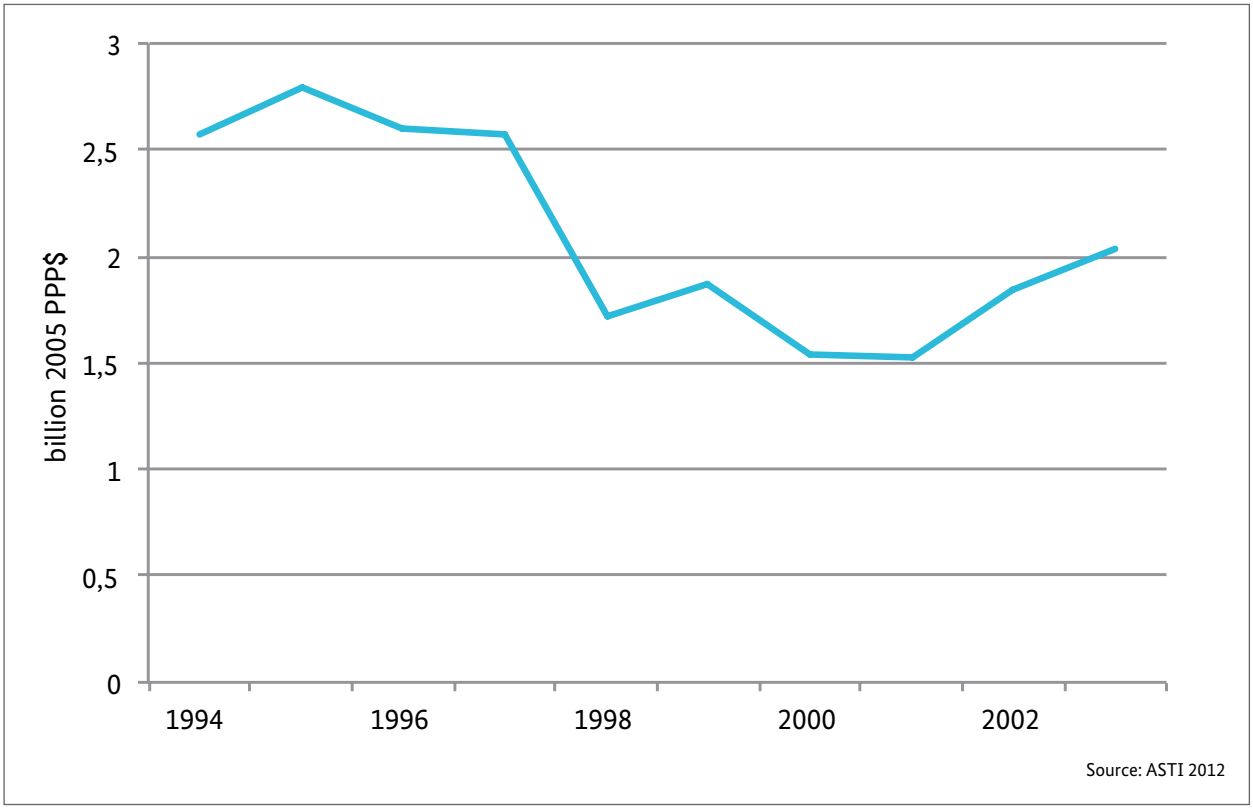
ASTI (2012) summarizes the key trends in agricultural R&D in Indonesia as follows:

- Indonesia's total number of agricultural researchers fell slightly during 1994–2003 due to a major reorganization of government-led agricultural R&D.
- With close to 5,000 full time researchers in 2003, Indonesia has one of the largest agricultural research systems in Asia in terms of staff.

3 As a comparison, the average share in developing and developed countries was 0.53 and 2.36 percent respectively in 2000 (World Bank 2007).

- Qualifications of Indonesian agricultural research staff improved steadily in recent years, principally due to donor-financed training programs.
- In 2003, the national government provided 90 percent of funding to the nine IAARD agencies. Research on plantation crops, on the other hand, is almost entirely financed by the plantation sector itself.
- The private sector accounts for about one-fifth of Indonesia's agricultural R&D expenditures.

Public expenditure on agricultural research and development 1994-2003



Source: ASTI 2012

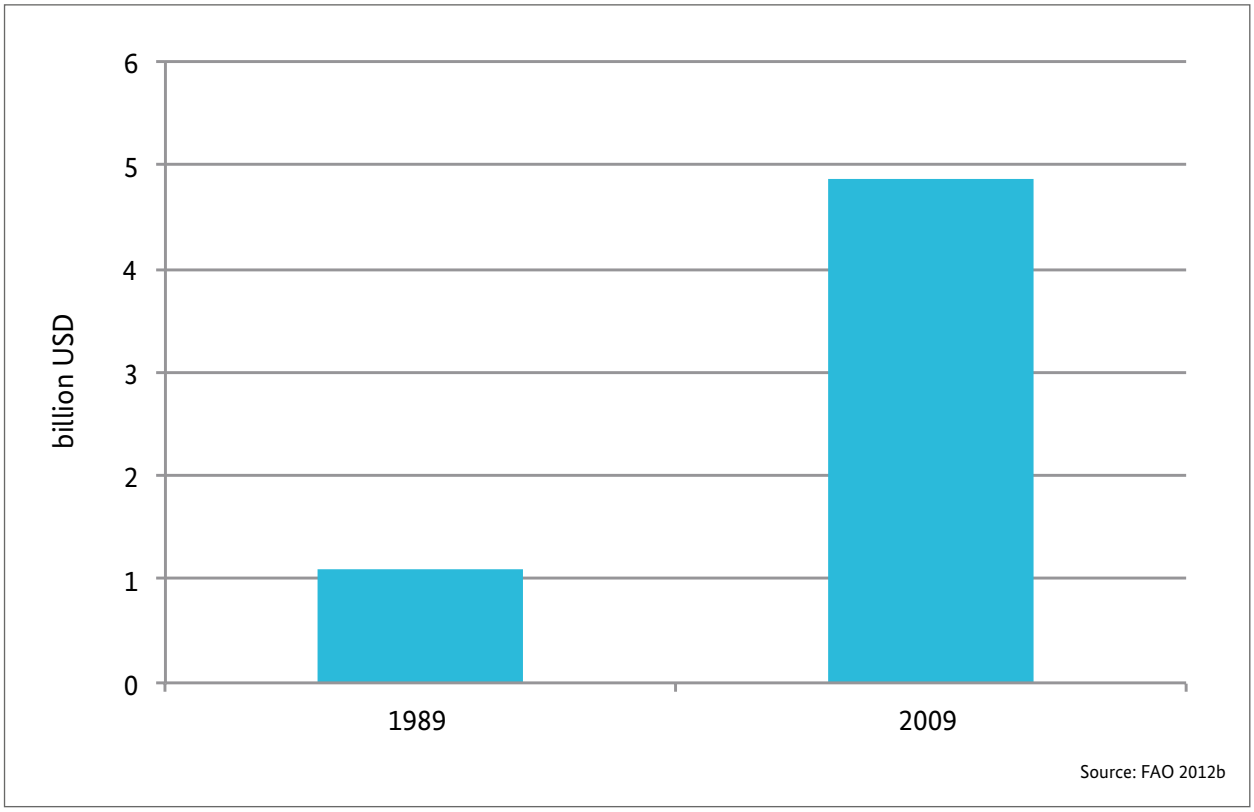
Regarding the forestry sector, the Indonesian government recently publicized its spatial policy when the so-called forest moratorium was ratified in 2011. This was the first time forest resources became transparently and publically available in form of a map. The Indicative Moratorium Map shows the areas in which the granting of new licenses has been suspended; this must be revised every six months in a transparent process. The map makes it easier for stakeholders to carry out monitoring, thus making it a strong tool for law enforcement and data transparency (Austin et al. 2012).

