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INTERVENTIONS FOR ACHIEVING SUSTAINABILITY IN TROPICAL FOREST AND AGRICULTURAL LANDSCAPES

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ABSTRACT

The rapid expansion of commodity agriculture in tropical forest landscapes is a key driver of deforestation. To meet the growing demand from a more prosperous and expanding global population, it is imperative to develop sustainable commodity supply chains that support higher agricultural productivity, and that enable improved environmental, economic, and social outcomes. Interventions by community, market, and state actors can enhance the sustainability of supply chains by affecting where and how agricultural production occurs. These interventions—in the form of novel or moderated institutions and policies, incentives, or information—can influence producers directly or achieve their impacts indirectly by influencing consumer, retailer, and processor decisions. Global datasets were used to document the trends in deforestation and commodity agriculture production and a framework was developed to facilitate analyses of commodity supply chains across multiple interventions, commodities, and countries. The framework can be used to compare and explain the impacts of different types of supply chain interventions. The paper demonstrates how the framework can be used by generating hypotheses about decisions and choices of different actors and likely effects on commodity agriculture expansion.

Keywords: climate change, deforestation, greenhouse gas emissions, livelihoods, supply chain, sustainability

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Peter Newton[1] and Arun Agrawal, and Lini Wollenberg

1. CHALLENGES IN FOREST-AGRICULTURE LANDSCAPES

Tropical forest landscapes have been extensively modified by the cultivation of agricultural commodities including beef, cocoa, palm oil, rubber and soybean. The production of, and area occupied by, these commodities has grown rapidly over the last two decades (Monfreda, Ramankutty, and Foley 2008; Rudel et al. 2009; Table 1). Greenhouse gas (GHG) emissions from agriculture contribute 10–12 percent of global anthropogenic emissions, but the expansion of agriculture also indirectly contributes to emissions by driving deforestation. Approximately 80 percent of deforestation results from agricultural expansion (Kissinger, Herold, and De Sy 2012; Fig. 1) and 12–15 percent of total CO2 emissions occur because of forest conversion for agriculture (van der Werf et al. 2009). Aggregate food production will need to increase by approximately 70 percent by 2050 to feed a projected population of 9.1 billion people who will be two to four times richer than today (FAO 2009). Demand for agricultural commodities will continue expanding as global population growth, per capita food consumption, and a dietary shift to meat and processed foods continue to increase. These trends will put greater pressure on remaining forested areas (Nelson et al. 2010; Wirsenius, Azar, and Berndes 2010).

Tropical landscapes where agriculture and forests meet therefore present several key conservation and development challenges. First, conservation of remaining tropical forests in these landscapes is necessary to maintain biodiversity and ecosystem services, mitigate carbon emissions from deforestation, and maintain the provision of subsistence and income-generating resources for forest-based local livelihoods. Second, higher food production is needed to feed a larger, richer, global population, provide subsistence and income-generating opportunities for agriculture-based local livelihoods, and support trade in agricultural commodities for higher national incomes. Finally, creation and enforcement of secure tenure rights in frontier landscapes is necessary for legal, equitable resource access and land use, especially for local groups and indigenous peoples.

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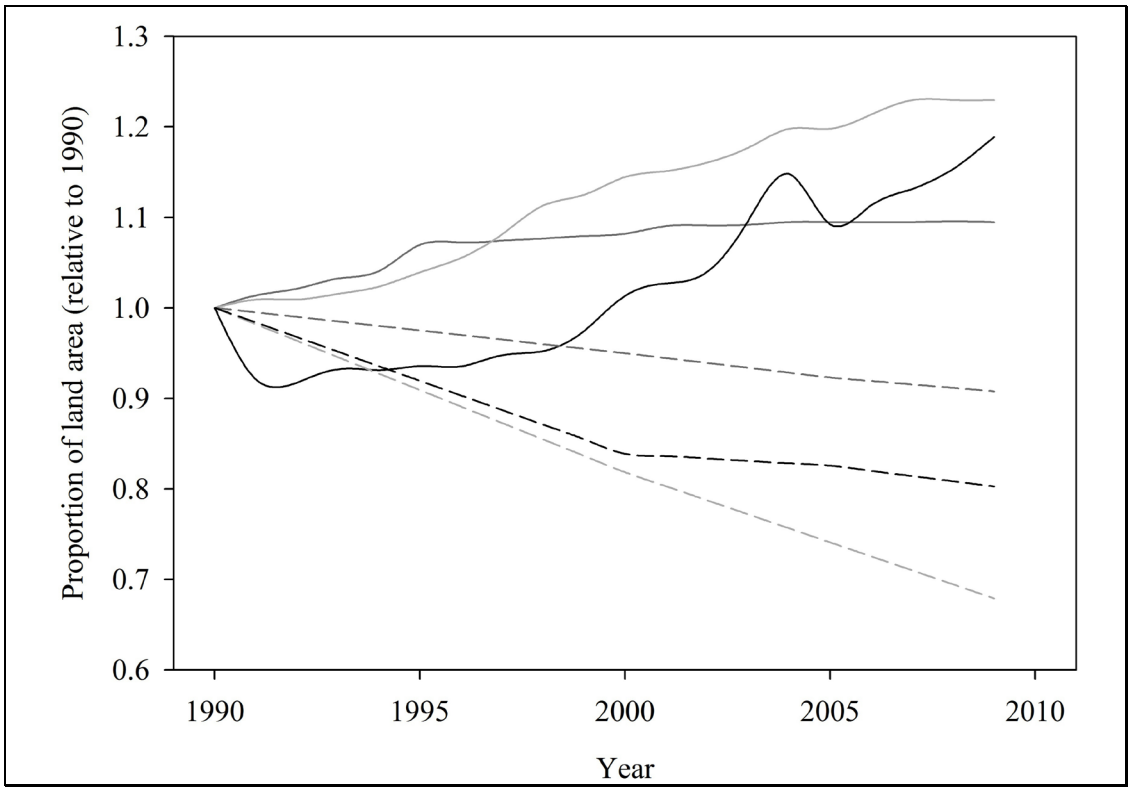
Table 1: The extent (in 2010) and change (since 1990) of area, yield, and production of key commodities in the top five producing countries globally

Commodity	Country	Area		Yield		Production	
		Million ha	% change	Hg/ha	% change	Million tons	% change
Cattle *	India					210.20	3.8
	Brazil					209.54	42.4
	USA					93.88	(2.0)
	China					83.80	5.4
	Argentina					48.95	(7.4)
Cocoa	Brazil	0.65	(1.6)	0.04	(7.4)	0.23	(8.9)
	Cote d'Ivoire	2.15	37.2	0.06	12.1	1.24	53.8
	Ghana	1.63	134.4	0.04	(8.1)	0.63	115.5
	Indonesia	1.03	546.0	0.08	(11.9)	0.81	469.1
	Nigeria	1.34	88.0	0.03	(6.8)	0.43	75.3
Palm oil	Indonesia	4.10	278.6			21.53	792.6
	Malaysia	3.60	108.6			16.99	178.8
	Thailand					1.29	469.7
	Nigeria					1.09	48.8
	Colombia					0.80	217.5
Rubber	Thailand	1.93	37.8	0.16	56.2	3.05	115.2
	Indonesia	3.06	64.3	0.09	33.1	2.79	118.6
	Malaysia	1.29	(20.1)	0.07	(16.8)	0.86	(33.5)
	India	0.45	55.7	0.19	83.9	0.85	186.2
	China	0.69	75.6	0.10	48.8	0.69	161.4
Soy bean	Argentina	18.13	265.4	0.29	34.7	52.68	392.3
	Brazil	23.29	102.8	0.29	69.8	68.52	244.4
	China	8.52	12.6	0.18	21.7	15.08	37.0
	India	9.21	259.2	0.11	5.0	9.81	277.1
	USA	31.01	35.6	0.29	27.5	90.61	72.9

Source: FAO stat, except data in italics: Koh & Wilcove 2008 (period: 1990-2005)
Notes: Negative numbers in parentheses; *cattle production measured in head, not tons

Addressing these challenges will require more systematic and considered governance of agricultural expansion and intensification, particularly with respect to the spatial distribution of agriculture relative to forests (Angelson and Kaimowitz 2001), improved access to and distribution of food, and reduced food waste.

