

MINI FOCUS: SUSTAINABLE LANDSCAPES IN A WORLD OF CHANGE:
TROPICAL FORESTS, LAND USE AND IMPLEMENTATION OF REDD+

More food, more forests, fewer emissions, better livelihoods: linking REDD+, sustainable supply chains and domestic policy in Brazil, Indonesia and Colombia

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The triple, intertwined challenges of climate change, the conversion of tropical forests to crop lands and grazing pastures, and the shortage of new arable land demand urgent solutions. The main approaches for increasing food production while sparing forests and lowering carbon emissions include sustainable supply chain initiatives, domestic policies and finance, and REDD+. These approaches are advancing largely in isolation, separated by different scales of intervention, performance metrics and levers for shaping land user behavior. As a result of this disconnect, farmers are receiving few, if any, positive incentives to forgo legal forest clearing and to invest in more sustainable production systems. These three approaches could become mutually reinforcing through integrated, performance-based incentive systems operating across regions and scales, linked through a shared metric of jurisdiction-wide performance introduced here as the Jurisdictional Performance System.

Climate change, forest loss and the global shortage of new arable land are among the most urgent challenges that humanity is facing [1]. The ability of human societies to meet these challenges with effective, large-scale solutions over the next 10–20 years will strongly influence the levels of human suffering and the capacity of the Earth to sustain life for centuries to come. Increases in food prices since 2007 have driven hundreds of millions of poor people into hunger, feeding civil unrest [2]. The trend towards higher food prices, which is likely to continue for decades [1,3], is a reflection of a growing global imbalance in which the rate of growth in demand for land-based products (food, fuel, fiber and feed) is outpacing the rate of growth in supply [1,4]. Global demand is rising largely through rapid growth in per capita consumption in China, India, Brazil and other emerging economies, whose burgeoning consumption levels are still far below average per capita consumption

in the USA [3]. Growth in production is increasingly constrained by the dwindling supply of new arable land, especially in the temperate zone, declines in the rate at which yields are increasing [5] and extreme weather events [6]. Most of the potential growth in land-based production is found in the tropical and subtropical latitudes, into species- and carbon-rich forests and woodlands, and onto lands that are already cleared and below their productive potential [1,7].

Land use is the source of nearly one-third of the global anthropogenic flux of GHG emissions to the atmosphere [8], with nearly half of this total coming from the clearing and degradation of tropical forests [101]. Total emissions from land use are likely to increase as farming and livestock sectors around the world race to keep up with growth in demand. The near-term effects of climate change are likely to exacerbate this global imbalance as crop failure driven by weather

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Key terms

Low emission rural development:

Model of rural development in which GHG emissions decline, natural and social capital increase, community rights to land and other resources are respected, and sustainable economic development advances.

Sustainable Supply Chain initiatives:

Management of environmental, social and economic impacts, and the encouragement of good governance practices, throughout the lifecycle of goods and services.

Tropical Forest Alliance: Alliance between governments, private companies and civil society to support the Consumer's Goods Forum companies to achieve their zero net deforestation goal by 2020.

Jurisdictional REDD+: Designed with the goal of achieving reductions in GHG emissions from deforestation and forest degradation, and increasing carbon removals from the atmosphere through forest carbon enhancement, at the scale of the entire jurisdiction (e.g., nation, state, province), including through projects that are 'nested' within the jurisdiction-wide program.

extremes restricts food, fuel and fiber production globally, pushing prices higher [6,7]. But land use – all agricultural and forestry activities combined – is also the only sector that could rapidly shift from being a major net source of GHG emissions to the atmosphere to become a net sink. In just 7 years, emissions from tropical deforestation have declined by a total of 2.6 billion tons CO₂ in the Brazilian Amazon below the 10-year average through 2005; global GHG emissions in 2012 were 1.6% lower because of Brazil's achievement [1]. The potential for the uptake of carbon by regrowing forests is in evidence today; one-fourth of global emissions of CO₂ are re-absorbed by these forests [9]. This 'terrestrial carbon sink' could increase. Several nations (such as China and Brazil) have created massive programs for re-establishing forests and tree plantations over vast landscapes; and large areas of marginal, deforested land could support

regrowth through natural succession if certain barriers (such as escaped fire) are removed [10]. Improved soil management could remove CO₂ from the atmosphere at a rate equivalent to 5–15% of global emissions, while increasing productivity and water use efficiency [11].

One of the most significant opportunities to address the triple challenge of climate change, forest loss and the shortage of new arable land is to increase the productivity of lands already cleared but far below their productive potential, as measures are taken to keep remaining forests standing. Brazil has demonstrated in the Amazon region that intensification combined with laws and policies to reduce deforestation is feasible at a very large scale. Its success in reducing deforestation was achieved while cattle and soy production continued to increase, largely because of rapid increases in the productivity of cattle operations [1,12].

The purpose of this Policy Focus is to examine possible opportunities for supporting the transition to **low emission rural development** (LED-R) at scale through low-emissions development strategies that integrate **Sustainable Supply Chain (SSC) initiatives**, REDD+, and domestic policies and finance. Our analysis focuses on the tropical latitudes, where most of the potential for increasing agricultural production lies and where most of the emissions from deforestation take place [7,9,13]. We then examine some of the opportunities for designing

and implementing rural low-emission development strategies (LEDS) in three tropical forest jurisdictions: Mato Grosso State (Brazil), Central Kalimantan Province (Indonesia) and Colombia (the nation). These case study jurisdictions have all initiated the transition to LED-R, and illustrate the diversity of circumstances, obstacles and opportunities for achieving this transition. In this article, we use 'jurisdiction' to refer to landscapes that are geographically defined by political boundaries, including nations, states/provinces and municipalities/districts.

A critical challenge over the next decade is to initiate and sustain a worldwide transition of the current prevailing rural development model, in which agriculture and livestock production areas expand into native, carbon- and species-rich forestlands and woodlands, some of which are indigenous communities' territories, to an alternate model that we call 'LED-R' [1]. Successful low emission rural development achieves significant declines in GHG emissions as it slows then reverses the erosion of natural capital (native ecosystems, fertile soils, healthy watersheds and many services provided by natural ecosystems), builds social capital (through stronger institutions and governance capacity, more resilient social organization, higher education levels), improves livelihoods (through greater food and water security, higher incomes of economically marginalized families, improved access to health care, rights over land and natural resources, and electrification) and sustainably develops the regional economy (through increased production of food, fuel, fiber and feed, industries that add value to rural production, responsible infrastructure, technical assistance, innovative finance programs and favorable fiscal policies). Low emission rural development can be viewed as an elaboration of the concept of sustainable development as first defined by the Brundtland commission in its seminal report, 'Our Common Future' [14], with an important difference: a greater emphasis on climate change mitigation. This emphasis is important for two reasons: a stable climate is a pillar of sustainable development, and GHG emissions and uptake by the terrestrial biota are the only ecosystem services for which policy and finance mechanisms are being designed to influence at scale. It is a model whose implementation will vary greatly depending upon the phase of frontier expansion of the landscape in question, the specific mix of formal and informal governance structures, the prevailing legal and policy frameworks, the vernacular institutions and social norms that mark specific communities, and the natural resource base.

SSCs, REDD+, & domestic policies & finance

To achieve low emission rural development, regionally tailored strategies must be developed that make sense

for the distinctive mix of landscapes, institutions and stakeholders in particular regions, but that also draw upon, leverage and integrate larger policy approaches. Currently, three major approaches are underway in various parts of the world, at multiple levels of governance, that offer important opportunities for catalyzing and supporting successful rural low emission development pathways. The first category is often called SSCs, referring to efforts underway to integrate sustainable practices across the entire chain of producers, buyers, processors, product manufacturers, and retailers of agricultural and forest commodities. One manifestation of this approach is agricultural commodity ‘roundtables’, which are multiple-stakeholder processes that have developed international performance principles and criteria for the production and, in some cases, the processing of a particular agricultural commodity. Roundtables have been developed for palm oil (Roundtable for Sustainable Palm Oil [RSPO]), soybeans (Roundtable for Responsible Soy [RTRS]), sugarcane and sugarcane ethanol (Bonsucro®), biofuels (Roundtable for Sustainable Biofuels) and are under development for beef (Global Roundtable for Sustainable Beef) [1]. These roundtables were designed to achieve ‘market transformation’, in other words, to become so widely adopted by the buyers of each commodity that producers who are not certified are effectively excluded from the market. RSPO, which has certified 15% of global production, is the farthest along down this pathway. Roundtables build upon a previous generation of certification systems, such as the Forest Stewardship Council and the Marine Stewardship Council [15].

SSC approaches are also manifested through the Consumer Goods Forum’s (CGF’s) ‘zero net deforestation’ commitment. More than 400 retail and commodity-buying businesses with total combined sales of US\$3.37 trillion committed in 2010 to restrict their purchase of soy, beef, palm oil, paper and wood to suppliers who had achieved ‘zero net deforestation’ by 2020 [102]. Through the ‘**Tropical Forest Alliance**’ (TFA), the US Government, Norway and Great Britain have supported the CGF commitment [103]. Other initiatives also fall under the umbrella of SSCs, such as the soy and beef moratoria of Brazil. These moratoria were motivated by Greenpeace campaigns targeting the buyers of soy and beef grown in the Amazon in areas of active deforestation. In both cases, industry-wide agreements were made to no longer buy soy or beef grown on land that was recently cleared of mature forest. The cut-off dates were July 2006 and October 2009, respectively [1,16–18]. The moratoria continue today although their end is discussed annually. Many companies have developed their own SSC initiatives, led by Unilever.

A second major category of initiatives that are underway in dozens of tropical nations to reduce GHG emissions to the atmosphere by slowing the conversion of forests to crops and livestock is called REDD+ [1,19,20]. The central concept of REDD+ is the compensation of tropical forest nations that have demonstrated significant reductions in carbon emissions from deforestation and forest degradation, or significant increases in forest carbon enhancement. REDD+ was originally conceived as a component of the UNFCCC treaty that is under negotiation. But it is also being developed through various approaches that are proceeding outside of the UNFCCC process, including the novel collaboration among states and provinces of tropical forest nations (Brazil, Indonesia, Mexico, Peru and Nigeria) and the USA (led by California) called the Governors’ Climate and Forests Task Force. Since its inception in 2008, the Governors’ Climate and Forests Task Force has worked to develop robust **jurisdictional REDD+** programs capable of accessing various pay-for-performance systems, including GHG compliance markets, such as that being developed in California [104]. REDD+ is also advancing through multilateral processes such as the ‘Forest Carbon Partnership Facility’, administered by the World Bank, through the ‘UN REDD’ process and through individual nations. Norway, alone, has committed \$0.5 billion per year to REDD+, and has already formally committed a billion dollars to Brazil’s ‘Amazon Fund’ and another billion dollars to Indonesia’s REDD+ program. Both of these commitments are performance based – that is, they are dependent upon declining rates of deforestation in the target country. Finally, REDD+ is under development through numerous projects developed by private companies and conservation organizations [21]. The state of REDD+ finance and initiatives is reviewed elsewhere [1,21–24].