In Indonesia, state actors dominate media discourse on REDD+ and show strong pro-REDD+ attitudes. A high diversity of stakeholders is present in the media as well, especially international NGOs. A peculiarity of decentralized Indonesia is the relatively high number of subnational actors, which mirrors ongoing negotiations between central and local government regarding control over REDD+ resources and policy decisions. Business views and business–state relations regarding REDD+ are scantly explored in the media, although the role of the business sector is quite significant in the country (di Grigorio et al. 2012).

Promote private sector engagement

Indonesia ranked 129th in the ease of doing business list in 2011, with a slight setback in almost all areas compared to the year before. This low rank, even when compared to other countries in Pacific Asia, is apparently due to time consuming and costly processes for starting a business and enforcing contracts (World Bank 2012a). Nevertheless, FDI in the agricultural sector has increased dramatically in the past two decades, indicating substantial agribusiness activity overall. A sharp currency devaluation and trade liberalization following the Asian financial crisis in 1997 provided incentives for Indonesian agricultural producers to assert their comparative advantage in tropical perennial crops.

Foreign direct investment in Indonesia agriculture, net inflows 1989 and 2009 (BoP, current US$)



Source: FAO 2012b

The REDD+ Readiness phase in Indonesia already involves large and growing public funding as well as private investment (Dermawan et al. 2011). One flagship initiative that gained global attention was the signing of a forest moratorium in 2011. The tool aims to achieve buy-in from the industry for the voluntary GHG emissions reductions goals set by the government (26 percent by 2020, Dewan 2011). Large players, such as the Round Table on Sustainable Palm Oil, have supported the initiative from the beginning. Private sector support was achieved through contested compromises however. Secondary forest were excluded from the moratorium, and existing permits, including the possibility to extend existing permits or grant new permits that are "vital to national development" (defined as geothermal, oil and natural gas, electricity, rice and sugarcane) was upheld (Murdiyarso et al. 2011).

Further initiatives to engage private actors in the forestry and agriculture are listed below.

Name	Financing approach	Description	Country situation
Roundtable on Sustainable Palm Oil (RSPO)	• Sustainability standard to lower the uncertainty and risk of investments in the sector (e.g. loan preparations from World Bank)	• Supported by the Indonesian Palm Oil Producers Association, Unilever, the Hong Kong and Shanghai Banking Corporation, WWF, Oxfam and others	• The share of RSPO certified palm oil has risen to 11 percent of the total market • The impact on forest protection is not quantified
Primary Cooperative Credit	Contract signed between a company, smallholder cooperatives and banks, under the supervision of the government. Farmers entrust their land to the company, which plants, manages and harvests the crops. The landowners are paid a percentage of the harvest revenue after deduction of plantation establishment and management costs.	• Example of conditions offered in 1998 for a holding of 2 ha: 15 M Rp (= 1,225 €) at a 14% interest rate. Repayments began the fifth year after planting at 30% of the monthly net added value. • Contract is only favorable for smallholders if the bank's rate of interest, the estimated value of the initial debt, the price of fresh fruit bunches paid to smallholders and the percentage of monthly net added value that smallholders allocate to the reimbursement of their debt are set in a fair manner. • Success of scheme depends on good leadership in smallholder cooperatives	• Smallholders took less than 6 years to reimburse their credit. • Average returns to land on a full cycle of a plantation were 2,100 €/ha for oil palm, compared to only 200 €/ha for a paddy field. • Mixed results as regards the fairness of contracts; ethnic conflicts caused by transmigration; positive local perception of scheme; and improved livelihoods as compared to rice cultivation. • No impact on forest protection without environmental safeguards: participating farmers expand area rather than replace existing plantations by oil palms. (Feintrenie et al. 2010)

Rapid transformation from self-sufficiency to commodity exports, fueled by investments in agricultural research, fertilizer application and government subsidies has the potential to put the Indonesian agricultural sector on an efficiency growth path that is increasingly decoupled from area expansion. However, pressure from large players in the oil palm, timber and mining industries as well as corruption and fraud hamper the success of notable flagship initiatives like the Forest Moratorium. Indonesian palm oil productivity is far below the regional average, e.g. in comparison to Malaysia. Especially regarding small holders, yields can be significantly increased using existing practices and technologies. The findings of an initial analysis of the relationship between global agricultural commodities production and local food sovereignty suggest a village's proximity to an oil palm plantation negatively influences that community's food security (Orth 2007). This is mainly due to the limits to traditional shifting cultivation methods and NTFP collection that results from oil palm plantation expansion.

Laos

Pacific Asia

Forest cover: 41%

Deforestation rate 2005-2010: -0.49%

Main agricultural deforestation drivers: smallscale mixed agriculture, increasingly large scale plantations

In Laos, a relatively high rate of forest loss has seen forest cover fall from 70 percent in 1940 to 41.2 percent (or 9.8 million hectares) in 2002 (Phothisat 2011; FAOSTAT figures state a considerably higher forest cover and reflect inconsistencies in national forest assessments). Livelihoods in Lao PDR are dominated by agriculture, with more than 75 percent of the workforce involved in agrarian livelihoods (UNDP 2009). The dominant livelihood activity in the rural uplands is shifting cultivation. The main drivers of deforestation have been identified as conversion to agricultural land and plantation crops (including fast-growing plantations for pulp and paper and rubber) by commercial companies as well as by smallholders. Rubber plantations began as a modest way for northern upland Lao farmers to supplement their incomes, but this is fasting becoming dominating by rapidly-expanding agro-industry. Major expansion of rubber began around 2002 and substantial foreign commercial interest boosted production countrywide. Other sources identified as being responsible for deforestation and forest degradation are fires, timber extraction, pioneering shifting cultivation, energy and infrastructure development and urban expansion.