Figure 1: Spatial trends in the relative abundance of agricultural land (solid lines) and forest land (dashed lines) in Brazil (dark gray), Ghana (light gray), and Indonesia (black) between 1990 and 2009



Data: FAO Stat (www.faostat.fao.org)

Commodity agriculture production in tropical forest regions can increase independently of deforestation, through intensification or by spatially disaggregating agricultural expansion from forest areas. Intensification to achieve higher yields (increased production per unit area) is a necessary but insufficient step towards preventing further deforestation. First, although higher yields were achieved historically through a combination of investments in labor, technology, fertilizer, seed stock, and irrigation (Naylor 1996), increased yields will not meet the entire future increase in demand. Second, higher local yields and productivity may over time generate profits and efficiencies that stimulate further agricultural expansion and forest encroachment, especially where demand for the commodity is growing and labor is available (Angelson 2010; Rudel et al. 2009). Third, while high-yield commodity agricultural expansion can decrease the total land area used (Burney, Davis, and Lobell 2010); this can bypass existing agricultural or degraded lands and encourage deforestation in primary forest areas. For example, high-yield palm oil development in Peru has primarily targeted primary forest sites, demonstrating the inadequacy of intensification alone as a mechanism for avoided deforestation (Gutiérrez-Vélez et al. 2011). Spatial disaggregation of agriculture and forests is therefore an additional part of the solution, with a particular need to develop regulatory or incentive mechanisms that overcome the problems of low productivity and high costs associated with agricultural expansion in low-carbon,

degraded lands. There is already some evidence of these mechanisms succeeding. In the Brazilian state of Mato Grosso, between the first and second half of the decade 2001–2010, higher productivity increased soy production by 22 percent with a corresponding decline in deforestation-causing soy cropland expansion (Macedo et al. 2012).

Innovations that support agricultural intensification must therefore be complemented by institutions and incentives that prevent expansion into forested areas (Wollenberg et al. 2011). A combination of more secure tenure rights and effective institutions are critical to ensure that the technical potential for agricultural mitigation is harnessed and implemented as interventions that will lead to deforestation-reducing land-use changes (Bryan et al. 2012). Effective governance of the agriculture and forest sectors will require coordinated efforts by governments of producer and consumer countries, by civil society, and by those directly involved in the supply chain (German, Schoneveld, and Pacheco 2011). Only through improved institutional support for innovative changes will some of the challenges of tropical-forest and agriculture landscapes be met.

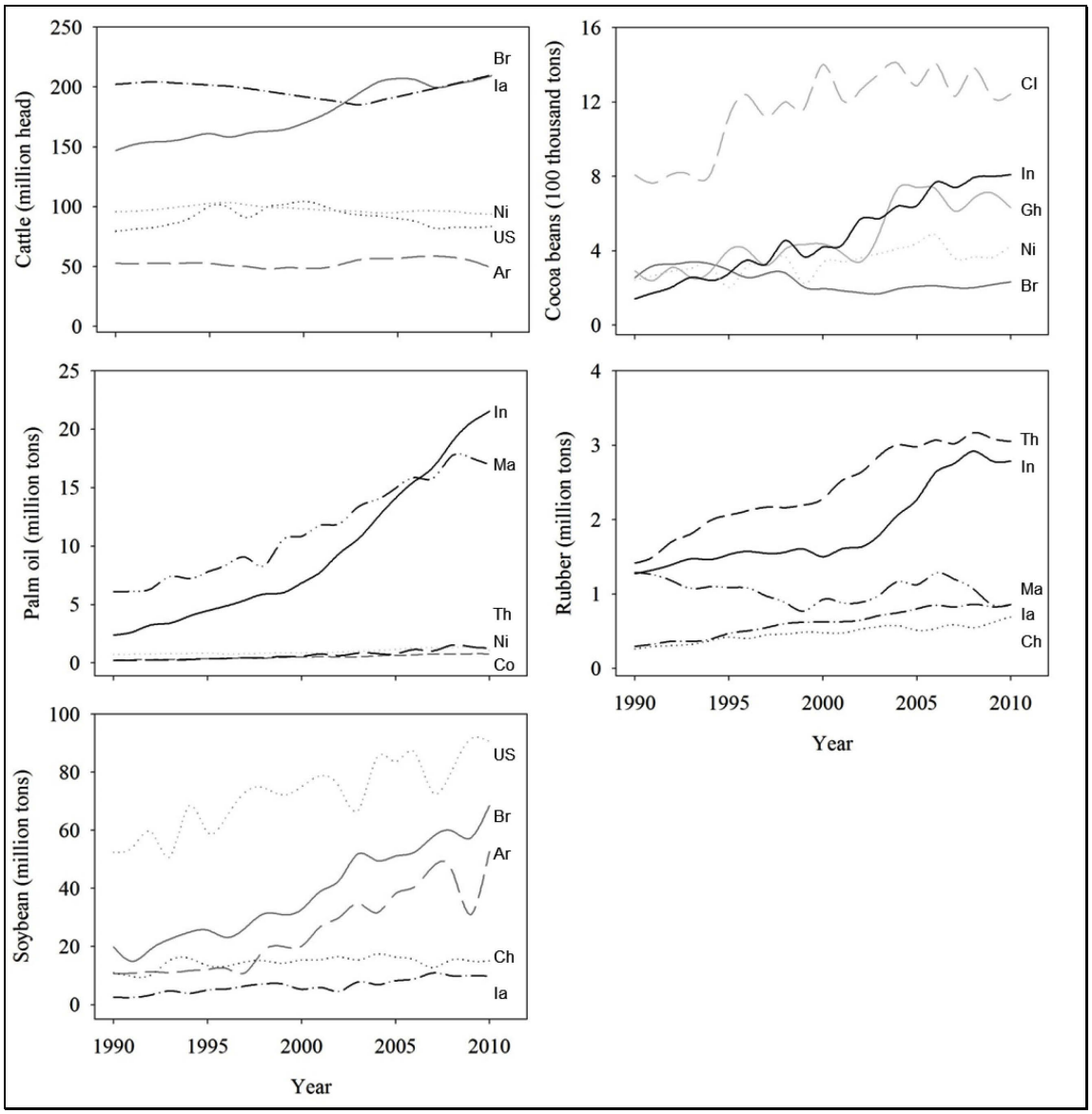
Nonetheless, the evidence base for assessing the impacts of different governance interventions in reducing the negative impacts of commodity agriculture production in tropical forest landscapes remains limited. As a first step to guide analyses of such interventions, this paper develops a framework for comparing and explaining the impacts of commodity agriculture interventions by different actors. It also outlines the governance arrangements associated with different types of intervention and generates hypotheses about the effects of different interventions on GHG and livelihood outcomes.

Section 2 of the paper reviews the trends, drivers, and impacts of production and spatial expansion for key agricultural commodities in tropical forest landscapes. Sections 3 and 4 describe the range of commodity agriculture interventions that are in the process of being developed and implemented in agriculture-forest frontier landscapes. Finally, sections 5 and 6 of the paper assess how different interventions can be expected to influence commodity agriculture production.

2. TRENDS AND IMPACTS OF KEY AGRICULTURAL COMMODITIES

This paper focuses on five commodities associated with high rates of tropical forest loss: beef, cocoa, palm oil, rubber and soybeans. There is considerable spatial heterogeneity across countries and continents in the impact of these commodities on deforestation: beef and soybean production dominate as agricultural drivers of deforestation in South America; palm oil and rubber are key drivers of deforestation in Southeast Asia; and cocoa has the largest impact on African forests (Barona et al. 2010; Wilcove and Koh 2010; Ziegler, Fox, and Xu 2009; Figure 2). All five commodities have demonstrated rapid and sustained growth in production across the countries in which they are principally produced (Figure 2).

