

Policy In Focus

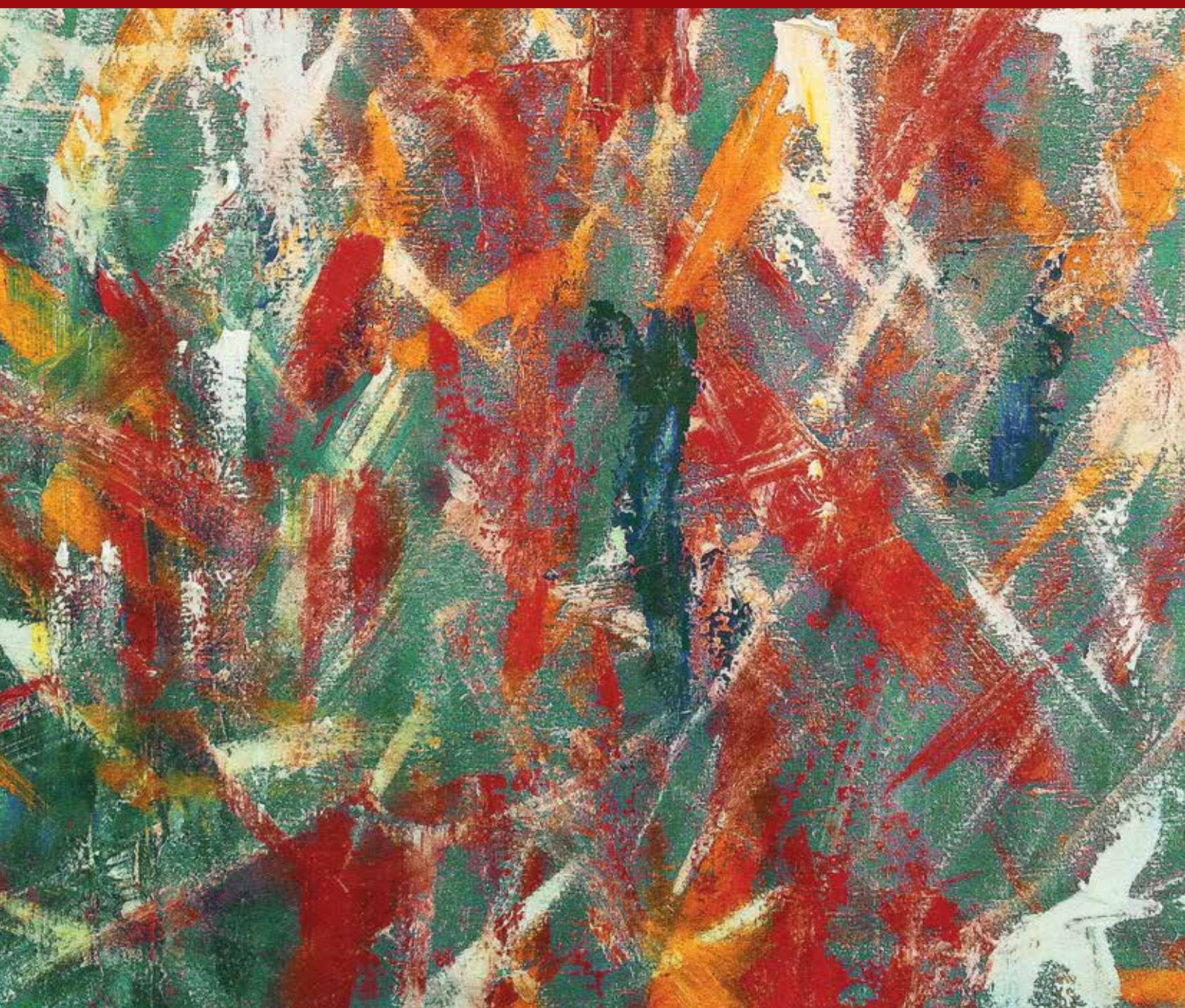


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*A publication of
The International Policy Centre for Inclusive Growth
United Nations Development Programme*