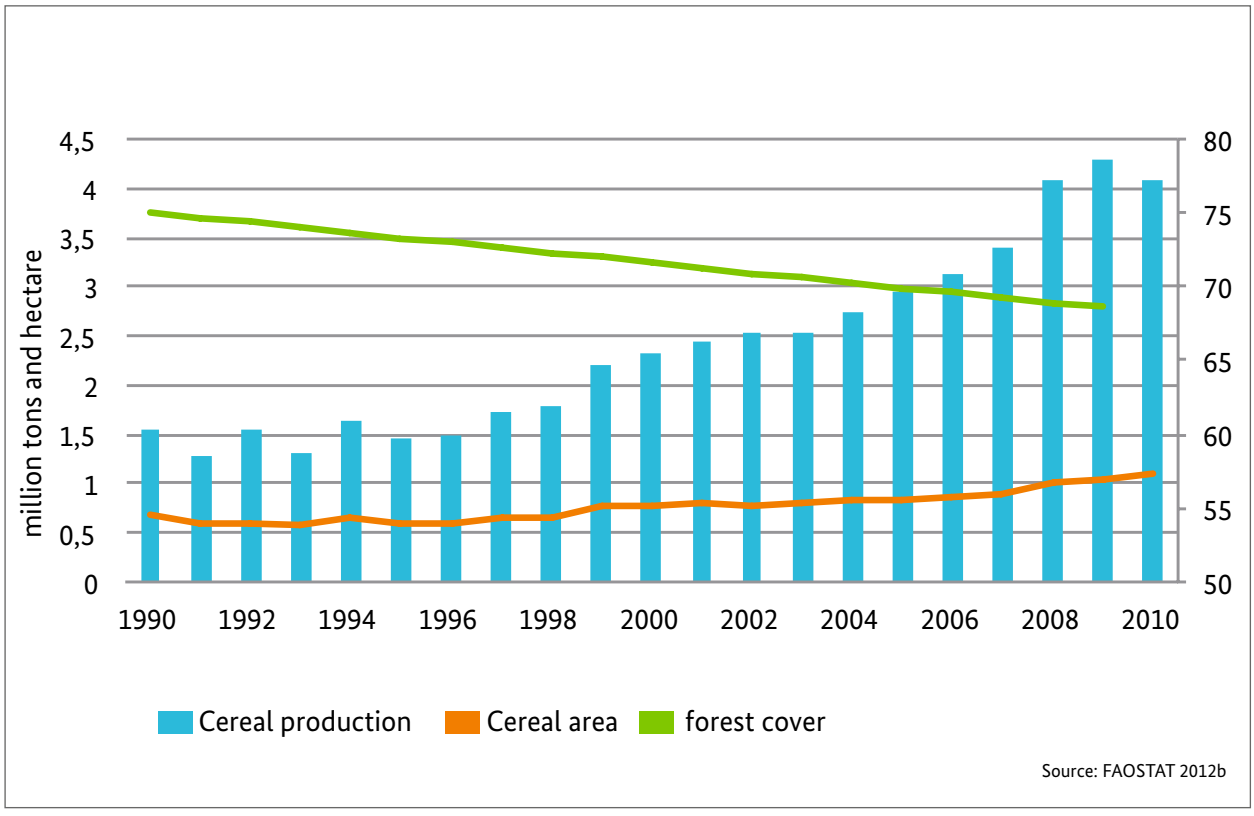
Decouple agricultural growth and agricultural area expansion

Increases in agricultural production have been decoupled step by step from area expansion in Laos over the last three decades in a process involving overall economic reform, improved production technologies and more efficient land use. In 1986, the government of Laos adopted a new economic strategy favoring a state-led, market-oriented economy. In the early 1990s, the first approaches to secure land tenure and property rights were realized as an effective means of encouraging efficient land use and poverty eradication.

Both government and donor agencies began communicating the disadvantages of traditional shifting agriculture, promoting the newer method of cash crop based sedentary agriculture under the Land and Forest Allocation (LFA) program. This later became a nationwide policy in 1994. The program addressed two objectives: (1) to enable farmers to raise agricultural productivity and income by ensuring land tenure security, and (2) to encourage village communities to protect and use forest resources on a sustainable basis. This policy also had the effect of beginning to transform the traditional rice-based system to a cash crops-based system, thus creating further incentives to deforest or install timber plantations in many regions (Takahashi et al. 2010).

Deforested and eroded slopes, Laos

Productivity development in cereal production vs. forest loss 1990-2010



Source: FAOSTAT 2012b

Category	Country situation
REDD+ related polices	
Enabling	• Forestry Strategy 2020 (with the goal to increase forest cover to 70% by 2020) • Climate Change Strategy, National Adaptation Programme of Action to Climate Change • Prime Ministerial Decree on Forest Policy Reform • Land Use Planning and Land Allocation program since mid-1990s, although with negative socio-economic effects on smallholders • 7th Socio-Economic Development Plan • Stabilization of shifting agriculture Program • National policy efforts to eradicate poverty and develop rural communities
Hindering	• Promotion of FDI in the agricultural sector with no safeguard policies • Tax dependence on forest and mining industries (logging royalties constitute 20% of government tax revenues) • Large investments in hydropower and mining industry limit arable land • Voluntary, negotiated, forced, coerced, manipulated, or strongly encouraged forms of resettlement
Overall policy environment	
Policy inclusiveness	• The democracy category score according to the Economist Intelligence Unit is one of the lowest: 2.10 out of 10 points, equal to an authoritarian state. • Level of centralization: Centralized
Sectoral integration	• Ministries involved in REDD+: Ministry of Agriculture and Forest (MAF), Ministry of Natural Resources and the Environment, Ministry of Planning and investment (MPI), Department of Mining, Department of Electricity, Department of Law, Ministry of Finance involved through the REDD+ task force • Ministries involved in agricultural development: MAF, MPI
Equity	• Percentage of forest under public ownership: 100%, above regional average • Gini concentration of agricultural holdings: 0.38, meaning a medium land distribution. This relatively low score compared to other developing countries has increased recently and there is evidence that some ethnic groups have difficulty transitioning to sedentary commercial agriculture. • Arable land per capita: 0.22, slightly increasing

Sources: FAO 2012b, USAID 2012, World Bank 2012a

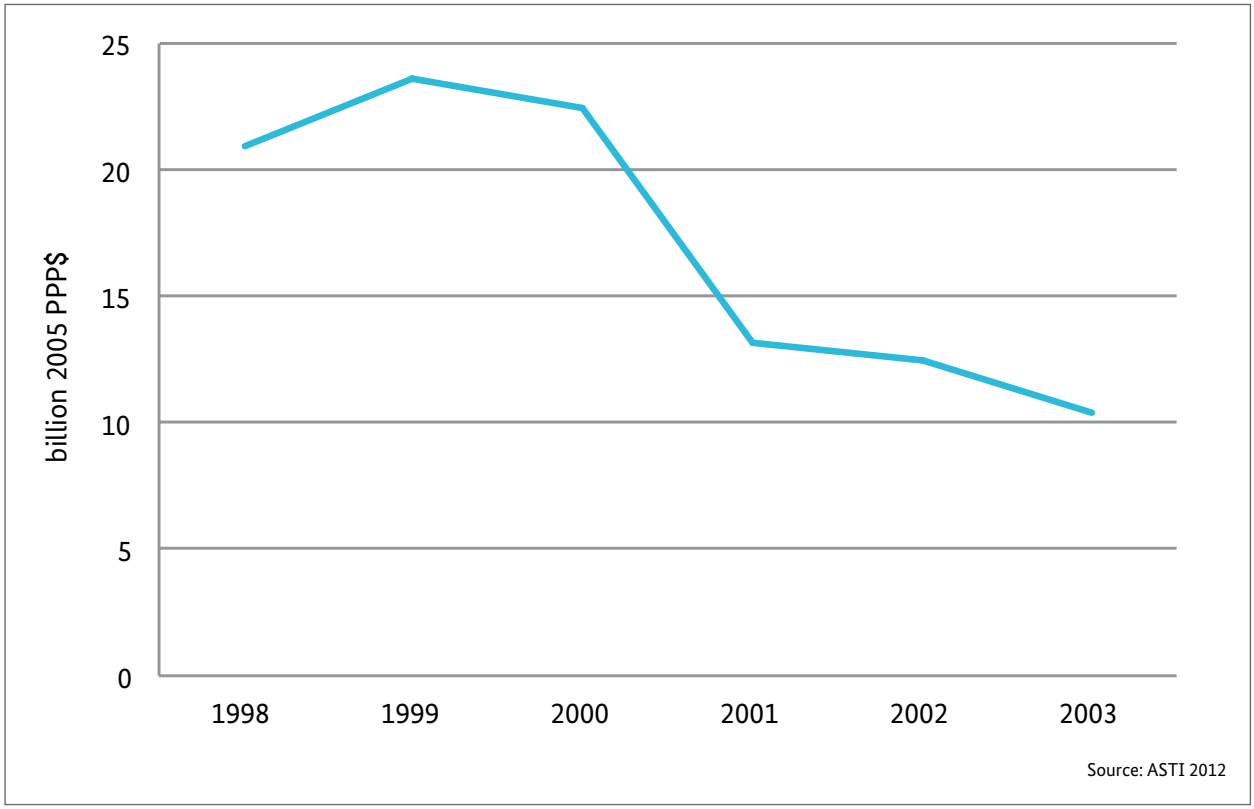
Connect land users with information providers