Figure 2: Temporal trends in the production of five agricultural commodities by the top five producing countries in each case, between 1990 and 2010



Source: FAO Stat (www.faostat.fao.org). Line styles are consistent between graphs: North and South America (dark gray lines; *Argentina*: long dash (Ar); *Brazil*: solid (Br); *Colombia*: short-dash (Co); *USA*: dotted (US)), Africa (light gray lines; *Côte d'Ivoire*: long-dash (CI); *Ghana*: solid (Gh); *Nigeria*: dotted (Ni)), and Asia (black lines; *China*: dotted (Ch); *India*: dash-dot (Ia); *Indonesia*: solid (In); *Malaysia*: dash-dot-dot (Ma); *Thailand*: long-dash (Th)).

Beef

Brazil is the largest producer of beef globally, with a national cattle herd in 2006 of 171.6 million head (IBGE 2012; Table 1). Beef production is the primary direct driver of Amazonian deforestation: 75 percent of forest conversion in Brazil is associated with cattle ranching (Bustamante et al. 2012). Lessening the impact of small and large-scale ranchers on forest cover is therefore important to reducing

deforestation in Brazil. Livestock production in forest areas is driven by cheap land prices, increasing road access, a tradition of colonization, and pastures that become economically unviable after a few years. Beef production is also a driver of deforestation in other South American countries: the Amazonian cattle herd grew 11 percent annually between 1997 and 2004 (Nepstad, Stickler, and Almeida 2006) and ranching is estimated to be responsible for approximately 20 percent of deforestation in Bolivia (Killeen et al. 2008). More than 80 percent of Brazilian beef is consumed domestically (FAO 2012), but global population growth and shifts in dietary patterns are projected to increase meat demand by 85 percent by 2050 (FAO 2009; Kearney 2010), with the majority of demand from Asia, South America and oil-exporting countries.

Cocoa

Cocoa beans are the only commodity considered here for which production has been dominated by African countries: Côte d'Ivoire and Ghana were the first and third largest producers in 2010, respectively (Table 1; Figure. 2). Cocoa production in both countries is dominated by smallholder farmers (average farm size in Côte d'Ivoire is 2.8 ha), who generally achieve lower yields relative to domestic and global industrial producers (Robins and Baffoe 2012). At a global level, cocoa plays a small role in tropical deforestation, occupying only 0.3 percent of the total original tropical forest extent, globally. However, the local impact is significant: more than 13 percent of Côte d'Ivoire's original forest area had been converted to cocoa plantations by 2000 (Rice and Greenberg 2000). The driver of cocoa expansion is demand for the beans as an ingredient in chocolate, particularly in Europe which consumes 40 percent of the global production.

Palm Oil

About 88 percent of the global production of 50 million tons of palm oil in 2011 was produced in just two Southeast Asian countries, Indonesia (25.4 M tons) and Malaysia (18.7 M tons) (Hoyle and Levang 2012; Table 1; Figure 2). In both countries, more than half of oil palm expansion in the past decade has occurred in tropical forests and this is projected to continue (Koh and Wilcove 2008). The fate of tropical forests in Southeast Asia is therefore intrinsically associated with the development of oil palm cultivation. Palm oil is consumed globally, but consumption is dominated by huge Asian markets, particularly in China and India, and is expected to grow further irrespective of consumption patterns elsewhere (Wilcove and Koh 2010). Palm oil is the favored cooking oil in Asia, and production is also increasing in response to bioenergy demand (Sheil et al. 2009). Oil palm has also been a driver of deforestation in Colombia and Ecuador for two decades and is now expanding in South America as also in west and central Africa (Hoyle and Levang 2012; Butler and Laurance 2009). Countries such as Peru are creating legal incentives for palm oil cultivation, to stimulate economic growth (Gutierrez-Velez et al. 2011).

Rubber

Southeast Asia produces 97 percent of the world's natural rubber (Fox and Castella 2010; Table 1; Figure 2). Rubber plantations are established predominantly in

mainland mountain areas and do not compete directly with oil palm, but overall they have caused up to 500,000 ha of additional deforestation across the region (Ziegler, Fox, and Xu 2009). Montane forest loss has also led to soil erosion and disruption of hydrological systems. Demand for rubber stems largely from the increase automobile production and the need for tires in China (Li et al. 2007); global rubber production is projected to increase by 3.7 percent annually in the next decade and so the expansion of rubber is a substantial threat to forest cover in the region.

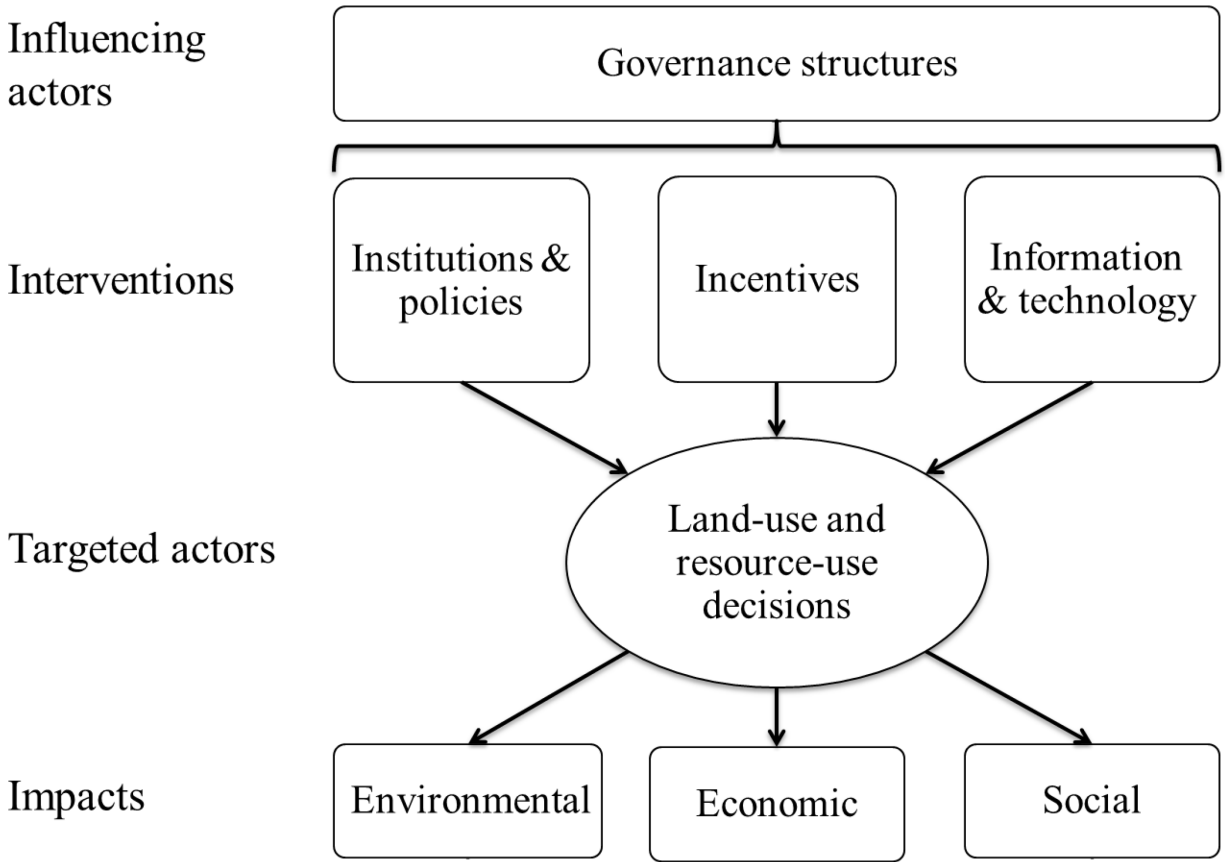
Soybean

Brazil is the second largest producer of soybean after the USA, supplying 26 percent of the world's total soybean output in 2010 (global total: 262.2 million tons; FAO 2012; Table 1; Figure 2). Soybean cultivation occurs both in forested areas (directly driving forest loss) and in the Brazilian *cerrado* (grasslands), where it indirectly drives deforestation by pushing up land prices, creating infrastructure and access, and displacing smallholders and cattle ranchers into forest areas (Barona et al. 2010; Dros 2004; Nepstad, Stickler, and Almeida 2006). There is little scope for further increasing yields of soybean in either the USA or Brazil (Licker et al. 2010), implying that without technological breakthroughs, additional production increases in those countries will require expansion. Approximately 83 percent of soybean is used for livestock feed for cattle, pigs, and chickens, principally in Europe and North America, and global production is expected to increase from 237 million tons per year (2010) to over 300 million tons per year by 2020 (Dros 2004).