August 2014 ■ No. 29

Development without Deforestation



The International Policy Centre for Inclusive Growth (IPC-IG) is a joint project between the United Nations and Brazil to promote South-South learning on social policies. It specialises in research-based policy recommendations on how to reduce poverty and inequality as well as boost inclusive development. The IPC-IG is linked to the UNDP Brazil Country Office, the Secretariat of Strategic Affairs (SAE) and the Institute for Applied Economic Research (IPEA) of the Government of Brazil.

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Policy in Focus

Policy in Focus is a regular publication of the International Policy Centre for Inclusive Growth (IPC-IG). This special edition was made in partnership with UNDP Brazil exploring the work of the UNDP and the Global Environment Facility (GEF). We would like to recognise the many partners who have contributed to the UNDP Brazil project implemented in the northwest of Mato Grosso, outlined in this publication, and also thank the GEF (www.thegef.org) for their financial contribution towards that initiative.

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Editor's note: This special edition presents some of the ongoing discussions about forest frontier regions of the Amazon and the Himalayas surrounding the themes of deforestation, degradation and their juxtaposed or complementary relationship with development. The contributing authors were able to raise some pertinent questions about the future of economic growth as well as the biodiversity and communities that exist in such regions today. Simultaneously, drawing heavily from the experiences of the UNDP project with GEF financing, the collective body of articles highlights some successful cases of development without deforestation, providing insight for forest frontier regions around the world.

On behalf of the UNDP IPC-IG I am grateful to UNDP Brazil for their support in the development of this special edition, in particular to our Specialist Guest Editors Carlos Ferreira de Abreu Castro and Guilherme Lambais as well as Manoel Salles for his dedication to the publication of this issue. Finally, I would like to express my sincerest appreciation to all of the authors for their generous and insightful contributions, without which this publication simply would not have been possible.

This special edition is dedicated to Jorge Luis Vivan who passed away during the development of this issue. Our thoughts go out to his friends and family.

Policy^{International}

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© 2014 International Policy Centre for Inclusive Growth
United Nations Development Programme

ISSN: 2318-8995

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The conservation projects managed by the United Nations Development Programme (UNDP) in Brazil are underpinned by a strong element of inclusive local development, consisting of innovative initiatives regarding the sustainable use of biodiversity. There are many examples of projects in Mangrove, Caatinga and Cerrado areas, which conciliate the production of goods and environmental services with the generation of jobs, income and an increase in life quality.

It is always an enormous challenge to assure opportunities to the most vulnerable populations living in areas characterised by a great expansion of agricultural commodities production and cattle ranching, while respecting people's livelihoods and protecting the environment.

In the Brazilian Amazon this challenge is even greater. We need to adopt agriculture and forestry systems with higher production and lower environmental impacts in order to overcome the traditional and prevailing "slash and burn" model. How should biodiversity conservation projects be implemented in areas of intense conflict involving, among others, indigenous populations, loggers, poachers, smallholders, cattle ranchers and agro commodities producers?

For many years, the cities in the Northwestern region of Mato Grosso have been at the top of the list of municipalities with the highest number of murders per capita and the highest deforestation rates in Brazil. It was in this region that UNDP and the State Environment Secretariat developed a project, financed by the Global Environment Facility, which demonstrated that there are sound alternatives for development in the Amazon region. Such alternatives could simultaneously conserve natural resources and produce goods and services, as exemplified by the production of Brazil nuts in indigenous areas and land reform settlements. The standing forest is generating income which is considerably higher than the income deriving from the surrounding deforested areas.