Finally, a third category of initiatives that are contributing to LED-R are operating within tropical nations, where most of the world’s agricultural and livestock expansion into forests and woodlands is taking place. It includes domestic policies and programs, including fiscal policies (e.g., tax, trade and subsidies [22–25]), finance programs (e.g., agricultural credit and loan programs for rural enterprise), transfers (e.g., national-state government payments for education, health and highways), land-use laws and regulations (e.g., protected areas, land-use zoning and rules for private property forests), labor law and environmental regulations. The potential influence of domestic policies and programs on the land-use decisions of farmers, livestock producers and other land managers is enormous, since they often determine the types of land-use activities that are permitted by law across entire jurisdictions (through the creation of protected areas, the formal recognition of indigenous lands or restrictions on forest clearing at the

level of the property) and the profitability of different land-use options. This potential is largely unexploited. These policies and programs are extremely diverse, with a wide range of political systems, levels of decentralization and institutional capacity. In most nations with large forest estates, policies designed to protect natural resources (e.g., protected area networks, incentives for sustainable production, as well as laws that require or reward productive land use in order to gain land tenure) are often in conflict with policies designed to facilitate natural resource exploitation (e.g., subsidies for agricultural, livestock, logging expansion and roads into remote forest regions). Examples of additional policies and finance programs are provided within the case studies for Brazil, Indonesia and Colombia below and in [Table 1](#).

In practice, many developing nations lack the institutional capacity to effectively implement policies and programs in remote regions where agriculture is expanding into forests, and where the exploitation of timber, minerals and petroleum drives 'boom and bust' frontier dynamics. Throughout history, the capacity of civilizations to govern vast tropical forest frontiers is generally low; poorly implemented land-use regulations often feed informal economies through which powerful resource grabbers can buy their way through legal requirements [26]. There are, however, important exceptions that demonstrate that forest frontier governance is possible [27,28].

Strengths & weaknesses of the three approaches

SSCs, REDD+, and domestic policies and programs currently operate largely in isolation from one another, with different stakeholders, different units of intervention (farms, mills and entire jurisdictions) and different performance metrics ([Tables 1 & 2](#), & [Figure 1](#)). SSC approaches are driven in large part by reputational risks to businesses that are buying commodities from regions where tropical forests are being cleared or where forced labor is an issue. The focus of supply chain initiatives has been on those entities (farms, mills, processors and traders) that are directly engaged in the supply chain. Certification standards (roundtables, Forest Stewardship Council and Marine Stewardship Council), the CGF 'zero net deforestation' initiative and Brazil's moratoria are voluntary, and have been designed to operate largely independently of governments and policies. An important strength of these SSC approaches is the high level of private sector engagement and efficiency. They are beginning to transform markets and engage entire farm sectors in some regions in the transition to sustainable, certified production systems [1]. SSC approaches are weakened by the fact that their impact is constrained to participating farms and mills; they

also generally do not deliberately seek to influence the policies, domestic finance programs and institutional issues that often dominate land-use dynamics. This means that, even if fully successful, SSC approaches as currently designed will achieve sustainability within the supply chains of the agricultural commodities that are targeted, but have no mechanism for securing or restoring the ecological integrity or social performance of the broader landscape. In one plausible future scenario of SSC approaches, rural landscapes could have islands of certified, sustainable farms or mills that produce or process a particular commodity embedded in a sea of unsustainable 'business as usual' resource depletion and bad labor practices driven by markets and products for which an SSC approach has not been developed. This is a concern shared by some private sector leaders in SSC approaches, and is the focus of new 'landscape' approaches to SSCs led by EcoAgriculture Partners [29], the World Bank [105] and other organizations. These landscape initiatives seek to increase the scale of SSC interventions, but are generally not yet focused on building bridges to REDD+ or domestic policy. SSC approaches also face large obstacles to achieving scale [1], including the high cost of certifying and auditing individual farms and mills, delays among businesses in implementing their commitments to buy commodities from sustainable, certified sources, and the low level of participation among buyers in some important markets (such as Chinese importers of palm oil).

More than 30 tropical nations have begun to develop REDD+ plans for reducing their deforestation and forest degradation, and industrialized nations have committed more than \$7 billion to its implementation [1]. The unified, market-based, global finance mechanism that was originally envisioned as the source of large-scale funding to compensate nations for their achievements is still many years away [1,22–25,30]. One consequence of this delay is that political leaders who have taken bold steps to lower deforestation and forest degradation in their states and nations, including the three jurisdictions described below, are losing their will, discouraged by the lack of recognition and compensation for their efforts [31,32]. To put this in perspective, the decline in CO₂ emissions from deforestation in the Brazilian Amazon during the first 3 years (2008–2010) of the Kyoto Protocol (~1.5 billion tons CO₂ [GtCO₂]) was similar in magnitude to the emissions reductions achieved by the EU with the help of the EU ETS (~1.9 GtCO₂) during this same period [1]. Brazil's accomplishments have attracted disbursements of approximately \$0.4 billion, the EU-ETS emissions reductions were achieved with financial transactions totaling \$0.4 trillion [1]. Although REDD+ finance disbursements are not directly comparable to the EU-ETS's financial transactions,

Table 1. Some of the initiatives currently underway under each of the three categories (sustainable supply chain, REDD+, and domestic policy and finance), the scale at which the initiative operates and the metrics used for defining performance in reducing deforestation.

Approach/initiative	Scale of implementation	Deforestation performance metric	Ref.
Sustainable supply chain			
Commodity roundtables (e.g., RSPO, RTRS and Bonsucro®)	Farms (RTRS), mills (Bonsucro, RSPO)	Variable; prohibit clearing of primary forests and other 'High Value Conservation Areas' after cut-off date established by each roundtable	[1]
Consumer Goods Forum and Tropical Forest Alliance 'zero net deforestation' initiative	Farms, mills, possibly entire jurisdictions	Zero net deforestation supply chains (farms and mills) by 2020	[112,113]
Brazilian soy and beef moratoria	Farms (soy); ranches and meat-packing plants (beef)	Prohibits production on land cleared after July 2006 (soy) and October 2009 (beef) in the Amazon forest biome	[114,115]
REDD+			
Brazil National Climate Change Policy and Amazon Fund	Entire Brazilian Amazon and 'Cerrado' savanna	Reduction in deforestation to 20% (Amazon) and 60% (Cerrado) of historical average (1996–2005) by 2020	[116,117]
Brazilian Amazon State REDD+ Programs (e.g., Acre State's 'Incentive System for Ecosystem Services; Mato Grosso State's REDD+' law)	Entire state	Reduction in deforestation to 17% (Acre) and 11% (Mato Grosso) of historical average (1996–2005) by 2020	[118,119]
Indonesian national REDD+ commitment and Norway US\$1 billion commitment	Entire nation	Reduce emissions by 26% (own effort) or 41% (with international support) by 2020 below business-as-usual baseline; land use contributes as much as 80% of national emissions, with deforestation and peat degradation as the major sources	[120,121]
Colombia's deforestation commitment	Entire nation	End deforestation by 2020	[122]
Domestic policy & finance (outside of REDD+)			
Brazil's 'ABC' (Low Carbon Agriculture) Loan Program, approximately \$1.5 billion made available each year	Farmers and agribusinesses	No deforestation criterion. Supports agricultural intensification, forest restoration and other investments that favor low-emission production	[1]
Brazilian Government's 'Municípios Críticos' (Critical Municipalities) program	Municipality (political land unit below the state)	Decline in deforestation for the entire municipality; at least two-thirds of rural properties join the Rural Environmental Registry (CAR)	[123,124]
Pará State's Municípios Verdes (Green Municipalities) program	Municipality	Maximum of 40 km ² annual deforestation for the entire municipality; 80% of rural properties must join the Rural Environmental Registry (CAR)	[125]
Brazilian Forest Code	All rural properties	Establishes minimum area of forest reserve on private properties (80% in the Amazon; 20% in the Cerrado)	[126]
Indonesia's forests and plantations policy	All forests	Establishes areas of forest conservation and production forests (controlled by the national government) and areas of 'non-forest' (e.g., plantations, controlled by Provincial and District governments)	[45]
Colombian Fund for Financing the Agricultural Sector (FINAGRO)	Farmers and agribusiness	No deforestation criterion	[127]

CAR: Cadastro Ambiental Rural (Environmental Registry of Rural Lands); FINAGRO: Fondo para el financiamiento del sector agropecuario; RSPO: Roundtable for Sustainable Palm Oil; RTRS: Roundtable for Responsible Soy.

the near thousand-fold difference in scale of financial flows is one measure of the fragility of the success in addressing deforestation in Brazil and elsewhere. Furthermore, REDD+ is being designed and implemented largely through the environmental, forestry or climate change units within national and state governments,

and through a profusion of projects designed by companies and NGOs that often have little or no effective connection to governments or public policies [20]. In this context, one of the important weaknesses of REDD+ is its general failure to engage agricultural and livestock sectors, the principal drivers of deforestation, or to

Table 2. Summary of the major strengths and weaknesses of three approaches that are contributing to the transition to low-emission rural development.

Approach	Strengths	Weaknesses
Sustainable supply chains	Strong private sector engagement (buyers, processors and producers) Have achieved impressive results (e.g., Brazil's soy moratorium has helped lower deforestation) and penetration (e.g., Roundtable for Sustainable Palm Oil has certified 15% of world production of palm oil)	Expensive to scale up (one farm/mill at a time) Small number of commodities; potential for green farms in a sea of business-as-usual rural frontier expansion Disconnected from domestic policies Farmer frustration with lack of price premiums and market demand
REDD+	'Jurisdictional': designed to operate across entire nations or states Historical average approach to performance baseline is simple, robust and scalable. Bilateral finance committed	Global finance mechanism postponed Engagement of farm and livestock sectors (both private and governmental) is weak. Excessive focus on projects has diverted attention from jurisdictional performance
Domestic policies/finance	Potential for integrated approach to rural development: agriculture, forestry, agrarian reform, infra-structure, credit, land tenure and land-use zoning. Large financial levers (e.g., tax, subsidies and credit). Power of law and law enforcement	Hard for political leaders to get elected on sustainable growth platform Governance capacity often weak in rural zone Most policies still favor agricultural expansion and resource depletion

deliver tangible benefits to indigenous peoples and other types of rural communities.