3. FRAMEWORK I: COMMODITY AGRICULTURE SUPPLY CHAINS

Interventions can be broadly defined as novel or modified institutions and policies, incentives, and information and technology designed to influence the behavior of individuals or groups—in this case, in relation to agricultural commodity production (Agrawal and Ribot 2012; Figure 3). Institutions are the formal and informal mechanisms that structure social and individual expectations, behaviors, and interactions. Policies implemented by local, regional, and national government agencies may affect production, such as by prohibiting activities that encroach on forest land or by creating the legal framework for the development of more sustainable alternatives, or consumption, such as by reducing demand for commodities from environmentally damaging land uses. Incentives include both rewards ("carrots") and disincentives or sanctions ("sticks") (Börner et al. 2011). Rewards are represented by financial compensation that encourage land-use changes that may not otherwise be economically viable; disincentives are taxes, fines, or sanctions that make lucrative but ecologically damaging activities less profitable. Finally, producer access to new information or technological innovations can lead to more sustainable and profitable agricultural practices, and consumer awareness of environmental or social impacts of commodity production can significantly alter the demand for that commodity.

Figure 3: The relationship between actors, interventions and impacts



Source: Devised by authors

All interventions in forest-agriculture landscapes aim to increase the sustainability of commodity production to enhance environmental, economic, and/or social outcomes. Agricultural commodity production is directly tied to market demand and supply trends, and so effectively implemented and enforced interventions that influence one or more actors or linkages within supply chains have the potential to exert influence on the production of agricultural commodities. The assessment of how interventions influence producer behavior therefore focuses on the supply chain context.

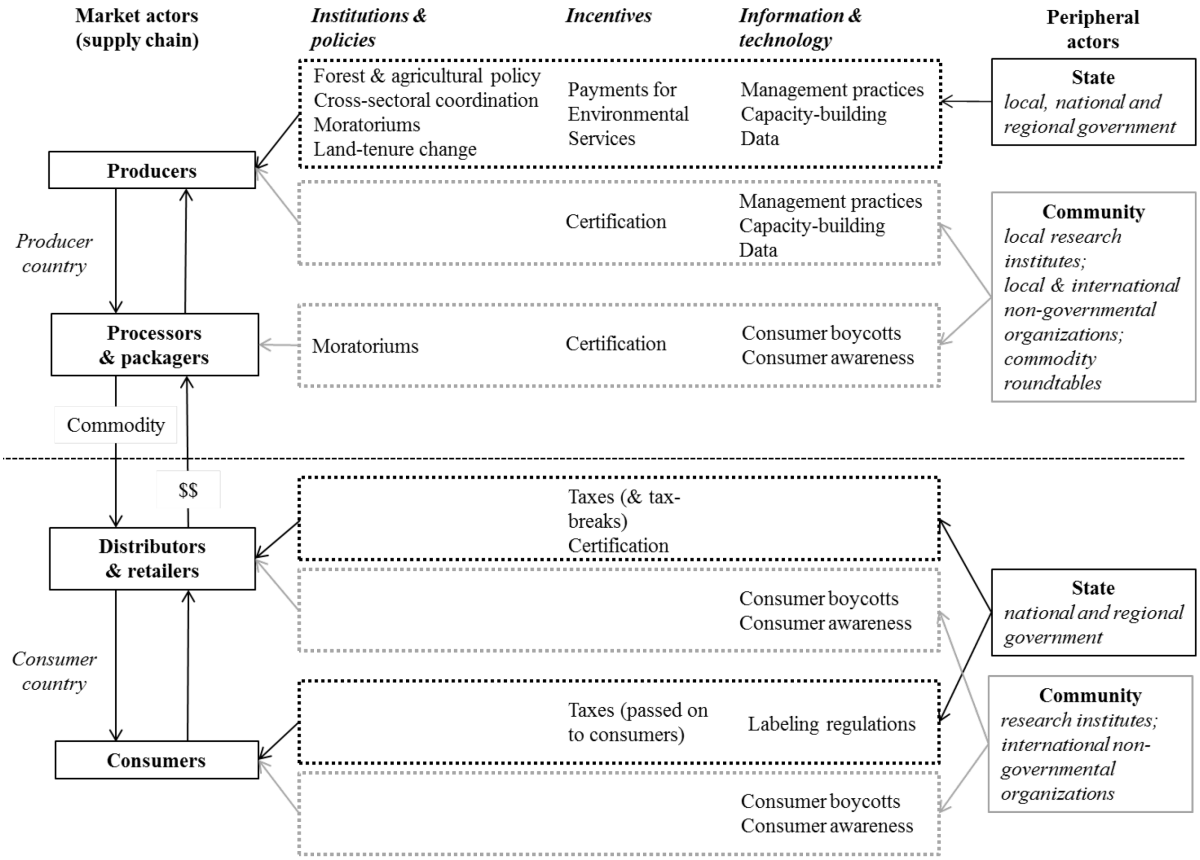
Supply chains vary in complexity, but can be thought of as involving actors in three principal *sectors*: the market, the state, and civil society (or *community*, from hereon) (Lemos and Agrawal 2006). Market actors are directly involved in the supply chain; state and community actors are relatively more peripheral stakeholders that can nonetheless exert substantial influence on the chain even without being obligate participants (Smith 2008). In turn, each sector contains several distinct *groups* (from hereon) of actors. Key groups of actors within the market sector include producers, processors and packagers, distributors and retailers, and consumers (Ericksen 2008), as well as producer institutions such as cooperatives. Groups of state actors include all levels of government (local, national, and regional) both in producer and in consumer countries. Finally, the principal groups of actors within the community sector include NGOs

(nongovernmental organizations) and civil society groups; research institutions and commodity roundtables are also included in this sector. Research institutions may be state-funded, but usually maintain a large degree of autonomy. Commodity roundtables are multistakeholder initiatives that seek to improve agricultural sustainability by incentivizing producers to adhere to sustainability standards (Brassett, Richardson, and Smith 2011). They explicitly exclude government actors, but convene groups from both the community and market sectors, including producers, retailers, NGOs, and academics. Most commodity roundtables have been initiated by, or are closely associated with, an NGO: such as the World Wildlife Fund (WWF) with the Roundtable on Sustainable Palm Oil (RSPO) and the National Wildlife Foundation (NWF) with the Brazilian Roundtable on Sustainable Biofuels (RSB).

4. FRAMEWORK II: DESCRIBING THE MAJOR SUPPLY CHAIN INTERVENTIONS

Interventions implemented by community, market and/or state actors can influence any one or more market actors in the supply chain (Smith 2008). They can do so by creating new patterns of behaviors through changed governance structures that target the land-use practices of agriculture commodity producers, the sourcing policies of distributors and retailers, or the purchase decisions of consumers (Figure 4). A wide variety of specific interventions have been used across tropical landscapes with diverse impacts on emissions and livelihoods. Interventions can be broadly classified as being most closely associated with one of the three categories of institutions, incentives, or information, and it is convenient to consider different interventions within this classification system. However, an intervention may bridge more than one category: for example, an agricultural certification program offers both an incentive to producers (a higher sales price), as well as information to consumers (awareness of environmental and social impact). Here, some of the major interventions used in forest-agriculture landscapes are outlined, grouped within the three categories according to the relative emphasis on institutions, incentives and information in each case.