Public expenditure on agriculture as a share of GDP in Laos has been unusually high compared to other developing countries (above 10 percent on average from 1990 to 2007). R&D specific expenditure as a share of agricultural GDP was 0.24 percent in 2003, down from 0.59 in 1998[4]. More recent data is not available, but it can be assumed that public investments in agricultural science have not increased (ASTI 2012). Further key trends since 2000 are:

4 As a comparison, the average share in developed countries was 2.36 percent in 2000 (World Bank 2007).

- During 1998-2003, the total number of agricultural researchers increased steadily, (although with low absolute numbers), while at constant prices the agricultural R&D expenditures declined by half during 1999–2003.
- The principal agricultural research agency, the National Agriculture and Forestry Research Institute (NAFRI) accounted for 90 percent of Laos' agricultural R&D spending in 2003.
- NAFRI employed only a few scientists holding PhD degrees. However, researcher qualification levels are expected to rise because a large number of NAFRI researchers are currently undertaking PhD and MSc training abroad.
- Since its establishment in 1999, NAFRI has depended almost exclusively on donor support, with the result that its donor-driven research does not always contribute to Laos' overall agricultural R&D needs.
- Private sector involvement in agricultural R&D is limited.

Productivity development in cereal production vs. forest loss 1990-2010



Source: ASTI 2012

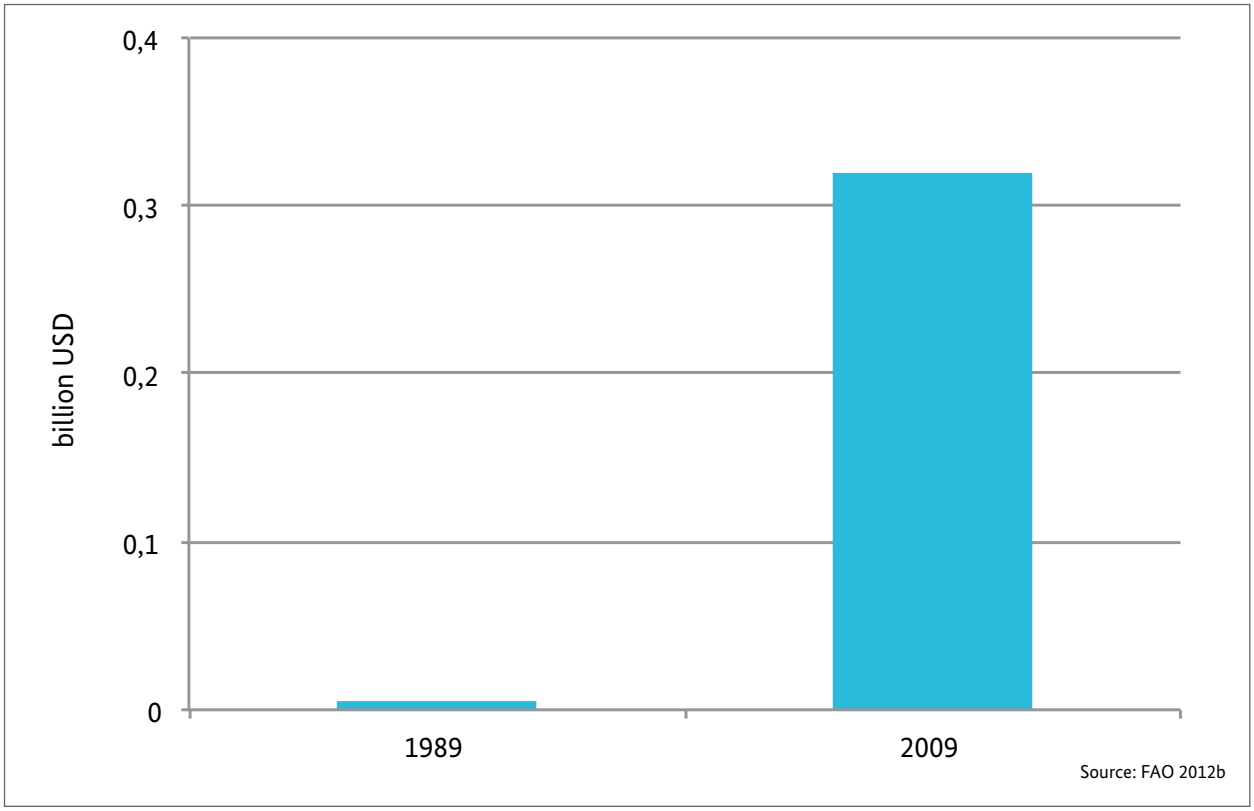
The JICA-supported Program for Forest Information Management (FIMP) will address the problem of inconsistency between forest cover assessments at various times by preparing a nation-wide forest base-map. A National Forest Inventory was carried out between 1991 and 1999 and there are plans to conduct another as soon as possible. Although a large amount of data and information relevant for REDD+ has been collected, a major shortcoming is the proper storage, retrieval and reporting of this very information. Instead of preparing a separate reporting system for forest carbon and REDD+, it is to be incorporated it into the proposed integrated Forest Information System (Lao PDR 2010).

According to the R-PP, there are more than 200 national-level stakeholders with an interest in REDD+. The range of interests in REDD+ is vast and stakeholder collaboration is extremely complex the existence of 49 official ethnic groups, many of whom do not have written material in their languages and the fact that 70 percent of the country's population lives in rural areas with limited to no accessibility during the rainy season. Nevertheless, two national level REDD+ stakeholder consultations have been held so far and pilot projects currently tackling the challenge of engaging stakeholders in free, prior and informed consent.

Promote private sector engagement

Laos ranked 165th out of 183 in the ease of doing business list in 2011, with a slight setback compared to the year before, mainly in the category of access to credit. This very low rank, especially when compared to other countries in Pacific Asia, is apparently due to a lack of regulations protecting investors as well as the lack of formal processes to resolve insolvency (World Bank 2012a). Although FDI in the agricultural sector has increased dramatically in the past two decades, it still remains at a level that is below investment levels in developing and transitioning countries in the early 1990s. The increase indicates tremendous investment interest from the private sector that needs to be regulated and channeled in order to avoid land grabbing, which has happened in the past due to a lack of regulatory mechanisms.

Foreign direct investment in Laotian agriculture, net inflows 1989 and 2009 (BoP, current US$)



Laos was selected as one of the pilot countries for the Forest Investment Program (FIP), a targeted program of the Strategic Climate Fund (SCF), which is one of two funds within the framework of the Climate Investment Funds (CIF). The FIP supports developing countries' efforts to reduce deforestation and forest degradation and promotes sustainable forest management that leads to emission reductions and the protection of carbon reservoirs (REDD+). It achieves this by providing scaled-up financing to developing countries for readiness reforms and public and private investments, identified through national REDD Readiness or equivalent strategies. The FIB subcommittee for Laos developed and endorsed the investment plan in 2011 and a first tranche of funding for MDB preparation and supervision services has been approved. Meetings were held with potential private sector partners including small and international plantation companies, Lao National Chamber of Commerce and Industry (LNCCI) who is a member of the National REDD+ Task Force, and the plantation and wood processing associations (Climate Investment Funds 2011).