Domestic policies and finance programs of tropical forest nations and states offer the greatest potential for driving the transition to LED-R. In the realm of agriculture and livestock, the design and implementation of domestic policies and programs, and the leveraging of large domestic sources of rural credit and other finance could accelerate the transition to LED-R via support to sustainable production systems that maintain and enhance long-term productivity on lands already converted to crops or livestock, attract investments and penetrate markets, while increasing the security of food, fuel, fiber and feed supplies for local and regional human populations. The nations that are the focus of the case studies examined in this article demonstrate the scale of influence of domestic policies and finance over agricultural sectors. Brazil makes \$50 billion per year available to its farmers and agricultural industries, with approximately 10% of this amount available for agricultural investment [106], Colombia makes \$4 billion per year available [107] and Indonesia makes \$1.5 billion available [108]. Little of this finance is actually designed to promote sustainable production systems, and many policies encourage (indirectly) resource grabbing and forest clearing motivated by land speculation. Laws are often implemented with little

attention to the institutional capacity that is necessary to implement them [33]. And, yet, all three case studies reveal important progress and opportunities for overcoming these barriers. Domestic policies and programs have an enormous potential to support the transition to LED-R that is still largely unexploited.

Linking & strengthening the three approaches

Rural LEDS will only succeed if sufficient sectors, and powerful entities and individuals see it as advancing their interests, motivating them to support the design and implementation of these strategies. As a rural development model that is founded on building natural and social capital, improving livelihoods and advancing economic development, the potential for achieving a broad base of support is high. Achieving this support will require a carefully orchestrated effort to align the jurisdictional approach of REDD+ with its focus on relatively simple indicators of jurisdictional performance, with the financial incentives and enforcement mechanisms available through existing domestic policy mechanisms, and linking these with a robust approach to supply chain governance that strengthens the broader market transition to exclude unsustainable producers.

The main challenge in many regions will be to overcome the vested interests of the powerful industries and actors who are engaged in lucrative, often illicit or illegal, economic activities and who wield their power to maintain the status quo. Rural LEDS will succeed when there are effective positive incentives for responsible, sustainable

Key term

Jurisdictional Performance System: Introduced in this article. A system for measuring the progress of entire jurisdictions towards low-emission rural development designed to facilitate convergence among Sustainable Supply Chain initiatives, REDD+, and domestic policies and finance.

farming and business, and when law enforcement suppresses the activities of illegal resource grabbers. To achieve these changes, supply chain sustainability and performance-based finance for large-scale reductions of GHG emissions from land use (the core mechanism of REDD+) must be built into domestic policies and finance systems, and the institutions whose responsibility it is to carry these policies and programs out.

SSC initiatives and REDD+ are not currently achieving their potential to strengthen and align domestic policies and programs. SSC approaches have not yet developed mechanisms for recognizing performance at the jurisdiction level, or informing the design and implementation of public policies and finance programs that could favor large-scale compliance with standards among agricultural, livestock and forestry sectors. REDD+ has made little progress in engaging agricultural sectors at all. Farmers' expectations of positive incentives for those who forgo forest conversion to crops and livestock, which were prevalent in the years leading up to the Copenhagen climate treaty summit in 2009, were largely abandoned when the global mechanism for financing these incentives was postponed. Finally, domestic policies continue to be developed largely within silos, with a narrow focus on improving production (in the case of agricultural ministries) and improving environmental conservation (in the case of environmental ministries). There are incentives for favoring the transition to LED-R associated with each of the three approaches, but these incentives are not currently converging because of the different metrics of environmental and social performance adopted within each approach, and the different scales at which they operate (Table 1 & Figure 1). The three approaches analyzed here might be synergistically inter-connected through alignment of the potential incentives associated with each approach around a shared 'jurisdictional' set of metrics for measuring the progress of entire counties, states (or their equivalents) and nations towards LED-R. Sustainability indices have been developed previously, such as the Environmental Performance Index that ranks nations' progress towards sustainability [109], but none

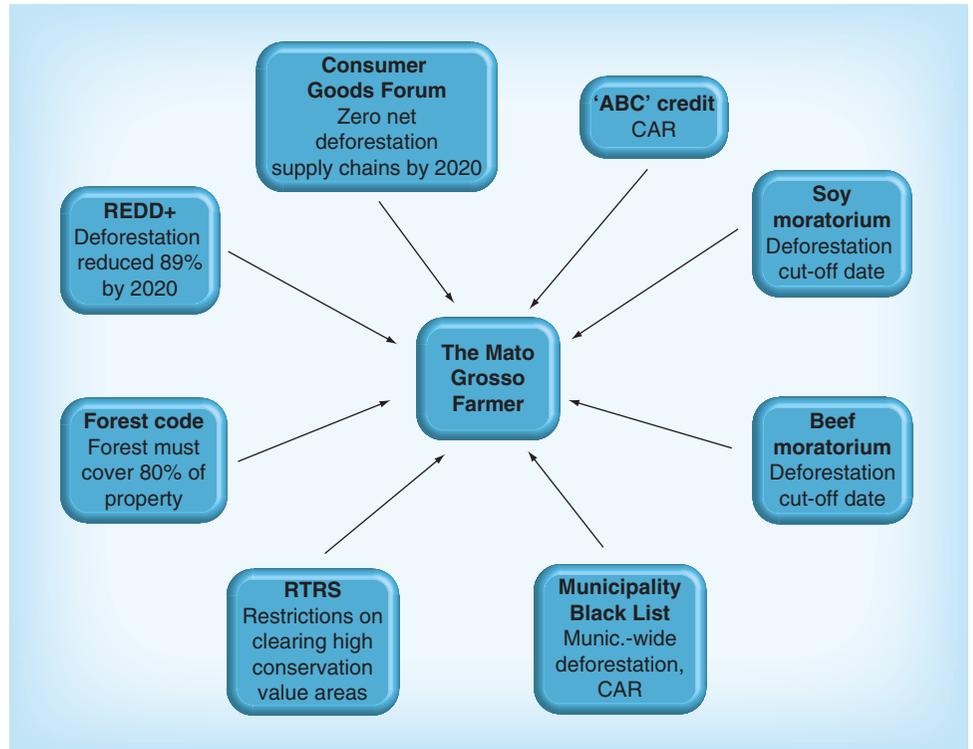


Figure 1. Fragmentation of the forest dialogue in Mato Grosso (Brazil). The Mato Grosso farmer today in the Amazon biome is subjected to at least eight dialogues involving forests and deforestation, each with its own different approaches. One goal of the Jurisdictional Performance System would be to establish a single definition of progress in addressing the problem of deforestation and other key issues that several different initiatives could agree on, facilitating linkages and synergies across policies and processes. See Table 1 and the main text for further information on these deforestation dialogues.

CAR: Cadastro Ambiental Rural (Environmental Registry of Rural Lands); RTRS: Roundtable for Responsible Soy.

of them we are aware of have been designed specifically to measure jurisdictions' progress in the transition to LED-R in a way that strengthens linkages with multiple markets, international finance, and domestic policies and programs.

In addition to shared metrics, linkage of the three approaches will also depend upon design and development of legal frameworks and strong implementing institutions for integrating SSC approaches, emerging REDD+ markets, and domestic policies and finance.

A Jurisdictional Performance System

The unification and integration of SSC, REDD+, and domestic policies and finance, might be facilitated through a shared system for measuring performance across entire counties, states and nations. We refer to this metric here as the 'Jurisdictional Performance System' (JPS). There are several important characteristics that the JPS could have that might increase its chances of

success in unifying disparate processes. Critical features of the JPS are summarized in [Box 1](#).

If the JPS is to be implemented around the world across a wide diversity of landscapes, production systems, rural economies, governmental systems, cultures and supply chains, it will be necessary for it to evolve through bottom-up, multi-stakeholder dialogues that are operating within a clear, simple set of principles that are established internationally. This could be viewed as an expanded approach to the national interpretations of international standards, such as commodity roundtables. Some potential principles are summarized in [Box 2](#).

In practice, the JPS might be developed through a series of workshops in which sectors come together and identify points of consensus. An example of such a workshop was held in Cuiabá, Mato Grosso (Brazil) in January 2013 [110]. Representatives of the soy and beef industries, farmer organizations, commodity roundtables, the finance sector, government (município, state, federal), special programs (e.g., the Municípios Verdes program of Pará), international commodity buyers and NGOs discussed the need for a shared definition of progress at the jurisdictional level in addressing the issue of deforestation (separate workshops are planned for indigenous peoples and smallholders). Mato Grosso has achieved a 90% decline in deforestation below its

10-year average (see case study below), which has been accomplished with virtually no positive incentives to either the farmers and ranchers whose collective land-use decision-making changed dramatically to achieve the decline, or the indigenous communities who have suppressed agricultural expansion along their territorial borders [34]. This failure was the broader context of the meeting. The workshop concluded that a shared metric for measuring progress in reducing deforestation across jurisdictions was necessary, with widespread agreement that jurisdiction-wide indicators should include zero illegal deforestation, zero forced labor and increasing productivity. The farm and livestock sector representatives stated that they could support a 2020 ‘zero net deforestation’ target, or possibly a ‘zero deforestation’ target, if there were effective mechanisms for fairly compensating those landholders who retain forests on their private holdings that they could legally convert to crops or livestock. This high level of agreement was reached in 1 day of dialogue.

We present a hypothetical illustration of how four parameters could be used, initially, as the basis of a JPS ranking system, and the types of incentives that could be implemented to encourage a ‘race to the top’ among jurisdictions ([Figures 2 & 3](#)). The parameters that we have used for this illustrative example include annual deforestation (relative to the 10-year average deforestation

Box 1. Recommended characteristics of a ‘Jurisdictional Performance System’ that could be developed and implemented to measure the progress of jurisdictions towards low-emission rural development, linking together sustainable supply chain, REDD+ and domestic policy approaches.

- Simple: focusing on three or four key issues initially, but growing more complex over time
- Easy and inexpensive to implement/monitor: building on existing monitoring systems
- Focusing on performance, not practices: featuring the measurement of jurisdiction-wide performance, not the means for achieving that performance
- ‘Homegrown’: aligned with, ‘owned’ and developed by the rural sectors of each region
- Compatible with international standards/commitments: compatible with, and supportive of, the standards (e.g., commodity roundtables, Forest Stewardship Council and REDD+ safeguards), processes (e.g., soy and beef moratoria and Consumer Goods Forum 2020 agenda) and commitments (e.g., Unilever’s sustainability goals) that have been developed within sustainable supply chain initiatives
- Progressive: encouraging improvement over time, with clear incremental steps towards higher performance
- Scalable: designed to easily scale across the hierarchy of jurisdictions (from counties, to states, to nations)

Box 2. Examples of some of the principles that might be established to guide the development of national and regional interpretations of the Jurisdictional Performance System around the world.