Figure 4: A framework for analyzing the opportunities for actors to influence commodity supply chains through interventions



Source: Devised by authors

Institutions and Policies

Forest Policy

Forest policies at both the national and state level can significantly alter deforestation and land-use by producers. For example, Brazil's forest code (law 4.771) requires Amazonian landowners to retain at least 80 percent of their properties as forest. A proposed revision of the code (April 2012) threatened to reduce this proportion to just 50 percent, which—had it not been vetoed by the Brazilian president—would have opened the gateway for the clearance of considerable additional forest for cattle ranching (Tollefson 2012). Similarly, a two year moratorium by the Indonesian government on new permits for oil palm and timber concessions, which began in 2011, is expected to directly reduce the extent of legal deforestation within peatland forests (Austin, Sheppard, and Stolle 2012; Clements et al. 2010; Sloan, Edwards, and Laurance 2012). National forest land-use policy can therefore, depending on its intent and effectiveness, rapidly either augment or diminish the potential to control agricultural expansion.

Agricultural Policy

Agricultural policy that promotes intensification, expansion or altered practices can also directly affect forest cover. For example, rapid deforestation in Brazilian Amazonia between 1960 and 1980 was in part attributable to federal programs that used tax incentives, credit access and subsidies to encourage investment in large-scale farming and cattle ranching (Fearnside 2005). More recently, national policies that promote oil palm development in Indonesia have demonstrated direct conflict with targets for reduced deforestation and greenhouse gas emissions (Colchester et al. 2006).

Cross-Sectoral Coordination

Conflict or coordination between forest and agricultural policy can dramatically enhance or reduce progress towards deforestation goals (Kissinger, Herold, and De Sy 2012). Such conflict is demonstrated in Indonesia, where local government support for oil palm development to provide jobs and income contrasts with national-level goals for reduced deforestation and GHG emissions. Conversely, actor and policy integration has been successfully demonstrated in two cases in Brazil. First, the state of Acre is piloting a subregional program under the Reducing Emissions from Deforestation and forest Degradation (REDD+) initiative as part of the Acre Sustainable Development Plan, which offers a mix of incentives and payments that encompasses all land types, including both forests and agriculture, and all scales of producer (Kissinger 2011). Second, the ProAmbiente program that engaged smallholders in planning and accounting for their land-use activities provides valuable lessons in designing cross-sectoral REDD+ strategies (Moutinho et al. 2011).

Commodity Moratoriums

Moratoriums may directly contribute to GHG emissions reductions by affecting producer and processor behavior in the long term, or may simply buy time for alternative governance mechanisms to be implemented (Austin et al. 2012). A number of commodity-specific moratoriums have positively affected land-use change via the supply chain. For example, the 2006 Soy Moratorium—a pledge by major soybean companies not to trade soybean produced in deforested areas of the Brazilian Amazon—showed signs of success after just five years (Boucher et al. 2011; Rudorff et al. 2011). A similar moratorium was begun in 2009 by major Brazilian retailers, slaughterhouses, and distributors who stopped purchases of cattle reared on pasture created by forest conversion (Boucher et al. 2011). Both the soy and beef moratoria were initiated at least partly as a result of pressures from civil society—largely in response to Greenpeace (2006 and 2009) reports that highlighted these commodities as key drivers of Amazonian deforestation. Finally, in an example from a consumer country, the palm oil importer associations of both Belgium and The Netherlands have committed to allowing only sustainable palm oil into those markets by 2015 (Task Force Sustainable Palm Oil 2010).

Land Tenure Change

Poorly defined land tenure and insecure resource access rights are frequently cited as obstacles to forest conservation and livelihood development, for several reasons (Sunderlin, Larson, and Cronkleton 2009). First, clear land tenure is often a prerequisite to enrollment in incentive initiatives such as REDD+ programs, but such clarity is not frequently associated with the forests used by marginalized groups, including indigenous people and traditional forest populations (Sunderlin, Larson, and Cronkleton 2009). These groups may therefore be excluded from engaging in programs that would increase their capacity to maintain forest quality and to prevent agricultural expansion through forest conversion. Poorer households in South America were less likely to enjoy secure land tenure, to possess a formal land title, or to be able to afford the opportunity or transaction costs, all of which acted as obstacles to participation in payments for environmental services programs (Pagiola, Arcenas, and Platais 2005).

Second, many tropical forest countries contain a large areal extent of previously deforested land, but opportunities to divert agricultural expansion onto such degraded lands can be restricted by poor clarification of land tenure. Indonesia contains at least 12 million ha of such "degraded lands" and possibly as much as 30 million ha (Persey et al. 2011), yet primary forest continues to be cleared to establish new oil palm plantations. Agricultural expansion into degraded land is in part constrained by economic factors (for example, recently converted pasture is more productive than degraded land; oil palm concessions in primary forest areas carry the benefit of timber sales as an intermediary revenue stream before the plantations become profitable), but is also hindered by legal considerations (for example, degraded land often does not have clear tenure). In Indonesia, such uncertainty may be expressed as existing land-use claims from companies and communities or by differences in land-use classification and planning at the levels of national and local government. Similarly, oil palm plantation developers in Peru tend to avoid previously cleared land as it is "frequently under uncertain and disputed tenure; it is simpler to establish tenure over forests, officially owned by the State" (Gutierrez-Velez et al. 2011). A number of organizations are attempting to facilitate a shift of commodity agriculture expansion from primary forest onto degraded land.

Legally recognized and enforced land rights and resource access have the potential to shift land-use away from deforestation and damaging agricultural practices, and to enable forest conservation mechanisms. But undertaking such clarification can be politically costly and government action to clarify tenure has a long history of difficulties (Robinson, Holland, and Naughton-Treves 2011).

Incentives

Payments for Environmental Services

Payments for environmental services (PES) are financial incentives that reward improved land-use and are a direct, conditional mechanism for conservation (Wunder 2005). Within forest landscapes, the most prominent PES initiative is that of Reducing Emissions from Deforestation and forest Degradation (REDD+). REDD+ is a set of international policies and incentives by which countries able to reduce

GHG emissions from the clearing of forests can be compensated (Angelson 2008; Parker et al. 2009). Many jurisdictions are also exploring how voluntary carbon market approaches for avoided deforestation that reward individuals, communities and projects on a subnational scale could potentially nest into national-level REDD+ strategies. Critics have observed that REDD+ has been the subject of lengthy discourse, but that implementation to date has been limited. However, some REDD+-type programs are already working with forest communities. One example is the Katingan Peatland Restoration and Conservation Project in an area of Kalimantan with high pressure for conversion to oil palm plantations. The project seeks to "reduce greenhouse gas emissions within a peat land forest concession by avoiding previously planned deforestation from land conversion and by restoring and conserving peat swamp forests, while safeguarding community and biodiversity benefits" (Hartono and Utama 2012). By engaging communities in conservation, creating alternative income-generating opportunities and promoting sustainable forest management, the Kalimantan Peatland Project and others like it have sought to ensure that forest conservation is a preferable land use compared to conversion for agriculture. Including incentives in these programs for actors in the supply chain of major commodity crops could further reduce pressures for conversion.

In addition to multilateral commitments to the REDD+ process, a number of national governments have independently committed funds to support avoided deforestation goals in countries with high pressure to clear forests via bilateral funding arrangements. Leading these initiatives has been Norway, independently agreeing performance-related payments of $0.25 billion to Guyana and $1 billion both to Brazil's Amazon Fund and to Indonesia in return for verifiable reduced deforestation rates (Clements et al. 2010; Donovan, Clarke, and Sloth 2010; Tollefson 2009). Similarly, in a 2010 agreement with the UNDP the government of Ecuador pledged not to extract a vast oil reserve under its Amazonian Yasuni Reserve, in return for approximately US $7 billion raised in emissions credits (Finer, Moncel, and Jenkins 2010). A subnational example of REDD+-type efforts to mitigate emissions can be found in California's Global Warming Solutions Act, which caps future emissions in California. Based on this Act, efforts are underway to regulate emissions in a number of high forest cover provinces including 13 in developing countries (Agrawal, Nepstad, and Chhatre 2011).

REDD+ is a direct means for governments of high-GHG emissions countries to commit funds as rewards to countries that achieve lower rates of deforestation. However, financial incentives at a national level have to date largely focused on the forest sector and do not directly address the drivers of deforestation. It remains to in-country state and community sector actors to find ways to translate those funds into avoided deforestation.