A summary of this initiative is presented in the following table:

Name	Financing approach	Description	Results
Forest Investment Program (FIP)	Investment plan developed and endorsed by FIP subcommittee, resulting in a funding request of 20-30 million USD towards ADB, IFC and World Bank.	Three thematic components with defined success indicators (e.g. area, tons CO_2 sequestered): • Scaling-up Participatory Sustainable Forest Management in all state forest areas • Expanding village forest in unclassified forest areas • Smallholder forestry, including link to private sector partnerships • Crosscutting theme to ensure an enabling environment (through legal/regulatory reform, law enforcement, capacity building, development of PES and REDD+, MRV, and knowledge management)	1 million USD approved in FIP funding as preparation grants for two projects: • Protecting Forests for Sustainable Ecosystem Services (ADB) • Scaling-up Participatory Sustainable Forest Management (World Bank)

Agriculture in Laos is transitioning from subsistence farming to large-scale production of cash crops, a development that along with FDI-related land grabbing, energy projects and infrastructure development is increasingly driving deforestation. Resettlements and displacements lead to further deforestation and degradation. Markets are increasingly being liberalized since the 1990s, but initiatives for involving the private sector in forest protection remain limited. Promising policies such as the Forest Strategy 2020 and attempts for land titling and registration are starting. Yet these programs have to prove their success in providing alternative livelihoods for numerous shifting cultivators that so far have not been able to sustainably intensify their production.

Oil-palm plantation, Indonesia

Overview of Case Studies

The analytical framework employed above provides a new context for policy assessment and could present a useful tool for policy makers and program developers. Presently, the analysis employs the framework in providing an overview of the REDD+ countries, but this can be serve as the baseline for a more in-depth analysis in the future. Depending on the user's access to national or project-relevant sources of information, more detailed analysis can accompany the global indicators. The following table provides a summary of the key indicators explained in detail above:

Summary of key country indicators

Country	Deforestation Rate (%)	Stage in Forest Transition Curve (Figure 2)	Policy Inclusiveness	% of forest under public ownership	Equity[5]
Brazil	-0.42	HFMD	7.12	81	0.85
Cameroon	-1.07	HFLD	2.96	98	0.40
Indonesia	-0.71	HFHD	6.53	91	0.56
Laos	-0.49	LFLD	2.10	100	0.38

5 Gini concentration of agricultural holdings, range: 0-1, 0=equal distribution

6 Conclusion and recommendations

The success of REDD+ is closely interlinked with sustainable and inclusive agricultural and rural development. Good governance and value chain efficiency are preconditions to sustainable agriculture and sustainable intensification. Four pathways to address agriculture as a main driver of deforestation have been identified. These pathways ensure 'no regrets,' meaning they should be considered sustained investments in improving agricultural efficiency (Karsenty 2012). In other words, if REDD+ does not materialize at the international level in a timely and effective way, efforts along these pathways will in any case advance much-needed agricultural development.

Our case studies featured concrete lessons on how countries achieve progress in addressing agricultural drivers in national REDD+ processes. This section outlines investment opportunities for how the four identified pathways could be better integrated in German development cooperation.

Limitations

Before presenting the recommendations, it is important to discuss some limitations of the methodology. The chosen indicators are meant to be illustrative, showing general trends, and should not be considered a thorough representation of the chosen countries' agriculture sectors. The indicators were chosen in part based on the quality of the data available, which was considered more thorough for certain commodities, e.g. cereals. Trade-offs between relevance to deforestation and data robustness were made when choosing the indicators and indicative commodities.

Although this report focuses almost exclusively on supply-side drivers, it is important to keep in mind that demand-side measures have an impact, especially in the agriculture sector. Unsustainable consumer behavior is mostly a challenge for the more affluent part of society in developed and developing countries. Consumption choices can be influenced through a range of policy instruments that should be linked to pathways of aligning food security with forest protection outlined in this chapter. Influencing dietary choices and reducing food waste at the consumer end of the supply chain may help reduce agricultural expansion because it increases the available amount of food (Reay et al. 2012). For example, the mitigation potential of dietary change for future agricultural emissions is vast when considering the rapid increase of per capita meat, fish and dairy consumption during the past decades (FAOSTAT 2012); as well as projections for further exponential growth (OECD-FAO 2011), especially coming from Asia and Latin America middle class consumers. In industrialized and some transitioning countries however, policies that achieve a reduction in animal product consumption or successfully address excessive calorific intake (Reay et al. 2012) can tap into the mitigation potential of more sustainable consumption.

Decouple agricultural growth from agricultural area expansion

Agricultural outputs will need to increase in order to compensate for a growing global population and changing dietary habits that put more pressure on land. In order to minimize the conversion of more land to agriculture, investment in R&D must aim to increase attainable yields and reduce post-harvest losses by increasing supply chain efficiency. Public investment in this area was neglected for more than a decade and is recovering only slowly in response to food security concerns. With well-placed investments, natural resource-dependent economies whose agricultural outputs remain far below what agricultural best practice allow can result in yield breakthroughs. In any case, substantial investment in improved seed, extension and value chain development will be required.

Experience from the case studies demonstrates that achieving higher agricultural yields has been successfully decoupled from cultivated area expansion in various subsectors of the case study countries. For example, this happened for cattle and soy production in Brazil as well as for rice in Asia and overall crop production in Indonesia. Cases where delinking was mainly achieved by using more agricultural inputs, for example in the context of the Green Revolution in Asia, also highlight that related environmental costs of intensification can be extremely high unless sustainable agricultural land management practices and improved inputs are adopted. There are a number of well-known technologies and tools for sustainable agricultural intensification that integrate trees in the landscape and therefore can reduce natural forest degradation such as silvopastoral systems and other agroforestry systems for feed, food, fiber and mulch production. REDD+ activities would benefit from a close collaboration with agricultural development initiatives to identify and

address the main agricultural deforestation drivers at landscape and national levels. This would sharpen the profile of sectoral interventions towards low carbon land use strategies that link agricultural development and forest protection.

At the same time, investments in value chains that reduce post-harvest losses should become a key focus for development cooperation. Efforts to improve efficiency along the supply chain will improve food security while increasing farm revenues. Global studies have shown there is important room for productivity increases both in large and smallscale farms (McKinsey 2011, FAO 2011). Unfortunately national data is very limited on value chain efficiency for agricultural commodities in our country case studies, except for Brazil, but global and regional estimates indicate an enormous potential for efficiency improvements around the world. Despite regional differences in per capita food loss in meat and cereal production and fruit and vegetable commodities, the overall loss rates remain high. In developing countries, the perishable produce is wasted mainly in the early stages of the value chain – production and postharvest activities, mainly due to climatic conditions and grading for quality standards (FAO 2011).

Climate-smart agricultural[6] technologies should be promoted in land use based projects and programs in a systematic way, possibly by focusing on regional commodity clusters and priority value chains in agro-ecological zones together with smallholder producer associations and the private sector. The principles of sustainable intensification and low carbon land use integrating climate-smart agriculture and forestry interventions should be introduced in curricula of universities, become part of extension modules for ministerial staff and land user and become guiding principles in the design of natural resource and regional development funds.

Connect institutions and sectors for integrated rural development

Integrated institutional programming is imperative for the transition to climate-smart land use. Intersectoral information flows and monitoring processes in partner countries can be enhanced by tapping into existing sectoral and cross-ministerial steering structures at the national level. Creating new fora and mechanisms solely for the purposes of REDD+ and land use planning is likely to not be as successful as integrating into evolving structures. Natural Resource Management coordination committees and climate change steering groups made up of representatives from different sectors are suitable structures that should be strengthened to enable landscape level planning and to reduce agricultural deforestation drivers.