- Rigor: the Jurisdictional Performance System (JPS) must measure, report and verify real indicators of environmental and social performance at the scale of entire jurisdictions
- Core categories of performance: the national and regional interpretations of the JPS should develop robust criteria for measuring performance in increasing natural and social capital, increasing production and economic development, and improving rural livelihoods
- Effective participation: the national and regional interpretations of the JPS should be developed with informed participation of all relevant stakeholders for the target region
- Inter-regional harmonization: multi-stakeholder processes that are developing regional interpretations of the JPS should work iteratively with similar processes in other regions to facilitate and strengthen linkages with international markets and policies

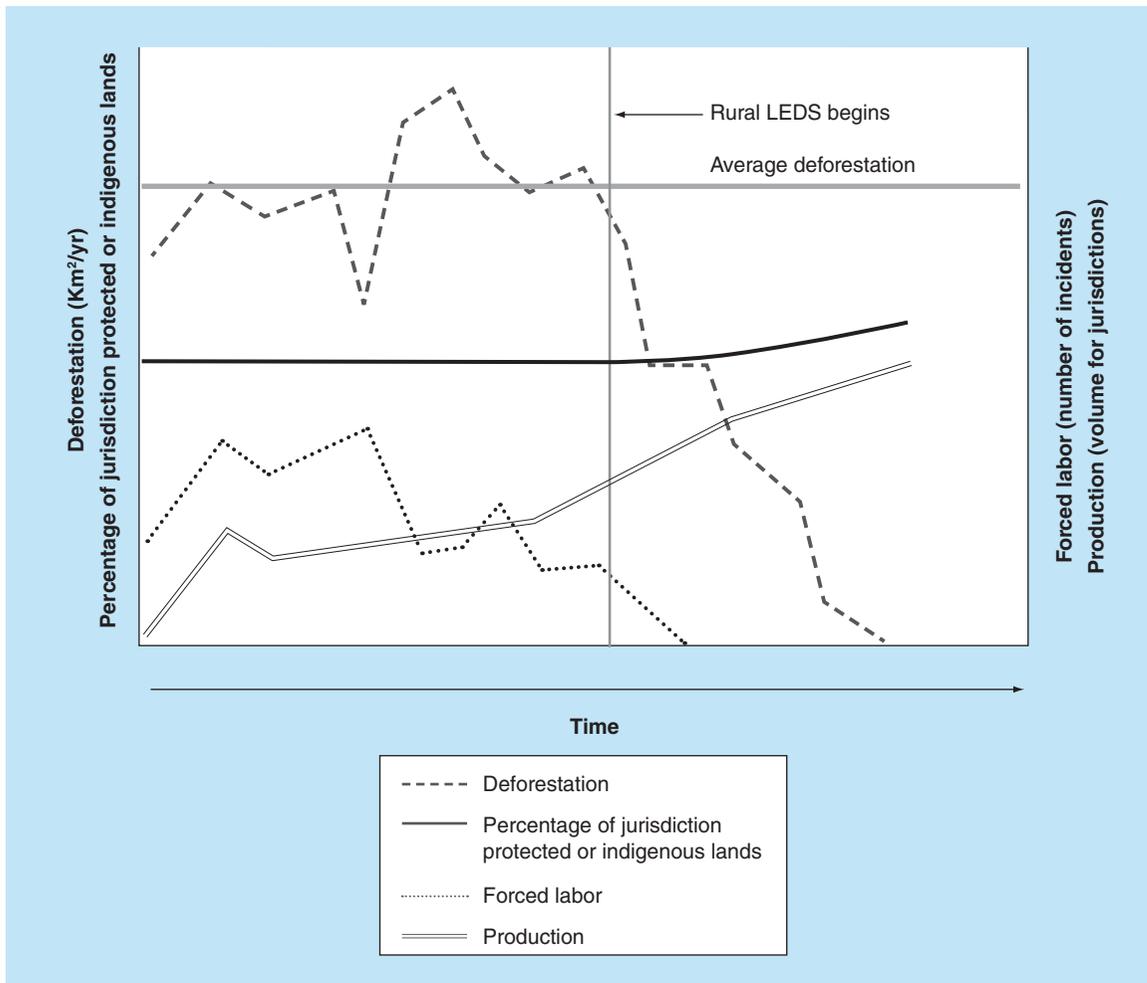


Figure 2. Hypothetical example of four parameters that could be used to develop a Jurisdictional Performance System for the performance of high-deforestation jurisdictions as they make the transition to low-emission rural development. The reduction of annual deforestation below its historical average is a robust parameter that has been adopted by many REDD+ programs and the ‘município verde’ program of Pará State described in the text and that is monitored by the Brazilian Government (Instituto Nacional de Pesquisas Espaciais [Brazilian National Institute for Spatial Research] 2012). The percentage of the jurisdiction under protected areas or indigenous territories is already part of Brazil’s ‘Imposto sobre Operações Relativas à Circulação de Mercadorias e sobre Serviços de Transporte Interestadual e Intermunicipal e de Comunicação (Tax on the Circulation of Goods, Interstate and Intercity Transportation and Communication Services) Verde’ program (Supplementary Information) and creates an incentive for formally recognizing and demarcating indigenous territories. The elimination of forced labor and jurisdiction-wide increases in agricultural production are priorities for many sectors. LEDS: Low-emission development strategies.

rate), the percentage of the jurisdiction that is set aside in formally recognized indigenous territories or protected areas, reports of forced labor, and agricultural and livestock production. Rank two, in this illustration, is reached when the average historical deforestation rate is reduced by at least half, there are at least 2 consecutive years with no/few reports of forced labor, when agricultural and livestock continues to increase at its average rate, and when a new indigenous territory is formally recognized, resolving a land dispute. Rank

three is reached when zero net deforestation is achieved, reports of forced labor continue low, production continues to rise and there are no outstanding unresolved land conflicts involving indigenous communities.

The JPS might help jurisdictions connect to emerging pay-for-performance climate change mitigation programs and markets if it included rigorous estimates of GHG emissions reductions that have been achieved. In the hypothetical example presented in Figure 2, for example, the decline in deforestation rate could be used

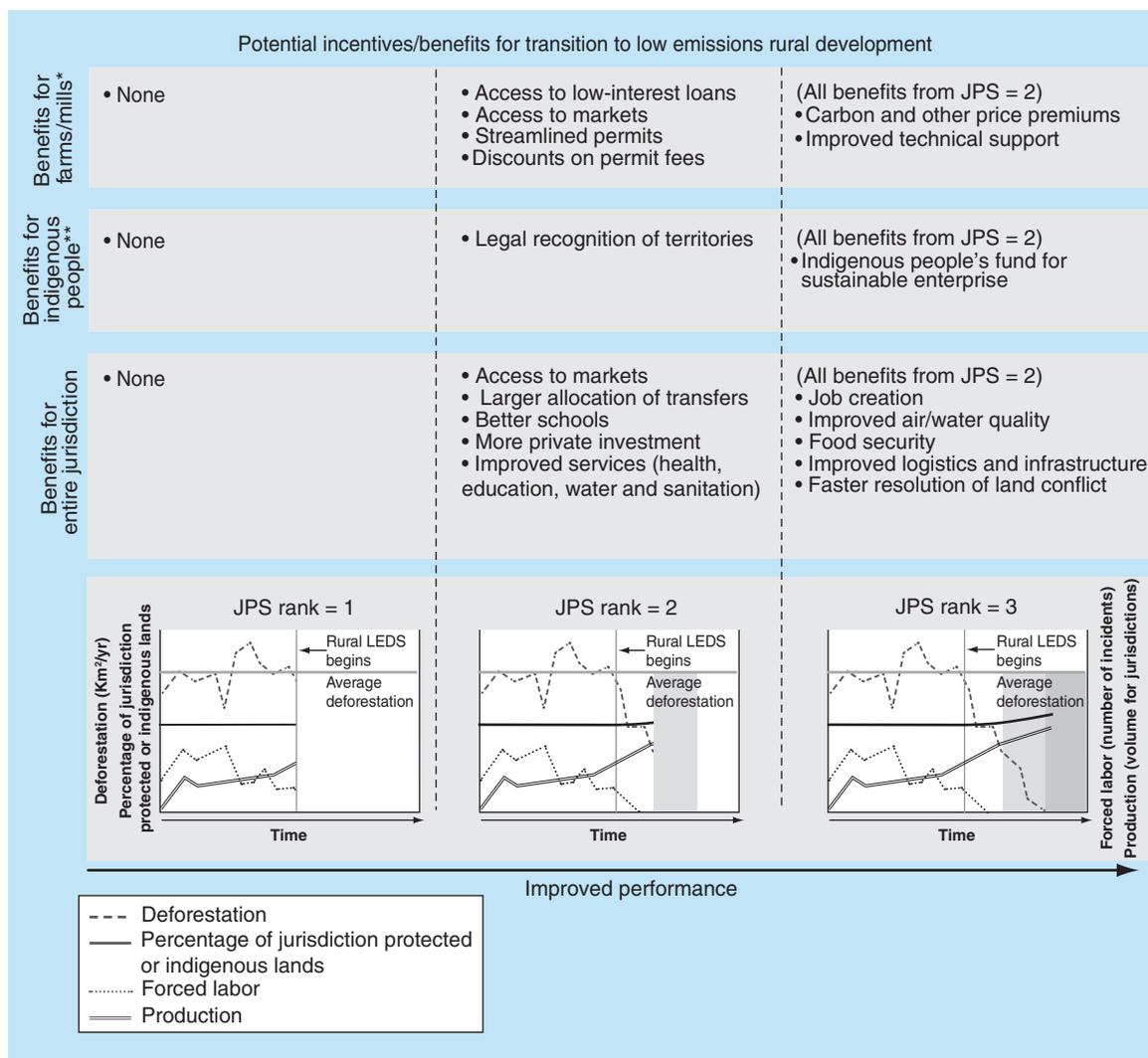


Figure 3. Hypothetical example, drawing from real-life incentives, of a possible linkage between a jurisdiction’s progress in improving its Jurisdictional Performance System rank and the flow of benefits to its farmers, indigenous people and broader rural societies. All of the incentives listed here are being implemented or under discussion in one of the three case studies (Brazil, Colombia and Indonesia) described in the following pages.

*: Including smallholders; **: Including traditional people; JPS: Jurisdictional Performance System; LEDS: Low-emission development strategies

to estimate the decline in CO₂ emissions from forest clearing in a way that is fully consistent with REDD+. Agricultural and livestock emissions of nitrous oxide and methane could be added to the jurisdiction’s GHG accounting to facilitate linkages with companies that have taken on emission reduction commitments.

The JPS could be used as a basis for determining the flow of benefits to farmers, indigenous groups and local governments through domestic transfers from the state or national government through: agricultural loan programs with differentiated interest rates that favor high-performing farms, businesses and jurisdictions;

improved rural services; the creation of rural enterprise funds targeting indigenous communities and smallholders; and other benefits summarized in Figure 3. The JPS could also be used by market actors. Roundtables could add criteria to their international standards that make it easier for farmers in high-performing jurisdictions to achieve certification. For example, farmers and mills in rank three jurisdictions, that have achieved zero net deforestation, could be exempted from the roundtable criteria concerning the clearing of primary forests. CGF companies could decide to accept rank two as signifying that a jurisdiction is on the pathway to

zero net deforestation. This window could be time constrained, such that jurisdictions have a maximum of 5 years to reach rank three and zero net deforestation. In recognizing this incremental approach to achieving the 2020 goal of zero net deforestation, the CGF would send a strong market signal that is in line with the pace and the progress already achieved within agricultural states and provinces, to slow and eventually end deforestation. One advantage of the historical baseline approach presented in this example is that it is fully compatible with REDD+ 'reference levels' (Table 1) and with jurisdictional programs already launched in Brazil (e.g., the municipalities 'Black List' and the 'Green Municipalities' programs; Table 1).