Commodity Standards and Product Certification

Formal, voluntary certification schemes are experiencing rapid growth in scope, area, and prevalence (Cohn and O'Rourke 2011). Standards are usually based on a combination of environmental and social objectives, such as operational GHG emissions, avoided deforestation, or employee working conditions (NWF 2011). Third-party certification programs, including those developed by commodity roundtables and by collective groups such as the Sustainable Agriculture Network, exist for many products, and the programs themselves are often certified by an

independent body such as ISEAL, whose code of good practice is seen as a global reference for developing commodity standards. Some certification programs have achieved measurable impact: palm oil approved by the Roundtable on Sustainable Palm Oil (RSPO) accounted for >10 percent of the global trade in 2011 (Kissinger 2012), and the Rainforest Alliance certifies more than 100 crops and is now effective in 25 tropical forest countries globally. Certification programs exert influence at both ends of the supply chain, in the sense that they offer incentives to producers in the form of greater market access, higher buying prices or protected reputations, and to consumers through assurances of lower environmental impacts of their consumption choices.

Taxes and Trade

Governments of consumer countries have the power to affect the supply chain by introducing tax breaks or providing subsidies to certified producers, or by levying taxes on noncertified commodities. For example, in 2011 the EU proposed to remove import duties on sustainable (RSPO-certified) palm oil to encourage production in producing countries. Conversely, increased taxes on noncertified commodities would drive up their cost, and amplify the demand for sustainable commodities. Trade restrictions, such as the proposed EU requirement for biofuel producers to pay a fee to offset net carbon emissions, would have a similar effect (Wilcove and Koh 2010). While a tax could be considered a regulation or policy, its principal effect in these cases is to incentivize behavior associated with greater sustainability, rather like a PES.

Information

Better Management Practices

Agricultural production may be increased through the introduction of novel technology, information, or farming practices, collectively termed "better management practices" (Clay 2004). However, access to new information and technologies may not be equal across producers, and smallholders and individual farmers particularly may not share the same access to resources as larger scale producers. Imperfect information may constrain producers' knowledge about different production methods, market opportunities, economies of scale, and the trade-offs between short- and long-term gains and losses that result from specific land-use decisions.

External actors who facilitate improved flows of information can thus favorably alter producer behavior to yield improved outcomes for both the farmer and the environment. Capacity-building, education, and awareness-raising programs can facilitate the adoption of better practices by producers, lessen their negative impacts, and increase the sustainability of production. Examples include: 1) the Brazilian Agricultural Research Corporation (EMBRAPA), a state organization that aims to "provide solutions for the sustainable development of Brazilian agribusiness through knowledge and technology generation and transfer". 2) Smallholder cattle ranchers in the Brazilian Amazon regularly clear-fell extensive forest areas on their properties to maximize pasture for their herd, but could benefit from leaving some trees standing. Evidence suggests that small forest

patches provide critical shade for cattle, stabilize topsoil, extend the life of pasture, and are a valuable source of firewood, all of which can, in aggregate, lead to greater beef production and improved ecological outcomes. An initiative in Brazil involving the Roundtable on Sustainable Livestock (GTPS) and other groups is attempting to disseminate this information and these ideas, but engaging with hundreds of land owners across the Amazon is challenging (N. Walker pers. comm.). 3) The "Land-Neutral Agriculture Expansion" mechanism could more formally align sustainability and productivity objectives while guarding against leakage (Strassburg et al. 2012). Finally, 4) the anticipated rapid expansion of oil palm plantations in Africa threatens the integrity of forests in countries such as Ethiopia, Ghana, and Cameroon. The "RSPO Africa Roadshow" delivers a capacity-building and awareness-raising program involving information and training across these countries and could help smallholders transition into production of this commodity (Proforest 2012).

Consumer Awareness

At the other end of the supply chain, even discerning consumers can only make informed decisions about the products that they purchase if the required information is available at low or no cost. Innovative labeling has the potential to inform consumers about the content and impact of their purchases, and may be introduced as law or as a result of corporate initiatives. For example, in 2011 the EU introduced Regulation 1169/2011, compelling companies selling products containing "vegetable oils" (as they were formerly and generically permitted to be listed) to provide a breakdown of every oil contained in the product, including palm oil. Similarly, the British supermarket chain Tesco piloted a scheme in 2007 to label individual products with an estimated carbon footprint, although the idea was abandoned as too complex to implement. But when available, such information can have a substantial effect on consumer decisions. One study found that consumers who associated margarine made with palm oil with threats to an iconic endangered species such as the tiger, via illustrative product labels, would readily pay a premium for an alternative product that had a lower perceived environmental impact (Bateman et al. 2010).

Consumer Boycotts

Information and awareness can manifest themselves not only in individual daily consumption decisions but in the harnessing of collective consumer voices and choices to persuade state and market sector actors to implement further changes to policy or practice. In practice, there are few successful examples of consumer boycotts because it is difficult to mobilize a large enough proportion of the market for the boycott to make a major difference in a large company's revenues. In 2010 Nestlé committed to sourcing only sustainable palm oil by 2015, following a campaign video by Greenpeace that accused Nestlé of using palm oil sourced from deforested regions of Southeast Asia and that encouraged consumers to boycott Nestlé products. However, it's unlikely that either share price or sales were directly affected, and the change was probably more due to the damaging negative publicity from social media pressure.

Corporate Social Responsibility

Even in the absence of direct pressure from state or community sector actors, or from consumers, other market sector actors can play an important role in the shift towards sustainable supply chains. Corporate social responsibility (CSR) can lessen the negative impacts of commodity production, particularly if a majority of actors within a given supply chain are engaged, and if those actors view sustainability as an imperative responsibility rather than only a reactionary response to market pressure (Kissinger 2012). Unilever's Sustainable Living Plan (Unilever 2010) commits to source all of its agricultural raw materials sustainably, and is a business-initiated policy shift towards sustainability (Kissinger 2012). On a more aggregated scale, the Forest Footprint Disclosure project works with multinational companies to publically assess their impact on deforestation, while the Consumer Goods Forum members pledged in 2010 to sustainably source soy, palm oil, beef, paper and board by 2020. Such initiatives may be small scale relative to overall production, but represent an acknowledgement by businesses of the need for sustainability, and a willingness to engage, even if CSR decisions are driven by financial rather than by environmental motivations.

Data

Data from satellite imagery and remote-sensing technologies, as well as from collations of national databases (such as FAOstat), are increasingly accessible to market, state and community actors, enabling them to observe, monitor, analyze and present information about commodity agriculture and deforestation with increasing accuracy and timeliness (International Sustainability Unit 2012). Such temporally and spatially extensive data may play a key role in targeting interventions and may act as a disincentive in their own right: awareness of illegal deforestation detectability may deter potential perpetrators. Extensive monitoring and increased transparency by the Brazilian space research agency (INPE) is credited with some of Brazil's success in reducing deforestation rates. INPE made their data freely available online from 2003, allowing independent research including that which led to the publication of reports (referred to above) associating deforestation with the soy and beef industries (Greenpeace 2006, 2009).

5. FRAMEWORK III: SUPPLY CHAIN ACTOR ROLES

All of the interventions discussed above can contribute to reduced deforestation by building sustainable commodity supply chains that influence where and how agricultural production takes place. Some interventions directly target individual producers, while others target different market sector actors (Figure 4). For example, REDD+ payments to a farmer may directly determine whether that farmer clears a patch of forest. In contrast, an NGO campaign that highlights the negative impacts of commodity agriculture on tropical forests or wildlife may alter consumer-level demand, causing sensitive retailers or processors to alter their sourcing policies, in turn pressuring producers to conform to new sustainability standards to prevent loss of sales and revenue.

Producers

Commodity supply chains are characterized by varying numbers of market actors within each group; for example, palm oil production in Indonesia is dominated by a few large commercial operatives, whereas cocoa production in Côte d'Ivoire is characterized by a large number of smallholder producers. Such differences in supply chain structure mean that state and community actors seeking to influence supply chain processes need to use strategies modulated to the specific context of their intervention. Instigating a change in production methods for a commodity dominated by a small number of large-scale producers may justify specific strategies targeted at individual producers. State and community actors may have to engage large businesses which have the power to resist unprofitable change but which, if successfully engaged, can alter the nature of the markets rapidly and dramatically.