Numerous examples emerge from the country case studies where progress has been made in linking various institutions in the forestry and agriculture sectors for better planning and policy enforcement. The case study of Brazil shows that continued growth in agricultural production can (to a certain extent) be decoupled from deforestation; but this is contingent upon a combination of measures and effective institutional partnerships. Although high pressure from agribusiness and other actors with an interest in deforestation (e.g. local elites profiting from corruption) remains in the case study countries, all have formulated cross-sectoral land use policies that can help enable REDD+ if implemented and enforced on the ground.

Rural development strategies, especially in Cameroon, exemplify the constant negotiation processes in tropical countries that seek to reconcile development needs with environmental objectives. At present, land scarcity results in expanding new agricultural areas into forests and scrublands. However, cross-ministerial steering mechanisms that either exist or are being created alongside national climate change action plans can be used to bring sectors together for a better integrated economic-ecological zoning process.

6 Climate-smart agriculture, as defined by FAO (2013), contributes to the achievement of sustainable development goals by jointly addressing food security and climate challenges. It is composed of three main pillars: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change and reducing and/or removing greenhouse gases emissions, where possible.

Stronger collaboration between sectoral departments that fosters an integrated landscape approach in development cooperation must first start within the institutions of development cooperation themselves. Project and program design should take REDD+ beyond the forest frontier, integrating the sector causing the most forest loss in the tropics: agriculture. Capacity for integrated programming – already the core of the integrated development models of German Development Cooperation – should be established to allow partner countries to integrate the most appropriate mix of instruments in order to achieve cross-sectoral collaboration in land use based projects and programs.

Connect land users with information providers

A range of political, infrastructure, and supply-chain bottlenecks have limited the spread of best practices in agricultural techniques to developing countries and significant barriers remain in successfully transferring state of the art knowledge, in particular to smallscale land users and farmers. Case studies demonstrate that the success of agricultural R&D is not contingent on the amount of money spent, but instead on the ability to efficiently deliver knowledge to land users through a demand-based system. Public expenditure for agricultural research in Brazil, for example, has declined and stagnated after a period of large and targeted investment. Nevertheless, a combination of regional institutions creating economies of scale in research, competitive allocation of funds and the transparent provision of information to the public constitute an efficient R&D system that can be seen as a model for other developing countries. Land user cooperatives are key for information sharing on efficient land use management techniques among smallholder land users. They often already exist and can be very effective in disseminating relevant information. However, such cooperatives often lack a clear service provision business model and therefore there is limited demand for their services. A best practice review of existing producer cooperative information sharing and management approaches, considering the most recent information technological advancements, would be a useful starting point to strengthen information sharing among producer cooperatives.

Today's technological advances must be better harnessed in the natural resource management sector and projects should focus on improved communication between research and farmers, especially for smallholders who stand the most to gain from enhanced knowledge transfer. Information technology is now supporting smallscale farmers e.g. in Kenya to receive crop specific information via mobile devices (Loucky 2012). Digital networks have revolutionized the ability to generate, communicate, share and access data through an increasing number of people, devices and sensors that are now connected by digital networks. These networks can help to transform the productivity of resource systems and should be used to develop agricultural information systems.

A more detailed analysis of how information technology can support land user to improve their livelihoods while supporting REDD+ implementation would shed light on potential new business opportunities for smallholder land user and service provider while the information collected would improve demand driven research. Further analysis could also identify possibilities to connect privately funded research with smallholders to enhance information sharing.

Promote private sector engagement

Tropical countries with high deforestation rates and agriculture-dependent economies are often the ones that at the same time provide relatively unfavorable conditions for doing business. Nevertheless, industrial agribusinesses are either the major drivers of deforestation in these countries or are increasingly becoming so, e.g. in Cameroon and Laos. Dramatically growing rates of FDI in all four case study countries point to a high interest from the private sector (domestic and international) to expand agricultural production in these countries.

The challenge is to get private actors (from smallscale farmers to international corporations) fully on board for forest protection. The Soy Moratorium in Brazil and the Forest Moratorium in Indonesia show that it is possible, although implementation beyond what is on paper depends on the ability of powerful state governments and civil society to defend their common interests. Models

such as international and national private sector commodity roundtables and emerging public-private agricultural investment models that aim to promote sustainable development in regional clusters (e.g. Grow Africa) can engage the private sector in agricultural development without or limited deforestation. Global initiatives of leading commodity traders to source woody biomass for their drying- and processing-related heat and energy demand from sustainably managed woodlots in order to reduce natural forest degradation can use REDD+ money to pay for certification costs of agricultural commodities (RT-REDD 2012). Further analysis could test several of these private sector engagement models in order to identify its impact on REDD+ implementation and to scale and disseminate promising models within REDD+ national implementation frameworks.

This report emphasizes the need for strong governance structures to guide and control private actors, especially in industries that depend on natural resources. These structures and enforcement capacities are often lacking in developing countries, yet are the prerequisites for sustainable development. Public administrations should enforce transparency and codes of conduct in their day-to-day work with forest concessions, especially when it comes to land registration and taxes. Considering the German development cooperation's long-standing commitment to governance support, respective activities could be embedded in existing or new projects and programs.

Regarding incentives, a lot more can be done to involve the private sector in sustainable land use activities including Payments for Environmental Services, of which REDD+ is just one possibility. Many concrete initiatives in case study countries and elsewhere are currently exploring the options to link REDD+ money to commodity certification; to engage the private sector in sharing the environmental costs for water use and to involve institutional investors in sustainable agriculture and forestry at the landscape level via dedicated investment funds; to get agribusinesses interested in climate-smart and resource efficient value chains; or to reward local governments who uphold transparent and inclusive processes when providing land for agricultural and forestry development.

Recently cleared area, Panama

References

Angelsen, A. 1999. “Agricultural Expansion and Deforestation: Modelling the Impact of Population, Market Forces and Property Rights.” Journal of Development Economics 58 (1): 185–218.

———. 2010. “Policies for Reduced Deforestation and Their Impact on Agricultural Production.” Proceedings of the National Academy of Sciences 107 (46): 19639–19644.

Angelsen, A., Brockhaus, M. Kanninen, M., Sills, E., Sunderlin, W. and Wertz-Kanounnikoff, S. 2009. Realising REDD+: National Strategy and Policy Options. Bogor, Indonesia: Cifor. http://books.google.com/books?hl=en&lr=&id=vNavVSPOtioC&oi=fnd&pg=PR9&dq=realising+redd:+national+strategies&ots=C4u34Q5c76&sig=KEzXGmye4OYPpBR8HN4O3Jm1s4s.

Angelsen, A., Brockhaus, M., Sunderlin, W. and Verchot, L. eds. 2012. Analysing REDD+ Challenges and Choices. Bogor, Indonesia: Center for International Forestry Research (CIFOR).

ASTI. 2012. Agricultural Science and Technology Indicators. facilitated by IFPRI. http://www.asti.cgiar.org/.

Austin, K., Prasodjo, R. and Stolle, F. 2012. A New Direction in Climate Compatible Development: Indonesia’s Forest Moratorium. World Resources Institute (WRI): Climate & Development Knowledge Network.

Boucher, D., Elias, P., Lininger, K., May-Tobin, C., Roquemore, S., Saxon, E. and others. 2011. “The Root of the Problem: What’s Driving Tropical Deforestation Today?” The Root of the Problem: What’s Driving Tropical Deforestation Today? http://www.cabdirect.org/abstracts/20113229372.html.