Roles of key stakeholders

There are near-term opportunities within current initiatives to develop an 'JPS', the systems that would put it into practice and the incentives for achieving improvements in the JPS rank.

▪ The CGF and TFA

The CGF and the TFA are designing regional interventions to chart the pathway to their 2020 zero net deforestation targets, beginning with a meeting focused on palm oil and deforestation in Jakarta, Indonesia, in June 2013. The CGF/TFA process is currently operating within a SSC approach, with linkages to REDD+. If it adopted a jurisdiction-wide approach, the CGF/TFA could unify and align domestic policies and finance to support the transition to zero net deforestation at scale. The jurisdictional approach could lower costs of traceability, since many jurisdictions already have in place systems and check points for monitoring the flow of commodities across political borders. It could also lower the costs within the supply chain, since farm-level monitoring could be substituted by jurisdiction-wide, satellite-based monitoring.

The opportunity

CGF companies and TFA nations could strengthen multistakeholder processes, such as that described above for Mato Grosso: by making commitments to buy commodities preferentially from those jurisdictions that are on the pathway to zero net deforestation (defined within the JPS); through a stronger role for CGF Chief Executive Officers, communicating to governmental leaders their commitment to work together in developing more productive, sustainable and efficient agricultural systems that can sell into the world's most demanding markets; and by participating in the design of a unified system for defining and measuring progress towards LED-R that includes the development of a broadly shared JPS.

▪ Agricultural Commodity Roundtables

RSPO, RTRS and Bonsucro have achieved a high level of engagement among agricultural and livestock organizations and businesses in the development of international standards for environmental and social performance. With standards focused on performance at the farm and mill level for the production of single commodities, the roundtables have thus far been unable to favor certification for farms and mills operating within high performing regions or jurisdictions. For example, Mato Grosso's 90% decline in deforestation does not help soy farmers in Mato Grosso comply with RTRS criteria for forests. Both RSPO and RTRS have devoted considerable effort to developing and improving their criteria related to forests and GHG emissions, and both are seeing the need to connect more effectively with governments and public policies.

The opportunity

Roundtables have an opportunity to magnify their positive impact on the transition to sustainability by: committing to participate in the development of the JPS principals, committing to participate in regional multistakeholder processes that are developing jurisdictional approaches to performance, including regional interpretations of the JPS, and initiating internal working groups to develop new criteria for roundtable standards that would make it easier for farmers and mills to comply with roundtable standards if they are in jurisdictions that are improving their JPS.

▪ Domestic farm sectors

Farmers, agricultural businesses and agricultural organizations have invested considerable resources into the development of regional SSCs, but generally with little or no connection to jurisdiction-wide performance. The livestock sector's global program for eradicating foot-and-mouth disease through the creation of disease-free zones that are free to sell into markets is a successful example of a jurisdictional approach, albeit for animal sanitation, with a simple performance standard – occurrence of the disease. These sectors know the principle barriers to the transition to SSCs and how these barriers might be overcome through more effective agricultural loan programs, farm-level incentive systems, technical assistance, streamlining of permitting and compliance, infrastructure and other changes.

The opportunity

Domestic farm sectors understand best what is needed to facilitate the transition to sustainability and the delivery of appropriate incentives to farmers who are making changes and investments in their production systems to achieve this transition. This potential is currently constrained by their focus on individual supply chains

instead of entire landscapes. If these sectors come forward in support of strategies for improving environmental and social performance across entire jurisdictions, they could reap substantial benefits (Figure 3). Specifically, these sectors could: commit to participate in multi-stakeholder dialogues that are developing regional interpretations of the JPS and the systems for achieving higher performance; participate in opportunities to develop state-wide programs for their sectors that could include 'carbon premiums' for their products, such as the REDD+ processes (described below); and negotiate with CGF and individual commodity-buying companies preferred market agreements and better, long-term contracts for producers in high-performing jurisdictions.

▪ National & subnational governments

Governments in Brazil, Indonesia, Colombia and elsewhere have taken important strides in the last few years in developing policies and programs for supporting their transitions to LED-R. Their approaches are still fragmented, however, with REDD+ programs developing under the auspices of the Ministries of Environment (or equivalent) and SSC initiatives, and 'low carbon' loan programs moving forward under the auspices of the Ministries of Agriculture or Forestry (or equivalent). They are poised to achieve integrated approaches to rural development that could include greater market access, higher levels of private sector investment, greater economic growth and jobs creation, larger tax revenues and improving livelihoods of rural communities. In other words, LED-R could become a powerful organizing paradigm that could foster a race to the top among jurisdictions, political leaders and government agencies trying to demonstrate (through the JPS) that they are making the most progress.

The opportunity

Progress made under REDD+, SSC initiatives, and more conventional domestic policies and programs (farm credit, tax structures and rural extension) must be integrated. REDD+ finance, for example, could be used together with agricultural finance programs to take on some of the risk associated with producers operating in regions of active deforestation who are making the transition to greater productivity in existing fields and pastures. Specifically, domestic governments could: commit to participate in multistakeholder processes that are developing a shared definition of progress (e.g., JPS) at the jurisdictional level in addressing deforestation and other key issues; mobilize their finance sectors to build the farm- and jurisdiction-level instruments to drive this progress; and build into their agricultural and livestock finance and technical support programs

conditions that help align these sectors with emerging international standards and LED-R.

▪ REDD+ donor nations

These nations, led by Norway, have forged innovative agreements with tropical forest nations. Their commitments and disbursements of performance-based finance have sometimes become entangled in complex bureaucratic processes. Most donor nations recognize and support the use of their funds for the creation of positive incentives for supporting the transition of agricultural sectors to LED-R, and most of their programs are focused on jurisdiction-wide performance in lowering GHG emissions from deforestation and forest degradation.

The opportunity

REDD+ donor nations should continue to give the signal that they recognize that domestic policies and finance must support the transition to LED-R if it is to be achieved over the long run, and that their commitment of funds should be used effectively towards that end. More specifically, they could: commit to participate in the design of the principles of an JPS; be available to participate in the regional multistakeholder dialogues that are developing JPS regionally and the systems to implement it as they encourage tropical government partners to streamline the delivery of positive incentives in support of innovation on the ground that is driving the transition to LED-R. Over the next few years, bilateral financial commitments to REDD+ and rural LED-R will play an important role in securing progress made thus far. It is important that donor nations deliver on their commitments as efficiently as possible, while renewing and expanding their commitments to continued, performance-based finance.

▪ NGOs

Many contributions to the transition to LED-R are currently being made by NGOs, including campaigns that reinforce the commitment of businesses to sustainability, support to global and regional dialogues, and standards through convening, analysis and engagement with a range of stakeholders, and support for the development of innovative governance and finance instruments.

The opportunity

NGOs' support for processes that would develop a shared definition of progress at the jurisdictional level will be important to its success. It is important that they continue to: support regional, bottom-up processes for designing rural LED-R; help with the development of integrative tools and frameworks for linking together

multiple initiatives; build the capacity of key sectors and stakeholders (e.g., indigenous peoples and smallholder groups who are often economically marginalized) to effectively defend their long-term interests through participation in multistakeholder dialogues; and support governments to develop the capacity to design and implement rural LED strategies.

The pathway forward: case studies from Brazil, Indonesia & Colombia

Successful strategies for driving the transition to LED-R will depend upon regionally tailored, nuanced approaches that are focused on the end (higher environmental, economic and social performance) while creatively designing the means to achieve this end. We illustrate possible approaches to achieving successful transitions that are emerging for the State of Mato Grosso, Brazil; the Province of Central Kalimantan, Indonesia; and for the nation of Colombia. A general framework for achieving the transition to LED-R is provided in [Figure 4](#).

▪ Mato Grosso

This 900,000 km² state is Brazil's leading agricultural producer, and was the leading deforesting state in Brazil and the world through 2005. The main drivers of deforestation in the state are cattle and soy [12], and 61% of its closed canopy forests are still standing [28]. Since then, it has achieved a 90% decline in deforestation below the average for 1996–2005 ([Figure 5](#)) [1,28]. This decline in deforestation was associated with a reduction in carbon emissions to the atmosphere of 1.3 billion tons of CO₂ equivalent (GtCO₂-e) [1], and resulted in no apparent inhibitory effect on the growth of the beef and soy sectors, the major drivers of deforestation ([Figure 5](#)) [1,12,13]. Rather, agreements between industry and civil society (e.g., the soy and beef moratoria; [Table 1](#)) and governmental interventions (e.g., the municipality black list; [Table 1](#)) created strong negative incentives for forest conversion to crops or pasture while the rapidly rising productivity of beef reduced the need for further forest conversion [1,12].

Mato Grosso's remarkable achievement is at risk. With high profits for soy growers during years of high commodity prices and with nearly 5 Mha of prime soy land cloaked with native forests [35], pressure to resume forest conversion is building. Farmers and agribusinesses are frustrated by the lack of positive incentives for their regional achievement. In one expression of this frustration, the powerful soy association of Mato Grosso, Aprosoja, left the RTRS in 2009 when an effective mechanism for compensating farmers for the costs of complying with the Forest Code had not been developed. Most of the cost of complying with

RTRS in Mato Grosso is legal compliance with the Forest Code [36].

A framework for securing and deepening Mato Grosso's transition to LED-R can be found in recent legislative and governance initiatives. The state recently approved a comprehensive state-wide REDD+ law that provides an important legal context for developing sector specific programs to support the transition to LED-R, and provides an important example of the integration of REDD+ into domestic policies. Programs for the cattle and soy industries are now under development, but participation from the powerful agricultural sector is weak. The national revision of the Forest Code also creates a legal context for designing new mechanisms for delivering positive incentives to farmers and ranchers whose production systems are in line with the state's deforestation reduction goals [33].

One component of Mato Grosso's rural low-emission development strategy could be the development of a two-tiered set of incentives for municipalities and farmers that are lowering their deforestation and increasing their production, building upon initiatives that are already being implemented in the State of Pará, north of Mato Grosso. Through Pará's 'Imposto sobre Operações Relativas à Circulação de Mercadorias e sobre Serviços de Transporte Interestadual e Intermunicipal e de Comunicação (ICMS, Tax on the Circulation of Goods, Interstate and Intercity Transportation and Communication Services) Verde' (Green ICMS) law, passed in 2013, a fraction of the revenues of the ICMS are allocated among municipalities according to three environmental criteria: the percentage of the municipality that is protected as indigenous territories or conservation areas; the percentage of the land outside of these protected areas that is registered within the state's rural environmental registry; and a combination of the reduction in deforestation and the size of remaining forest carbon stocks through a 'stock flux' formula [37]. (more information about Pará's Green ICMS is available in [Supplementary Data Section A](#)). At the farm level, procedures for accessing public credit and licensing rural properties could be streamlined for farmers in high-performing municipalities, as is already being implemented for six municipalities in Pará by the Ministry of Finance. Eventually, both public and private banks could develop differentiated interest rates and loan terms to deliver real, tangible benefits to farmers who are in high-performing municipalities (fostering collective action). Rabobank, which lends more than a billion dollars in loans to farmers in Mato Grosso each year, has launched a differentiated interest rate loan program that might be adapted to incorporate jurisdictional performance, for example.