In contrast, altering land-use behavior within commodity supply chains characterized by a large number of smallholders entails high transaction costs since it is challenging to engage and influence all the different actors. However, ecologically damaging land-use options such as forest conversion are usually more marginally profitable for smallholders and so the opportunity costs to overcome are lower. Therefore, each individual landowner may be less resistant to policy change and there may be greater potential for incentives to tip the balance in favor of more sustainable land-use practices.

Distributors and Retailers

A small number of major distributors and retailers dominate several major commodity supply chains. These companies have strong incentives to protect their market share and reputations, and so are sensitive to consumer pressure. If these companies adopt codes of good practice or implement assurances of sustainability in sourcing commodities, substantial pressure can be exerted on producers to comply with these standards. Examples where the market influence of large retailers has been leveraged include McDonalds' Sustainable Land Management Commitment which pledged to move towards buying five commodities, including beef and palm oil, from sustainable sources (Mongabay 2011). Another example is the commitment by Nestlé, Proctor & Gamble and Unilever to source only sustainable, RSPO-certified palm oil by 2015 (Laurance et al. 2010).

Consumers

Patterns of consumption are determined both by individual decisions, which may be influenced by dynamic societal or cultural norms, and by policies affecting consumer choice of, and access to, commodities. However, the potential for interventions that target consumers to affect supply chains is limited to the extent of influence of that consumer group in the total market. For example, the UK consumes just 1 percent of palm oil traded internationally: as an individual country it can only have only a limited impact on the palm oil industry, even with tough legislation and controls against imports and sales of unsustainably produced oil. In contrast, EU countries collectively account for 22 percent of consumption. Policy changes at this level thus offer much greater scope for influencing the market (DFID 2012). Even so, 78 percent of production remains unaffected by any EU

mechanism that encourages better production methods, and more than 50 percent of palm oil is consumed in China and India. These countries have so far shown less inclination to make discriminatory choices and, unless consumers in those markets can be persuaded to buy into sustainably sourced oil, the demand for cheap (and unsustainable) palm oil will continue to grow. The success of roundtables and certification programs may be limited if the biggest markets for commodities do not demonstrate a demand for such programs.

6. DISCUSSION

A huge diversity of interventions, based on new or adapted institutions, incentives, and information, has been and is being developed and implemented by community, market, and state actors to reduce deforestation and greenhouse gas emissions associated with commodity agriculture expansion, and to improve livelihoods in forest-agriculture landscapes. There is a growing body of literature that characterizes individual interventions and their impacts, and that documents the challenges of implementing these interventions. However, research has focused largely on individual commodities, cases, and countries, with relatively little comparative analysis across contexts. Comparing interventions and studying the collective experience of multiple case studies across commodities and countries can help to generate a more systematic understanding of the conditions under which different interventions lead to trade-offs and synergies between goals.

The complexity of commodity supply chains and the spatial variation in the drivers of deforestation at local, national, and global scales mean that no single intervention type will effectively alter patterns of land-use change globally, and the context in which interventions are implemented clearly plays some part in determining the impacts of those interventions. However, many processes, challenges and solutions are similar across commodity landscapes. For example, commodity roundtables and certification programs have emerged as interventions in cattle, soy, palm oil, and biofuel systems. Similarly, REDD+ funding is proposed as a mechanism to reduce the impact of commodity agriculture as a driver of deforestation globally. Outcomes from the study of one context may be applicable and useful outside of that system, and there is value in searching for commonalities among diverse interventions. In sum: interventions may appear disparate, but the governance arrangements, the mechanisms by which interventions influence supply chains, and the impacts of those interventions on deforestation, greenhouse gas emissions and livelihoods may share common properties that are relevant to the identification of generalizable lessons.

One consequence of the limited focus on cross-commodity comparisons is that there has been limited investment in the development of conceptual frameworks within which to integrate the aggregate experiences of a range of interventions globally. The approach of this framework enables diverse interventions to be mapped onto a single framework that is inclusive of all relevant actors and interventions, as well as their interaction with supply chains and their subsequent impacts on commodity agriculture production.

A common framework within which to consider intervention characteristics, mechanisms, and impacts is a useful tool for several reasons. First, it is an aid to support intervention planning. Understanding the relationships between different

actors and processes is critical for designing new interventions as well as for modifying the structure of existing ones, many of which are inceptive and are still evolving. Second, a framework can facilitate the evaluation of interventions with respect to: 1) the nature of the intervention and associated governance structures; 2) the expected impacts of the intervention on environmental, economic, and social outcomes; and 3) the degree to which these impacts can be measured, monitored, and are sustainable. Finally, it has been difficult to attribute causality to specific interventions, and common metrics for assessing intervention successes and shortcomings have yet to be adequately explored. Impact evaluation and monitoring may be facilitated by the development of indicators that can be used across contexts.

Different ways to evaluate the relationships of interventions to outcomes are discussed below, and a series of hypotheses (*Hx*) that can support future research on this subject are outlined.

Intervention Complementarity and Inclusivity

In the context of forest-agriculture landscapes, all of the interventions discussed above act to alter producer behavior either directly or indirectly through the supply chain. They can additionally be differentiated by the spatial and temporal scales over which they operate, by the groups of supply chain actor that they affect, and by the extent to which they ultimately influence commodity production.

Frequently, interventions are not implemented in isolation but as composite projects that employ complementary interventions that act in unison, or whereby an initial intervention creates ”enabling conditions” that are necessary for the subsequent successful implementation of another. In either case, the relationship may be catalytic or obligatory. Three examples of interdependent approaches are offered:

1. The Katingan Project, in Central Kalimantan, aims to generate carbon credits, by creating an Ecological Restoration Concession, and also to meet the needs of rural communities, by establishing a suite of income-generating opportunities for local communities. The project hopes that this combination of activities will maintain local support for forest conservation and will meet environmental, social and economic objectives.
2. The Brazilian soy and beef moratoria were catalyzed by the earlier interventions by civil society organizations, including awareness-raising reports by an international NGO (Boucher et al. 2011). It is uncertain that the political will for such a rapid and dramatic policy commitment would have existed without the pressure and attention generated by earlier reports.
3. The REDD+ bilateral funding arrangement between Norway and Indonesia is conditional on the successful enforcement of the moratorium by Indonesia on new permits for conversion of peat lands and national forest (Clements et al. 2010).

In sum, the combinations of institutions and policies, incentives, and information and technology, matched to the context of the intervention to influence

supply chains actors, is critical in determining the degree to which commodity production can be more sustainable, and to which alternatives to the business-as-usual scenario will be feasible.

Two hypotheses that follow from the above discussion are suggested:

H1: A single intervention may be less effective than a suite of interventions of different categories acting within the same system, that affect a single group of actors in more than one way, for example, by combining incentives with sanctions.

H2: An intervention or suite of interventions that include a) a greater diversity of actor groups, and b) a greater representativeness of all stakeholders affected by decisions within the commodity landscape, will be more effective and sustainable than those that are less diverse or inclusive.

Capacity to Influence the Supply Chain

The structure of the supply chain, the relationships among actors and actor responses determine the impact of an intervention or suite of interventions. These impacts can be measured as a function of a) the proportion of the local or global commodity production influenced by the intervention, and b) the additionality achieved by the intervention (a combination of land-use change, permanence, and avoided leakage). Together, these factors may contribute to the development of more sustainable commodity agriculture supply chains. However, these factors vary between actors according to the scale at which those actors operate. Smallholder decisionmaking, for example, may differ considerably from that of a large-scale commercial operator, who may respond to a different set of incentives.

A further three hypotheses that follow from the above discussion are suggested:

H3: Interventions that target groups of actors with a relatively large influence over the total demand and supply for a commodity will be more efficient at producing positive outcomes than those that target less influential actor groups.