Börner, J. and Wunder, S. 2012. “REDD+ the Brazilian way: Integrating old sticks with new carrots.” In Analysing REDD: Challenges and Choices, by Arild Angelsen. Bogor, Indonesia: Center for International Forestry Research (CIFOR).

Fometé, T. and Cerutti, P. “Verification in the forest sector in Cameroon.” (2008) in Legal timber: verification and governance in the forest sector. Brown, David, et al. (Eds.) Overseas Development Institute (ODI), 2009.

Chomitz, K.M. 2007. At Loggerheads?: Agricultural Expansion, Poverty Reduction, and Environment in the Tropical Forests. Washington, DC: World Bank Publications. http://books.google.com/books?hl=en&lr=&id=bIbu--faGGgC&oi=fnd&pg=PR5&dq=at+loggerheads&ots=7wYIeriKFd&sig=_wbbCVOLCmn6PrKcfykJPrs1-9A.

CIFOR. in progress. Learning from REDD: A Global Comparative Study. Global Comparative Study on REDD. Bogor, Indonesia: Center for International Forestry Research (CIFOR).

Cleaver, K. 2012. “Investing in Agriculture to Reduce Pverty and Hunger.” Internaitonal Food Policy Research Institute (IFPRI) 19 (2).

Climate Focus, Inc., IIASA, and UNIQUE Forestry Consultants. 2011. Carbon Market and Climate Finance for Climate-smart Agriculture in Developing Countries. DFID Climate Change, Agriculture and Food Security Policy Research Program. Washington, DC: Climate Focus Inc.

DeFries, R. and Rosenzweig, C. 2010. “Toward a Whole-landscape Approach for Sustainable Land Use in the Tropics.” Proceedings of the National Academy of Sciences 107 (46): 19627–19632.

Dermawan, A., Petkova, E., Sinaga, A., Muhajir, M. and Indriatmoko, Y. 2011. “Preventing the risks of corruption in REDD+ in Indonesia.” Summary report. United Nations Office on Drugs and Crime and CIFOR, Jakarta and Bogor, Indonesia.

Dewan, A. 2011. “Big Business Welcomes Deforestation Ban.” CIFOR Forests News Blog. http://blog.cifor.org/2979/big-business-welcomes-deforestation-ban/.

Dewbre, J., and de Battisti, A. B. (2008), “Agricultural Progress in Cameroon, Ghana and Mali: Why It Happened and How to Sustain it”, OECD Food, Agriculture and Fisheries Working Papers, No. 9, OECD Publishing.

Dkamela, G.P. 2011. “The context of REDD+ in Cameroon: drivers, agents and institutions.” CIFOR Occasional Paper (57). http://www.cabdirect.org/abstracts/20113387274.html;jsessionid=FAC6566ED082D42C82AB39A7C18EAD06.

EC. 2012. “Commission Staff Working Document Accompanying the Document Communication on Innovating for Sustainable Growth: A Bioeconomy for Europe”. European Commission (EC).

EC SCAR. 2011. Sustainable Food Consumption and Production in a Resource-constrained World. European Commission (EC) – Standing Committee on Agricultural Research (SCAR). SCAR Foresight Exercise. Brussels: European Commission (EC). http://ec.europa.eu/research/agriculture/scar/pdf/scar_feg3_final_report_01_02_2011.pdf.

Essama-Nssah, B., and Gockowski, J. J. 2000. Cameroon: Forest Sector Development in a Difficult Political Economy. World Bank Publications.

FAO. 1996. “Rome Declaration on World Food Security.” In Rome, Italy: FAO.

———. 2008. “An Introduction to the Basic Concepts of Food Security”. The EC - FAO Food Security Programme.

———. 2010. Global Forest Resource Assessment. Main Report, Key Findings and Databases. FAO Forestry Paper. Rome, Italy: Food and Agriculture Organisation (FAO). http://www.fao.org/forestry/fra/fra2010/en/.

———. 2012a. Impacts of Bioenergy on Food Security: Guidance for Assessment and Response at National and Project Levels. Environment and Natural Resource Management Working Paper. Rome, Italy: Food and Agriculture Organisation (FAO).

———. 2012b. “FAO Statistical Yearbook 2012. World food and agriculture.” http://www.fao.org/docrep/015/i2490e/i2490e00.htm

———. 2012c. “FAO Media Centre: Ten Central African Countries Agree to Improve Forest Monitoring.” http://www.fao.org/news/story/en/item/153735/icode/.

———. 2013. Climate-Smart Agriculture Sourcebook. Rome, Italy: Food and Agriculture Organisation (FAO). http://www.fao.org/climatechange/climatesmart/en/.

FAOSTAT. 2012. FAOSTAT. Rome, Italy. http://faostat.fao.org/.

Feintrenie, L., Chong, W. K. and Levang, P. 2010. Why Do Farmers Prefer Oil Palm? Lessons Learnt from Bungo District, Indonesia. Bogor, Indonesia: Center for International Forestry Research (CIFOR).

Fisher, B. 2010. “African Exception to Drivers of Deforestation.” Nature Geoscience 3 (6): 375–376. doi:10.1038/ngeo873.

Flaherty, K. 2011. “Benchmarking Agricultural Research Investment and Capacity Indicators Across Southern African Countries”. ASTI & IFPRI. http://www.asti.cgiar.org/pdf/ASTI-SADC-SAfrica.pdf.

Fuglie, K.O. 2010. “Sources of Growth in Indonesian Agriculture.” Journal of Productivity Analysis 33 (3): 225–240.

Gao, Y., et al. A global analysis of deforestation due to biofuel development. CIFOR, 2011.

Gibbs, H. K., Ruesch, A. S., Achard, F., Clayton, M. K., Holmgren, P., Ramankutty, N. and Foley, J. A. 2010. “Tropical Forests Were the Primary Sources of New Agricultural Land in the 1980s and 1990s.” Proceedings of the National Academy of Sciences 107 (38) (September 21): 16732–16737. doi:10.1073/pnas.0910275107.

Di Gregorio, M., Brockhaus, M., Cronin, T., and Muharrom, E. 2012. “Politics and Power in National REDD+ Policy Processes.” In Analysing REDD: Challenges and Choices, by Arild Angelsen. Bogor, Indonesia: CIFOR.

Griscom, B., Shoch, D., Stanley, B., Cortez, R. and Virgilio, N., 2009. Sensitivity of amounts and distribution of tropical forest carbon credits depending on baseline rules, Environmental Science & Policy, Volume 12, Issue 7, Pages 897-911, ISSN 1462-9011, 10.1016/j.envsci.2009.07.008.

Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R. and Meybeck, A. 2011. “Global Food Losses and Food Waste: Extent, Causes and Prevention”. United Nations Food and Agriculture Organization (FAO).

Hansen, M.C., Stehman, S.V. and Potapov, P.V. 2010. "Quantification of Global Gross Forest Cover Loss." Proceedings of the National Academy of Sciences (April 26). doi:10.1073/pnas.0912668107. http://www.pnas.org/content/early/2010/04/07/0912668107.

Hansen, M.C., Stehman, S.V. Potapov, P.V., Loveland, T.R., Townshend, J.R.G., DeFries, R.S., Pittman, K.W., et al. 2008. "Humid Tropical Forest Clearing from 2000 to 2005 Quantified by Using Multitemporal and Multiresolution Remotely Sensed Data." Proceedings of the National Academy of Sciences (June 30). doi:10.1073/pnas.0804042105. http://www.pnas.org/content/early/2008/06/27/0804042105.

Hosonuma, N., Herold, M., De Sy, V., De Fries, R.S., Brockhaus, M., Verchot, L., Angelsen, A., and Romijn, E. 2012. "An Assessment of Deforestation and Forest Degradation Drivers in Developing Countries." Environmental Research Letters 7.4.