A second component of the Mato Grosso rural low-emission development strategy could employ its

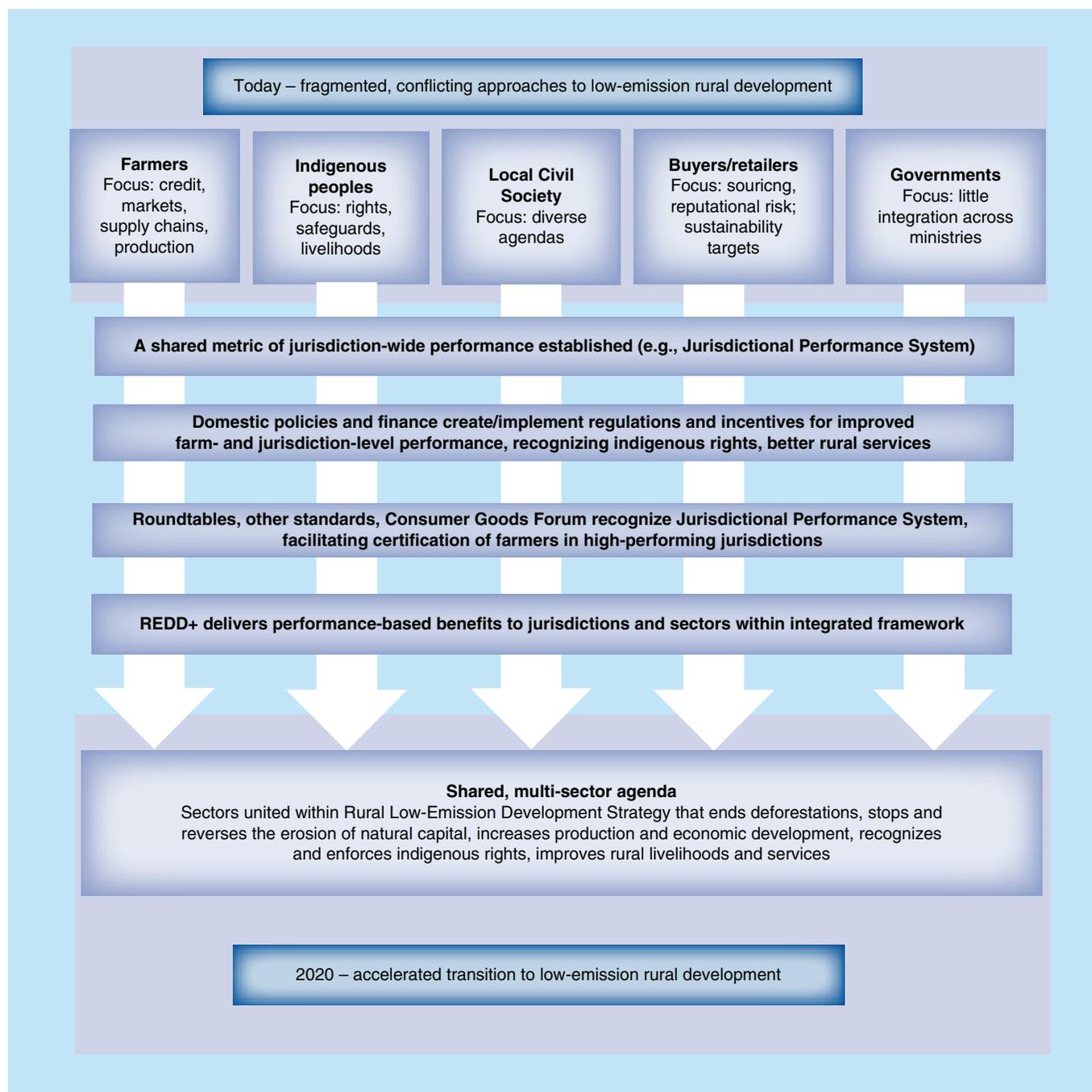


Figure 4. General framework for overcoming the fragmentation among initiatives that impedes progress towards low emission rural development today. The major concerns of the principle stakeholders must be recognized and addressed as convergence is achieved around a shared multi-sector agenda.

CO₂ emissions reductions in support of its farm sectors, its indigenous groups and its smallholder settlements. Sector-specific, state-wide programs could be designed within the legal framework provided by the state’s new REDD+ law and the nation’s new Forest Code to deliver positive incentives to the farmers and communities who are making measurable

progress towards more productive, sustainable farm systems. Endowment funds could be created for the long-term provision of finance for indigenous peoples. These programs could also be designed to foster collective action at the scale of entire municipalities to address critical issues, such as deforestation. In one hypothetical scenario, the state beef and soy sectors

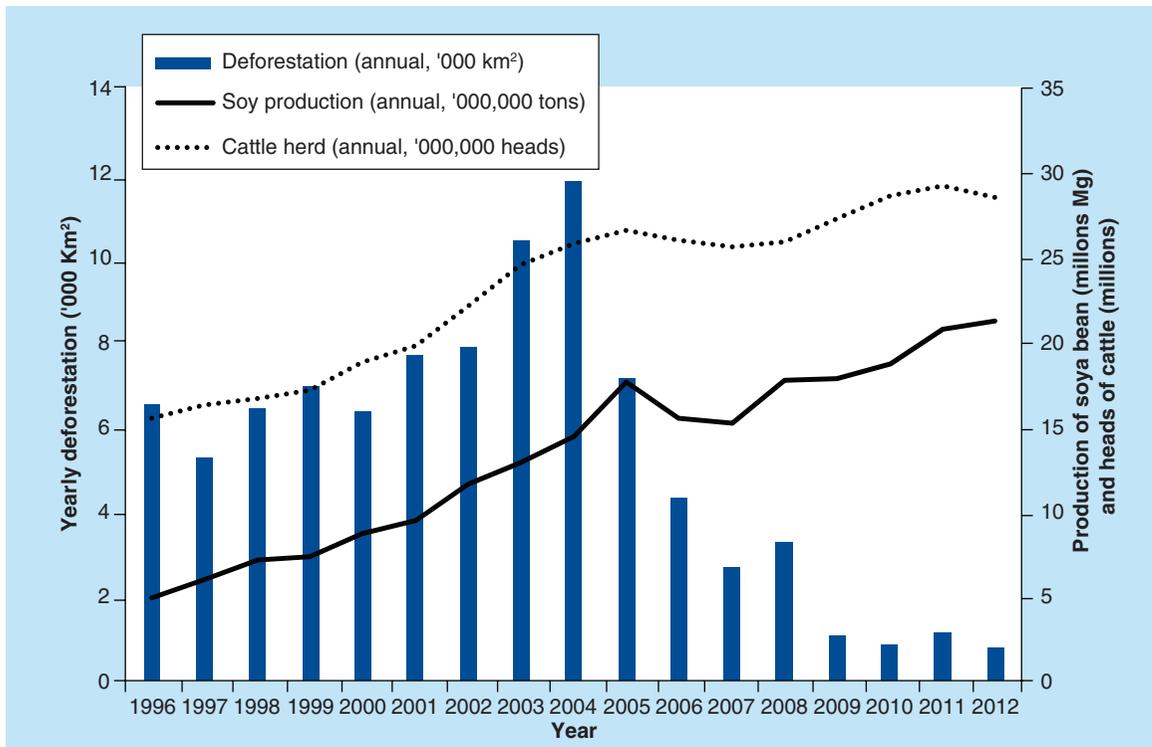


Figure 5. Annual deforestation, annual soy production and the size of the cattle herd (number of head) of Mato Grosso State, Brazil.

Adapted from [1].

would be allocated a portion of the state’s one-quarter billion tons of annual CO₂ emissions reductions (ERs) to be used as incentives for small- and medium-scale producers who are making the transition to sustainable, production systems, forgoing forest conversion to pasture and cropland. These emissions reductions could be sold to beef and soy buyers or, eventually, into regulated offset markets such as that under development in California [1]. ER buyers would acquire registered emissions reductions that could be held as an asset or retired as an offset against their own company’s CO₂ footprint. Carbon ER sales and revenues could be managed by a public-private partnership ‘company’, such as the one established in Acre State operating outside of the state government bureaucracy [38]. The company could allocate revenues to producers according to a formula that combines the JPS ranking and property-level performance. For example, the formula might recognize registration in the rural environmental registry program (Cadastro Ambiental Rural) and other performance measures of individual properties that can be monitored using satellites (e.g., fire occurrence, forest cover and deforestation). Farmers and livestock producers would, thereby, be motivated to improve the social and environmental performance of their entire municipality through collective action and of their own

individual property. Similar state-wide programs could be developed for smallholder settlements, indigenous groups and protected areas.

Finally, Mato Grosso’s progress could be reinforced through direct dialogue with CGF companies and commodity buyers to close performance-based agreements to preferentially source beef, soy and other commodities from the state’s municipalities and from the state generally as deforestation continues to remain low, moving further towards a 2020 zero net deforestation target. Consensus around the metric of performance (the regional JPS) would facilitate this negotiation.

▪ Central Kalimantan

After Brazil, Indonesia is historically the second largest deforester [39]. In 2009, it made a commitment to reduce emissions 26% by 2020 with its own resources and 41% with international assistance (Table 1). The Government of Norway responded to this announcement with a \$1 billion performance-based commitment. As Indonesia demonstrates success in moving towards its target, it can tap into Norwegian funding.

Central Kalimantan was selected as the ‘pilot province’ of Indonesia’s partnership with Norway. Similarly to many other provinces, this 158,000 km² jurisdiction

developed a REDD+ task force and plan [30]. More recently, Governor Teras Narang launched a ‘roadmap’ for low-emission rural development that focuses on implementation of the Province’s regulation for plantations and the resolution of conflicts between the national production forest classification and the areas designated for plantation development within the Province’s Districts [111]. The roadmap describes the goal of lowering deforestation to 80% below its 2006–2009 level by 2020, the elimination of deforestation from the Province’s palm oil sector, and an increase in small holder community participation in the province’s palm oil industry from 11 to 20% of annual production.

The chances of the roadmap’s success are enhanced by the strong political support of the Governor (Teras Narang) and three District-level Regents (called ‘bupatis’), support from the Ministry of Agriculture and support from the Presidential Unit that is driving the development of the nation’s REDD+ program. A common thread through these layers of government is the shared commitment to reconcile conflicts among national and district-level land designations, and to bring greater transparency to the concession permit and licensing process through an on-line plantation permit system.