As Jorge Luis Vivan—who has recently passed away, and to whom we dedicate this issue—used to emphasise, agroforestry is another great example of a production model that generates an income far superior to extensive cattle ranching and other land uses, which unfortunately hasn't received the appropriate attention from finance and research organisations. The lack of solid public policies, credit and technical support geared towards the sustainable production of timber and non-timber products elicit the conditions for further deforestation. As evidenced by the articles in this issue of *Policy in Focus*, deforestation by itself greatly increases the land value in forest frontier areas.

The goal of this edition is to stimulate the discussion around these issues and the associated challenges they present. We wish to better understand the obstacles for a development process that respects human and biological diversity.

The extremely intense transformation and degradation of the Amazon landscape occurs at a blinding speed, requiring coordinated long-term investments from technical cooperation agencies, development banks and finance funds, in order to oppose the driving forces of tropical deforestation and socio-cultural degradation.

The Frontiers of Interdisciplinary Research on Development without Deforestation

by Guilherme B. R. Lambais

Establishing the foundations of human development without deforestation is undeniably one of the backbones for safeguarding the economic system and the preservation of the species. Today it is known that life on Earth is a complex system and, henceforth, on the threshold of order and disorder. If unrestrained deforestation continues to occur and this threshold is surpassed, while endangering numerous species, it will also create new risks to the environment and the process of evolution itself, including the continuity of human life.

The Earth can be conceived as having nine thresholds, which together form the *planetary boundaries* in relation to a safe operating space for humanity. These are considered to be: (1) climate change; (2) the rate of biodiversity loss (terrestrial and marine); (3) the interference with the nitrogen and phosphorus cycles; (4) stratospheric ozone depletion; (5) ocean acidification; (6) global fresh-water use; (7) the change in land-use; (8) chemical pollution; and (9) atmospheric aerosol loading. The boundaries in three systems—the rate of biodiversity loss, climate change and the human interference with the nitrogen cycle—have already been exceeded (Rockström *et al.*, 2009). Deforestation is assumed to be one of the main causes for exceeding these boundaries.

This issue of *Policy in Focus* contributes to the growing literature that aims at analysing human development while also preserving forests in the Global South. This means examining how to create value, conserve and sustainably use the biodiversity that forest areas have to offer, and how to establish the long-term conditions so that forests are considered to be more valuable standing rather than cut down and commodified. The frontier areas of forests are one of the main loci of interaction between biophysical and human elements, which, in turn, determine the rate of landscape transformations. Forest frontier regions

are peculiar because they also demarcate areas of internal expansion of a country, given that external (political) borders are usually already well-defined.

It is useful, therefore, to outline the concept of the frontier. This is an issue that is often overlooked, despite its importance for understanding the reality of these areas and enabling feasible political propositions. The authors Vitor Fernandes and Bastiaan Reydon undertake this task in the first article of this issue. Despite the considerable geographic and historical specificity of this concept, the authors' analysis takes into consideration the main theoretical underpinnings for the understanding of the frontier concept, which can be applied to most frontier regions of the world. Defined broadly, the frontier can be conceived of as the expansion front in the anthropological sense of clashing societies (indigenous populations, small-scale farmers, loggers, large landowners etc.) combined with the pioneer zones in the economic sense of land-use change directed by modern capitalist structures.

Organising the geographic space in these areas remains a great challenge, because of the broad spectrum of issues involved therein; these forest frontiers are:

- the areas of the most biodiversity in the world;
- the home to established indigenous populations;
- the main migration route for poor smallholders in search of opportunities;
- the pioneer zones where international and domestic market forces reach out to, in the hope of high profits originating from natural resources (mining, agriculture and energy); and
- the places where large landowners set to expand their activities (cattle-ranching and agriculture).