H4: Interventions that directly target the behavior of producers are more likely to achieve permanence than those which target other market sector actors and only indirectly affect producers. Fluctuations in market dynamics and shifting consumer preferences mean that even if a consumer-targeted intervention currently influences a significant proportion of the total commodity market, there is little certainty that demand will not alter in the future.

H5: There are strong incentives for market actors to respond quickly to actions which threaten to damage their reputations or sales, and so supply chain linkages can be exploited to exert pressure on distributors and retailers, on processors and packagers, and on producers.

Trade-Offs, Monitoring, and Evaluation

The impact of any one intervention may be characterized by trade-offs between 1) economic, environmental, and social outcomes, 2) the extent of those outcomes on different spatial and temporal scales, 3) the extent to which those outcomes are felt by different actor groups, and 4) the relative emphasis on effectiveness, efficiency and equitability. A complete discussion of how these trade-offs may vary between different sorts of interventions is beyond the scope of this paper, but the

importance of monitoring and evaluation in establishing the magnitude and nature of such trade-offs is briefly considered.

The absence of established methods for comparing the relative and absolute influence of interventions on supply chains is a significant barrier to the extraction of meaningful lessons from disparate interventions. The attribution of impacts to specific interventions is notoriously difficult in contexts where multiple programs and policies are simultaneously acting to promote similar or conflicting outcomes, emphasizing the need for well-designed monitoring protocols. An important early step is to identify indicators and metrics of improved environmental, economic and social outcomes that are comparable across space and time. We highlight carbon and livelihood goals as being critical to the objectives of reduced deforestation and GHG emissions, and to the reduction of poverty and development of better socioeconomic conditions for rural forest- and agriculture-dependent people in tropical landscapes. However, the framework can be equally useful to the evaluation of intervention impacts on other outcomes and is a useful point of departure from which to begin this important assessment.

7. CONCLUSION

Changes in land-use in forest-agriculture landscapes present both threats and opportunities, to forests, people, and the climate. A growing array of innovative interventions based on institutions, incentives, or information aim to influence how and where commodity agriculture occurs in relation to forests, but there has been insufficient evaluation of how different interventions operate and how the lessons learned in one context may be applied in another. The framework can be used to characterize and evaluate the governance structure associated with disparate interventions, and demonstrates common pathways by which different actor groups interact with commodity supply chains. Understanding how interventions affect different parts of the supply chain and how they ultimately exert influence on agricultural production practices is critical in designing and developing effective interventions that will lead to improved environmental, economic and social outcomes.

8. CASE STUDY: GAR FOREST CONSERVATION POLICY

Overview

Golden Agri-Resources (GAR) is the second largest palm oil company in the world, with 463,400 ha of oil palm plantations in Indonesia (GAR 2011a). The *GAR Forest Conservation Policy* (FCP) is a set of standards which GAR devised and adopted in 2011, in collaboration with the global nonprofit TFT and with inputs from various stakeholders, including the NGO Greenpeace. The standards laid out in the FCP aim to reduce deforestation and its impacts on biodiversity, the climate, and local communities within GAR's palm oil operations. The development and implementation of the GAR FCP has involved two separate interventions, one triggered by the other.

Intervention 1: Greenpeace Consumer Information Campaign

The first intervention involved a sustained period of campaigning by environmental NGOs, led by Greenpeace who in 2010 used a video campaign to disseminate information to consumers that palm oil is associated with deforestation and biodiversity loss. The campaign linked specific products and retailers with environmental damage, generating direct accountability of retailers for their actions. The distributors, retailers, and processors implicated by the campaign severed the supply chain link between themselves and the producer (GAR) to protect their reputations and sales with consumers.

Greenpeace accused the Sinar Mas Group of malpractice in the establishment of oil palm plantations within its concessions, including: 1) clearing and planting on peatland deeper than 3 m, thus violating Indonesian law; 2) clearing primary forest, which is critical habitat for orangutans; 3) clearing forests without Timber Utilization permits; 4) clearing land by burning; 5) causing social conflicts through plantation expansion; and 6) using its membership of the Roundtable on Sustainable Palm Oil (RSPO) to engage in ”greenwashing”, promoting a false perception of sustainability.

Although many of the accusations were refuted both by GAR and by an independent assessment (BSI and CUC 2010), the campaigns led to the cessation of market relationships between GAR and several significant customers, including Burger King, Nestlé and Unilever, in 2010. The producer therefore lost key customers and, regardless of the accuracy of the accusations, could choose between financial loss and addressing the issues that had caused the supply chain disruption.

Intervention 2: The GAR Forest Conservation Policy

To address the concerns raised about its plantation practices, and to demonstrate its commitment to sustainability, GAR engaged in a multistakeholder collaboration with TFT to develop a set of policy-based standards, the Forest Conservation Policy (FCP), aimed at creating long-term sustainable growth for GAR and the palm oil industry (GAR 2011b). Various stakeholders, including Greenpeace, also provided inputs for the policy.

The FCP was launched on February 9, 2011 and was developed to ensure that GAR’s “palm oil operations have no deforestation footprint”. The four core standards of the FCP are:

1. To refrain from development on: a) all peatland (regardless of depth); b) high carbon stock (HCS) forests (provisionally defined as those containing >35 tC ha-1); and c) high conservation value (HCV) forests.
2. To ensure free, prior and informed consent for indigenous and local communities.
3. To comply with RSPO principles and criteria.
4. To comply with Indonesian law.

These standards apply to all plantations that GAR owns, manages, or invests in. GAR additionally aims to promote the FCP across the palm oil industry.

The intervention therefore included a market sector producer (GAR) and two community sector NGOs (Greenpeace and TFT). The Forest Conservation Policy created commitments to forest policy at three levels: national policy (Indonesian law), roundtable policy (adherence to RSPO certification standards), and a company-specific policy (that goes above and beyond either of the previous two). The FCP also involved membership of the RSPO roundtable (a civil society group) and the consumer assurances and producer incentives associated with RSPO certification.

Impacts and Monitoring

The FCP was formally launched in 2011, and so the timeframe for observable impacts is not extensive. However, in this period the multistakeholder group has mapped the distribution of high carbon stock forest across eight GAR concessions with new plantings (GAR 2012), and a third NGO (Greenomics Indonesia) has independently conducted an assessment of the efficacy of the FCP to date across three GAR concessions, using satellite imagery and permit data (Greenomics Indonesia 2012). This study indicated that 2,283 ha of secondary peatland forest may have been preserved under the FCP (from a total concession area of 60,000 ha), and that a lower volume of timber was removed from cleared forests, indicating a lower quality of forest was cleared. However, the study also suggested some continued violations, such as clearing without permits by GAR within its oil palm plantations.

Lessons Learned

In the context of the framework described in this paper, we can draw the following lessons from this case study, which may be worth considering for other systems and interventions.

1. An intervention that aimed to influence consumer purchase decisions and initiate boycotts (a consumer awareness campaign) threatened to damage market actors' reputations and sales. This was an effective incentive for key actors to engage in the development of a second intervention (a forest policy) that more directly targeted producer behavior and that may achieve more long-term and effective impacts on the supply chain.
2. These interventions targeted a large-scale producer with considerable market influence. A powerful international campaign was required to overcome the inertia and resistance to change associated with such an actor, but the extent of the impacts (in terms of the area of forest and proportion of total commodity production) that may be achieved by successfully engaging with such a company is significant.
3. A multistakeholder initiative has been effective in rapidly developing a solution that is acceptable to both the market (supply chain) and community (roundtable, NGO) actors. Part of its legitimacy is in setting standards that meet and exceed both state policy and industry standards.
4. GAR is one of the largest players in the palm oil industry and has committed, through the FCP, to use its position as an industry leader to encourage other companies to adopt similar sustainability standards.

There may be therefore be an additive effect that results from a) engagement with a key actor, and b) a demonstration of leadership, which could incentivize smaller producers with a lesser share of the commodity market to follow suit.

5. The integration of actors from multiple sectors, and the combination of different forms of intervention, has aligned several levels of the supply chain to identify common objectives.
6. The inclusion of non-market actors introduced the capacity for independent monitoring and evaluation which may help to contribute credibility to the intervention.

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