These innovations could lower the costs of Central Kalimantan’s RSPO-certified palm oil companies, who currently incur considerable delays and cash outlays with the cumbersome process of acquiring land permits and production licenses. In a recent study of 29 palm oil companies in Central Kalimantan, all of those interviewed stated that the licensing process is too long and bureaucratic, and 90% stated that it was too costly. The full licensing process can take up to 4 years.

The Central Kalimantan roadmap could also help resolve another problem faced by palm oil companies and Dayak indigenous communities who are interested in growing palm oil to sell to these companies. A recent constitutional court ruling has recognized community rights to their territories, which now must be implemented by multiple levels of government through consultation with communities and mapping of their territories. The roadmap, launched through a multi-stakeholder meeting in Central Kalimantan in June 2013, could help to identify those independent Dayak communities who have control over their territory and are interested in participating in the palm oil sector.

As in Mato Grosso, a commitment from palm oil buying companies to buy preferentially from Districts and Provinces that are succeeding in lowering their deforestation according to a regionally-negotiated JPS could greatly increase the potential success of Central Kalimantan’s transition to LED-R, providing an

example of a large-scale jurisdictional transition that could be replicated in other Indonesian provinces.

▪ Colombia

The nation of Colombia, with 1.1 million km² (only 0.2 million more than Mato Grosso), is also poised to embark upon a national transition to LED-R. Colombia has made a commitment to end deforestation by 2020; it long ago (1959) prohibited the clearing of forests in the Amazon and six other forest reserves, and it has progressive palm oil, sugarcane and biofuels sectors that have committed to zero deforestation, low-emission supply chains [40]. The cattle sector, represented by Federación Colombiana de Ganaderos (Colombian Federation of Livestock), has established a 2019 goal of reducing the area of pasture (that occupies three-fourths of the total area of cleared land) from 380,000 to 280,000 km² as it increases production [41]. If successful, this transition could free up land to help spare further agricultural expansion into the llanos (of the Orinoco valley) and the Amazon forest. An innovative government agricultural finance institution FINAGRO – Colombian Fund for Financing the Agricultural Sector – is poised to develop new instruments (under the supervision of Ministry of Agriculture and Rural Development) that leverage its \$4 billion in agricultural and forestry loans and subsidies that are currently made available to farmers and agribusinesses each year to favor the transition to LED-R more directly. With the prospects of a peace agreement that would end the 60-year war waged by the Fuerzas Armadas Revolucionarias de Colombia (FARC), with new free trade agreements with the USA, Europe and Chile, and with a bold REDD+ strategy focused on the Amazon, Colombia could accelerate this transition [40].

In Colombia, an important challenge is to weave together the many constituencies and sectors that are in favor of sustainable development. A critical initial goal is to engage the agricultural sectors (palm oil, sugarcane and biofuel) that are migrating toward the SSC agenda, the cattle sector, the peasant movements that include those organized to reconstitute the 5 million smallholders and villagers displaced by guerilla war and illicit crops, and the indigenous peoples’ movement in the design and implementation of a national rural low-emission development strategy. This national strategy might feature a spatial land-use plan, required by law, that would designate areas where no further forest conversion is allowed, where those farmers displaced by FARC activities can be resettled, where additional areas of indigenous territory must be recognized and demarcated, and where forests can be restored or regrown. The peace accords under negotiation between FARC

and the Colombian Government might be strengthened if the national rural LEDS places a priority on addressing the problem that gave rise to the FARC in the first place: the lack of economic opportunities for smallholders and villagers, and the accumulation of wealth by the rural elite [42,43]. In this regard, a critical element of the national rural LEDS would be the development of an effective system of technical and financial support for smallholder enterprises across the nation that functions across a diversity of circumstances, including participation as growers for the palm oil, sugarcane and biofuel industries. A pathway to LED-R, including the 2020 zero deforestation target and other targets for expanding agricultural, biofuel and livestock production, could be supported by a system of municipal-level incentives patterned on the ‘Green Municipalities’ program of Brazil (Table 1), which is already under discussion. Such a program might allocate incentives from, for example, the National Royalty Fund, according to performance measured through the Colombian version of the JPS. International REDD+ donors could establish a public–private partnership with the Ministry of Agriculture and Rural Development, implemented by FINAGRO, to take on some of the riskier production systems, including cattle operations in the Amazon region, financing the transition to more productive farms that are in line with FEDEGAN’s 2019 intensification goals.

Finally, the ‘Heart of the Amazon’ initiative of the Ministerio de Desarrollo Sostenible (the environment

ministry), which seeks to end deforestation and promote sustainable, forest-maintaining enterprises for smallholders and indigenous communities throughout an 11 million km² area of the Amazon region, could be expanded to encompass the entire Amazon region, integrated within the national spatial plan, with strong cross-sector support [40].

Future perspective

There is strong potential for large-scale transitions to LED-R. International, negotiated approaches to the establishment of global rules for sustainable land-use, including the commodity roundtables and REDD+, are works in progress whose ultimate success will depend upon more effective linkages with the policies, institutions and finance of tropical forest nations [44]. There are many opportunities to make these connections, illustrated by Mato Grosso, Central Kalimantan and Colombia. Innovation in developing frameworks for supporting the transition to LED-R is bubbling up in many states, provinces and nations of the world, and could be reinforced and strengthened through direct engagement with key actors who are advancing SSCs and REDD+. An integrated framework for supporting large-scale transitions LED-R might be created over the next few years, focused on improving environmental, economic and social performance as measured through a Jurisdictional Performance System that is interpreted regionally, but operating under principles establishes globally.

Executive summary

Background

- Climate change, food supply and forest loss are three intertwined challenges that require integrated solutions.
- Large-scale changes in rural development models, focused on the tropics, could increase food, fuel and fiber production, while sparing forests and reducing GHG emissions. This model is referred to here as ‘low-emission rural development’ (LED-R).

Sustainable supply chains, REDD+, & domestic policies & finance

- The three major approaches that could help achieve LED-R are sustainable supply chains, domestic policies and finance, and REDD+.

Strengths & weaknesses of the three approaches

- These approaches are generally failing to achieve potential synergies because of differences in the scale at which they operate (farmers and mills versus entire counties, states and nations) and differences in the metrics for measuring performance.

Linking & strengthening the three approaches

- Sustainable supply chains and REDD+ could connect to, and help align, the domestic policies, finance programs and institutions with LED-R through a shared metric of progress at the jurisdictional level, introduced here as the Jurisdictional Performance System (JPS), and regional integrated systems for delivering positive incentives for the transition to LED-R at the farm and jurisdiction level.

A shared metric of jurisdiction-wide progress: the JPS

- In a hypothetical example that draws upon real policy initiatives on the ground, a JPS might rank jurisdictions depending upon their progress in lowering deforestation, ending forced labor, recognizing and demarcating indigenous lands and protected areas, and increasing agricultural and livestock production.

Roles of key stakeholders

- There are specific interventions from the buyers of agricultural commodities, from domestic farm sectors, domestic governments, REDD+ donor nations and NGOs that could help realize this potential.

The pathway forward: case studies from Brazil, Indonesia & Colombia

- Mato Grosso, Central Kalimantan and Colombia have all initiated the transition to LED-R, but are facing substantial obstacles; they illustrate how sustainable supply chain, REDD+ and domestic policy approaches could be integrated to overcome these obstacles.

Supplementary data

To view the supplementary data that accompany this paper please visit the journal website at: www.future-science.com/doi/full/10.4155/CMT.13.65

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No writing assistance was utilized in the production of this manuscript.

References

Papers of special note have been highlighted as:

- of interest
 - of considerable interest
- 1 Nepstad DC, Boyd W, Stickler CM, Bezerra T, Azevedo AA. Responding to climate change and the global land crisis: REDD+, market transformation and low-emissions rural development. *Philos. Trans. R. Soc. B Biol. Sci.* 368(1619), 20120167 (2013).
 - **Synthesis of the status of jurisdictional REDD+ and market transformation initiatives, and the potential for synergistically linking the two, which introduces the concept of ‘low-emission rural development’ as a rural development model that integrates multiple agricultural, environmental and livelihood goals.**
 - 2 Cribb J. *The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It*. University of California Press, CA, USA (2010).
 - 3 The Organisation for Economic Co-operation and Development, Food and Agriculture Organization of the UN. *OECD-FAO Agricultural Outlook 2010–2248*. OECD Publishing, Paris, France (2010).
 - 4 Nepstad DC. *Recognizing and Managing the Tropical Agricultural Revolution in Latin America and the Caribbean*. Inter-American Development Bank, Washington, DC, USA (2011).
 - 5 Ray DK, Ramankutty N, Mueller ND, West PC, Foley JA. Recent patterns of crop yield growth and stagnation. *Nat. Commun.* 3, 1293 (2012).
 - 6 Lobell DB, Schlenker W, Costa-Roberts J. Climate trends and global crop production since 1980. *Science* 333(6042), 616–620 (2011).
 - 7 Lambin EF, Meyfroidt P. Global land use change, economic globalization, and the looming land scarcity. *Proc. Natl Acad. Sci. USA* 108(9), 3465–3472 (2011).
 - 8 IPCC. *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Geneva, Switzerland (2007).
 - 9 Pan YD, Birdsey RA, Fang JY et al. A large and persistent carbon sink in the world’s forests. *Science* 333(6045), 988–993 (2011).
 - 10 Zarin DJ, Davidson EA, Brondizio E et al. Legacy of fire slows carbon accumulation in Amazonian forest regrowth. *Front. Ecol. Environ.* 3, 365–369 (2005).
 - 11 Lal R. Soil carbon sequestration impacts on global climate change and food security. *Science* 304(5677), 1623–1627 (2004).
 - 12 Macedo MN, Defries RS, Morton DC, Stickler CM, Galford GL, Shimabukuro YE. Decoupling of deforestation and soy production in the southern Amazon during the late 2000s. *Proc. Natl Acad. Sci. USA* 109(4), 1341–1346 (2012).
 - **Documents the ‘decoupling’ of deforestation and increases in agricultural production, demonstrating the feasibility of producing more while keeping forests standing.**
 - 13 Tilman D, Balzer C, Hill J, Befort BL. Global food demand and the sustainable intensification of agriculture. *Proc. Natl Acad. Sci. USA* 108(50), 20260–20264 (2011).
 - 14 UN World Commission on Environment and Development. *Our Common Future, Report of the World Commission on Environment and Development*. Oxford University Press, Oxford, UK, 300 (1987).
 - 15 Cashore B, Gale F, Newsom D. *Confronting Sustainability: Forest Certification in Developing and Transitioning Countries*. Yale School of Forestry and Environmental Studies, New Haven, CT, USA (2006).
 - 16 Nepstad DC, Stickler CM, Almeida OT. Globalization of the Amazon soy and beef industries: opportunities for conservation. *Conserv. Biol.* 20(6), 1595–1603 (2006).
 - 17 Greenpeace. *Eating Up the Amazon*. Greenpeace International, Amsterdam, The Netherlands (2006).
 - 18 Greenpeace. *Slaughtering the Amazon*. Greenpeace International, Amsterdam, The Netherlands, 13 (2009).
 - 19 Gullison RE, Frumhoff PC, Canadell JG et al. Tropical forests and climate policy. *Science* 316(5827), 985–986 (2007).
 - 20 Agrawal A, Nepstad D, Chhatre A. Reducing emissions from deforestation and forest degradation. *Annu. Rev. Environ. Resour.* 36(1), 373–396 (2011).
 - 21 Peters-Stanley M, Yin D. *Maneuvering the Mosaic: State of the Voluntary Carbon Markets*. Bloomberg New LP, NY, USA, 126 (2013).
 - 22 Angelsen A. *Moving Ahead With REDD: Issues, Options and Implications*. Center for International Forestry Research, Bogor, Indonesia, 172 (2008).
 - 23 Angelsen A. *Realising REDD+. National Strategy and Policy Options*. Center for International Forestry Research, Bogor, Indonesia (2009).
 - 24 Angelsen A, Brockhaus M, Sunderlin WD, Verchot LV. *Analysing REDD+: Challenges and Choices*. Center for International Forestry Research, Bogor, Indonesia (2012).
 - 25 Angelsen A. Policies for reduced deforestation and their impact on agricultural production. *Proc. Natl Acad. Sci. USA* 107(46), 19639–19644 (2010).
 - 26 Brockhaus M, Obidzinski K, Dermawan A, Laumonier Y, Luttrell C. An overview of forest and land allocation policies in Indonesia: is the current framework sufficient to meet the needs of REDD plus? *For. Policy Econ.* 18, 30–37 (2012).
 - 27 Nepstad DC, McGrath D, Alencar A et al. Frontier governance in Amazonia. *Science* 295(5555), 629–631 (2002).