IPCC. 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Vol. 446. November. Intergovernmental Panel on Climate Change (IPCC).

Karsenty, A. 2012. Financing Options to Support REDD Activities: Based on a Review of the Literature. Report for the European Commission DG Climate Action. CIRAD.

Koh, L.P. and Wilcove, D. S. 2008. "Is oil palm agriculture really destroying tropical biodiversity?" Conservation Letters 1 (2): 60-64.

Lambin, E.F. and Meyfroidt, P. 2011. "Global Land Use Change, Economic Globalization, and the Looming Land Scarcity." Proceedings of the National Academy of Sciences 108 (9) (March 1): 3465–3472. doi:10.1073/pnas.1100480108.

Lang, B. and Dotzauer, H. 2012. "Personal Communication at GIZ Seminar."

Loucky, J. 2012. Mobile Agriculture Understanding the Challenges and Opportunities for Sustainable Mobile Agriculture Solutions. Harvard Kennedy School: USAID.

Lundgren, L. and Lundgren, B. 2012. "Capacity development strategy and plan for the agricultural sector." Unpublished first draft.

Macedo, M.N., DeFries, R.S., Morton, D.C., Stickler, C.M., Galford, G.L. and Shimabukuro, Y.E. 2012. "Decoupling of Deforestation and Soy Production in the Southern Amazon During the Late 2000s." Proceedings of the National Academy of Sciences 109 (4): 1341–1346.

Martha, Jr., Geraldo B., Alves, E. and Contini, E. 2012. "Land-saving Approaches and Beef Production Growth in Brazil." Agricultural Systems 110 (0) (July): 173–177. doi:10.1016/j.agsy.2012.03.001.

Mather, A. S. 1992. "The Forest Transition." Area 24 (4): 367–379.

MINADER. 2006. Cameroon's Rural Sector Development Strategy.

Murdiyarso, D., Dewi, S., Lawrence, D. and Seymour, F. 2011. Indonesia's Forest Moratorium A Stepping Stone to Better Forest Governance? Bogor, Indonesia: Center for International Forestry Research (CIFOR).

Negra, C. and Wollenberg, E. 2011. Lessons from REDD+ for Agriculture. CCAFS Report no. 4. Copenhagen, Denmark: The CGIAR Research Program, Climate Change, Agriculture and Food Security (CCAFS).

OECD-FAO. 2011. OECD-FAO Agricultural Outlook 2012-2021. OECD Publishing. www.agri-outlook.org.

Orth, M. 2007. Subsistence Foods to Export Goods: The impact of an oil palm plantation on local food sovereignty, North Barito, Central Kalimantan, Indonesia. http://www.biofuelwatch.org.uk/wp-content/uploads/foodsovereigntyindonesia.pdf.

Palmer, K. 2011. "Financing Early Stage Agriculture in Africa." World Finance: 89–91.

Pereira, P., Martha, G.B., Santana, C.A.M. and Alves, E. 2012. "The Development of Brazilian Agriculture: Future Technological Challenges and Opportunities." Agriculture & Food Security 1 (1): 4. doi:10.1186/2048-7010-1-4.

Oil-palm plantation, Indonesia

Pistorius, T. 2012. "From RED to REDD+: the evolution of a forest-based mitigation approach for developing countries." Current Opinion in Environmental Sustainability.

PNAS. 2010. "Climate Mitigation and Food Production in Tropical Landscapes Special Feature." Proceedings of the National Academy of Sciences 107 (46) (November 16): 19627–19672. doi:10.1073/pnas.1011163107.

Rademaekers, K. (ECORYS), Eichler, L. (ECORYS), Berg, J. (ECORYS), Obersteiner, M. (ECORYS) and Havlik, P. (ECORYS). 2010. Study on the Evolution of Some Deforestation Drivers and Their Potential Impacts on the Costs of an Avoiding Deforestation Scheme. Specific Contract No. DG.ENV.G.1 VA/11 ARES(2008) 52924. In the Context of the Framework Contract No. DG ENV/G.1/ FRA/2006/0073. Brussels, Belgium: European Commission Directorate-General for Environment.

Rantala, S. 2012. Linking knowledge to action: "REDD+ policy making in Tanzania". In Analysing REDD: Challenges and Choices, by Arild Angelsen. Bogor, Indonesia: CIFOR.

Reay, D., Davidson, E.A., Smith, K.A., Smith, P., Melillo, J.M., Dentener, F. and Crutzen, P.J. 2012. "Global agriculture and nitrous oxide emissions." Nature Climate Change 2 (6): 410-416.

RT-REDD. 2012. "Slowing Climate Change Through Better Farming: Early Results of the 'RT-REDD Consortium'". The REDD Desk. http://www.theredddesk.org/sites/default/files/resources/pdf/2012/slowing_climate_change_through_better_fa.pdf.

Rudel, T. K., Coomes, O.T., Moran, E., Achard, F., Angelsen, A., Xu, J. and Lambin, E. 2005. "Forest Transitions: Towards a Global Understanding of Land Use Change." Global Environmental Change Part A 15 (1): 23–31.

Spielman & Birner 2008: How Innovative Is Your Agriculture? Using Innovation Indicators and Benchmarks to Strengthen National Agricultural Innovation Systems. Agriculture and Rural Development Discussion Paper 41. The World Bank.

The Economist. 2011. Economist Intelligence Unit. http://www.eiu.com/.

The REDD Desk. The REDD Desk: REDD Countries Readiness Overview. http://www.theredddesk.org/.

UCS. 2010. Deforestation Today: It's Just Business. Briefing. Tropical Forests and Climate. Washington, DC: Union of Concerned Scientists (UCS). http://www.ucsusa.org/global_warming/solutions/forest_solutions/deforestation-today-business.html.

UNDP 2009. "Employment and livelihoods. "The 4th National Human Development Report." Ministry of Planning and Investment and UNDP. http://www.undplao.org/newsroom/publication/Lao_NHDR_2009_EN.pdf.

UNFCCC. 2009. "Draft Decision -/CP.15 Proposal by the President Copenhagen Accord." In Vol. FCCC/CP/2009/L.7. Copenhagen, Denmark: United Nations Framework Convention on Climate Change (UNFCCC).

USAID. 2012. USAID Land Tenure and Property Rights Portal. Washington, DC. http://usaidlandtenure.net/.

La Viña, A., Ang, L., De Leon, A. and Roxas, M. 2012. "The UNFCCC After Durban: Recognising Limitations and Calling for a Multi-track Approach to Climate Multilateralism and Action". Foundation for International Environmental Law and Development (FIELD).

World Bank. 2005. "Institutional Innovation in Agricultural Research and Extension Systems in Latin America and the Caribbean."

———. 2007. Agriculture for Development. World Development Report 2008. Washington, DC: World Bank.

———. 2012a. Doing Business: Economy Rankings. Washington, DC: The World Bank. http://www.doingbusiness.org/rankings.

———. 2012b. "Inclusive Green Growth: The Pathway to Sustainable Development."

WWF. 2012. "Oil Palm Development in Cameroon." WWF. http://wwf.panda.org/what_we_do/footprint/agriculture/palm_oil/publications/index.cfm?204509/Oil-Palm-Development-in-Cameroon.

Zomer, R., Trabucco, A., Coe, R., and Place, F. 2009. Trees on Farm: Analysis of Global Extent and Geographical Patterns of Agroforestry. ICRAF Working Paper no. 89. Nairobi, Kenya: World Agroforestry Centre.

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