- 28 Nepstad D, Soares BS, Merry F *et al.* The end of deforestation in the Brazilian Amazon. *Science* 326(5958), 1350–1351 (2009).
- 29 Kissinger GA, Brasser A, Gross L. *Scoping Study. Reducing Risk: Landscape Approaches to Sustainable Sourcing*. EcoAgriculture Partners, Washington, DC, USA (2013).
- 30 Santilli MP, Moutinho P, Schwartzman S, Nepstad DC, Curran L, Nobre CA. Tropical deforestation and the Kyoto Protocol: an editorial essay. *Clim. Chang.* 71, 267–276 (2005).
- 31 Nepstad DC, Boyd W, Azevedo A *et al.* *Overview of Subnational Programs to Reduce Emissions from Deforestation and Forest Degradation (REDD) as Part of the Governors' Climate and Forests Task Force*. Electric Power Research Institute, CA, USA (2012).
- 32 Boyd W. Climate change, fragmentation, and the challenges of global environmental law: elements of a post-Copenhagen assemblage. *Univ. Penn. J. Int. Law* 32(2), 457–550 (2010).
- **Review of international environmental law, focused on the UNFCCC, explains the slow progress and structural barriers to achieving a robust legal framework, and the constraints imposed by UN processes.**
- 33 Stickler CM, Nepstad DC, Azevedo AA, Mcgrath DG. Defending public interests in private lands: compliance, costs and potential environmental consequences of the Brazilian Forest Code in Mato Grosso. *Philos. Trans. R. Soc. B Biol. Sci.* 368(1619), 20120160 (2013).
- **Analysis of Brazil's 'Forest Code', which establishes restrictions on forest clearing at the level of the property, found that changes in the Code and lack of attention to implementation undermined its usefulness.**
- 34 Soares-Filho B, Moutinho P, Nepstad D *et al.* Role of Brazilian Amazon protected areas in climate change mitigation. *Proc. Natl Acad. Sci. USA* 107(24), 10821–10826 (2010).
- 35 Nepstad DC, Stickler CM. Managing the tropical agriculture revolution. *J. Sustain. Forest.* 27(1), 43–56 (2008).
- 36 KPMG, Initiatief Duurzame Handel (Sustainable Trade Initiative), World Wildlife Fund, Nederlandse Financierings-Maatschappij voor Ontwikkelingslanden N.V. (Netherlands Development Finance Company), International Finance Corporation. *Sustainable Insight: A Roadmap to Responsible Soy: Approaches to Increase Certification and Reduce Risk*. KPMG, Amstelveen, The Netherlands (2013).
- 37 Cattaneo A. *A "Stock-Flow with Targets" Mechanism for Distributing Incentive Payments to Reduce Emissions from Deforestation*. The Woods Hole Research Center, MA, USA, 5 (2009).
- 38 Alencar A, Nepstad DC, Mendonza E *et al.* *Acre State's Progress Towards Jurisdictional REDD+: Research, Analysis, and Recommendations for the State Carbon Incentive Program (ISA-Carbono)*. Amazon Environmental Research Institute, Brazil, 53 (2012).
- 39 FAO. *Global Forest Resources Assessment 2010. FAO Forestry Paper 163*. FAO, Rome, Italy, 378 (2010).
- 40 Nepstad DC, Bezerra T, Tepper D *et al.* *Addressing Agricultural Drivers of Deforestation in Colombia: Increasing Land-Based Production while Reducing Deforestation, Forest Degradation, Greenhouse Gas Emissions and Global Poverty. Report to the United Kingdom Foreign and Commonwealth Office and Department of Energy Climate Change, Forests and Climate Change Programme*. Earth Innovation Institute, CA, USA, 158 (2013).
- 41 Colombian Federation of Livestock. *Strategic Plan for Cattle Ranching in Colombia until 2019*. Colombian Federation of Livestock, Bogotá, Colombia (2006).
- 42 Rettberg A. *Constructing Peace in Colombia*. Universidad de los Andes, Department of Political Science, Uniandes, Bogotá, Colombia (2012).
- 43 Ospina W. *Where is the Yellow Band?* Mondadori, Bogotá, Colombia (2012).
- 44 Stickler CM, Bezerra TPR, Nepstad DC. *Global Rules for Sustainable Farming*. Amazon Environmental Research Institute, CA, USA (2012).
- 45 Brockhaus M, Obidzinski K, Dermawan A, Laumonier Y, Luttrell C. An overview of forest and land allocation policies in Indonesia: is the current framework sufficient to meet the needs of REDD+? *Forest Policy Econ.* 18, 30–37 (2011).
- **Websites**
- 101 Progress toward a consensus on carbon emissions from tropical deforestation. www.whrc.org/news/pressroom/pdf/WI_WHRC_Policy_Brief_Forest_CarbonEmissions_finalreportReduced.pdf
- 102 The Consumer Goods Forum Board Resolution on Deforestation. www.theconsumergoodsforum.com/pdf/pressreleases/2010/2010-2011-2029-climateprotection.pdf
- 103 First Tropical Forest Alliance 2020 Workshop Catalyzes Action to Reduce Global Deforestation. www.theconsumergoodsforum.com/PDF/PressReleases/2013-2007-2015-First_TFA_2020_Workshop_Catalyzes_Action_to_Reduce_Global_Tropical_Deforestation.pdf
- 104 The REDD Offset Working Group. California, Acre and Chiapas. <http://greentechleadership.org/documents/2013/07/row-final-recommendations-2.pdf>
- 105 The World Bank. Landscape approaches in sustainable development. <http://go.worldbank.org/S2G5CQ4KD0>
- 106 Ministry of Agriculture, Livestock and Supply. Agricultural and Livestock Plan for 2013/2014. www.agricultura.gov.br/pap
- 107 FINAGRO Accountability. www.finagro.com.co/qui%C3%A9nes-somos/rendici%C3%B3n-de-cuentas
- 108 Ministry of Finance of Republic of Indonesia, Directorate General of Budgeting. www.anggaran.depkeu.go.id/web-content-list.asp?ContentId=878
- 109 Yale University. Environmental performance index. www.epi.yale.edu
- 110 Instituto de Pesquisa Ambiental da Amazônia. www.ipam.org.br
- 111 The Government Of The Province Of Central Kalimantan. www.kalteng.go.id/ogi
- 112 The Consumer Goods Forum. www.theconsumergoodsforum.com/index.aspx
- 113 Tropical Forest Alliance 2020. www.tfa2020.com
- 114 Beef Moratoria. Finance Secretary of Mato Grosso release on the beef moratorium. <http://sefaz-mt.jusbrasil.com.br/noticias/1927608/protocolo-da-moratoria-da-carne-sera-assinado-na-fgv-em-sao-paulo>
- 115 Soy Moratoria. ABIOVE webpage on the Soy Moratoria. www.abiove.org.br/site/?page=moratoria-da-soja&area=NS0zLTE
- 116 Brazilian National Climate Change Mitigation Plan. The reduction target is included in the Decree 7.390 of December 9, 2010, art. Art. 6, I, which regulates the Law 12.187 of December 29, 2009. Office of the Brazilian President, Civil House. www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Decreto/D7390.htm
- 117 Amazon Fund. www.amazonfund.gov.br/FundoAmazonia/fam/site_en

- 118 Official website of the Government of Acre, Brazil, System of Incentives for Environmental Services.
www.ac.gov.br/wps/wcm/connect/fc02fb0047d011498a7bdb9c939a56dd/publicação_lei_2308_ling_PT.pdf?MOD=AJPERES
- 119 Law 9.878 of January 7, 2013. Official website of the Environmental Agency of the Government of Mato Grosso, Brazil.
www.sema.mt.gov.br/index.php?option=com_docman&task=cat_view&gid=156
- 120 The Indonesian REDD+ Program is being prepared by the REDD+ Task Force. Official website for the REDD+ Task Force in Indonesia.
www.satgasreddplus.org/en/redd-task-force/working-groups-structure
- 121 Letter of Intent Between the Government of the Kingdom of Norway and the Government of the Republic of Indonesia on Cooperation on reducing GHG emissions from deforestation and forest degradation. May 26, 2010. P. 4.
www.unorcid.org/upload/doc_lib/Norway-Indonesia-LoI.pdf
- 122 UNFCCC Secretariat. 2011. Nationally Appropriate Mitigation Actions. P. 12. March, 2011. Colombia.
<http://unfccc.int/resource/docs/2011/awglca14/eng/inf01.pdf>
- 123 Decree n. 6.321 of December 21, 2007, Brazil.
www.planalto.gov.br/ccivil_03/_ato2007-2010/2007/Decreto/D6321.htm
- 124 Official website of the Brazilian Ministry of Environment with a list of the critic municipalities.
www.mma.gov.br/florestas/controle-e-prevenção-do-desmatamento/plano-de-ação-para-amazônia-ppcdam/lista-de-munic%C3%ADpios-prioritários-da-amazônia
- 125 Official website of the Municípios Verdes Program.
<http://municipiosverdes.com.br>
- 126 Law 12.651, of May 25, 2012.
www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12651.htm
- 127 Finagro official website.
www.finagro.com.co