Following the 1992 Rio Conference, the Northwest region of the Brazilian state of Mato Grosso was chosen to be a focal point for various pilot projects, including a major project funded by the Global Environment Facility (GEF) with a set of activities dealing with alternatives to deforestation and local sustainable development under the coordination of Carlos Castro of UNDP Brazil. The second article by Jorge Luis Vivan (*in memoriam*) *et al.* analyses the UNDP project (financed by a GEF grant) employing primary and secondary data on biophysical, socio-economic and institutional parameters on small farms and land reform settlements. As one of the main findings, the authors state that certain individual small farms with intensive agroforestry land use demonstrate up to 63 times the revenue per hectare than cattle ranching—an impressive achievement from a socio-economic standpoint. However, projects that best demonstrated forest preservation across the landscape did so through support for cooperative infrastructure and institutional arrangements, including certification, for forest extractive and agroforestry commodity supply chains. Rather than designing incentives around individual farm properties, such supply chain interventions were structured over longer time periods and involved an entire land reform settlement as well as several indigenous territories in the region.

Similarly, Peter May *et al.* turn to the same projects as the previous article but do so from an analytical *policymix* perspective. This analytical framework sets out to examine the existing policies in an integrated and dynamic manner, because one level of policy intermingles with another, both horizontally (economic, agricultural and environmental policies) and vertically (the municipal, state and federal government levels as well as the project and landscape levels). The authors highlight the positive effects of the projects at the landscape and

municipal levels, such as the reduction of deforestation and the establishment of community governance, although they point out that further work still needs to be done in this field. Analyses demonstrate that adequate governance is essential for the establishment of the possibility of development without deforestation.

The fourth article, by Frederico Lopéz-Casero *et al.*, provides an innovative approach for developing the forestry-sector and REDD+ (Reducing Emissions from Deforestation and Forest Degradation) governance. The authors explore, through action research in Nepal, how the development of a multi-stage, multi-stakeholder and multi-level process can ensure effective and legitimate governance for forest carbon emissions trading. Fundamental for proper REDD+ governance and for curbing deforestation is land governance itself. Bastiaan Reydon and Vitor Fernandes, in the fifth article, clearly demonstrate why land governance is essential for the sustainable development of the Amazon: their research shows that, on average, cleared areas are worth four times more than they would be worth as standing forests. This indicates that land governance should be one of the first measures to be taken when implementing any type of policies that aim at preventing deforestation, because, first and foremost, any possibility of profiting illegally from cleared land (through logging and the speculation of land assets) must be eliminated.

In a related discussion, Aldicir Scariot describes the international debate about policies opposing land sparing—that is, the total protection of some areas, prohibiting any form of land use—and land sharing, which is the sharing of activities, including protection, in a given area. Scariot takes the position that total land sparing is not feasible in areas of indigenous populations because this type of policy would penalise them the most. Therefore, it is desirable for both policies to be integrated into what the author proposes as a mixed strategy.

It should be evident by now that there are many instruments for achieving human development without resorting to deforestation. The seventh article—by

Raoni Rajão *et al.*—provides a critical assessment of the instruments for controlling deforestation. The objective is to go beyond the ‘panacea’ of the search for an ‘optimal’ instrument. Most likely there is no such thing as an optimal policy regarding this issue, and we are best served by engaging with an informed mix of various types of policies, described by the authors.

In the eighth article, Jean-Marie Baland and Dilip Mookherjee take the issue of deforestation back to the Himalayas to the forest region that stretches across Nepal and India. The authors provide a critical assessment of the issue therein, providing a review of theory and evidence, using an extensive and detailed variety of micro-level data sets, in order to evaluate the causes and the rate of forest degradation in the region, thus providing short- and long-term policy recommendations.

Some socio-economic issues pertaining to frontier regions are dealt with from the ninth to the twelfth article. The ninth article by André Sant’Anna and Carlos Young, analyses the age-old problem of the interrelationship between property rights, deforestation and violence. The authors, through rigorous analysis, point to the immediate necessity of dealing with the issue of property rights in order to curb both deforestation and violence at the frontier regions. The tenth article, by Gabriel Lui, describes the consequences of social policies, mainly *Bolsa Família* and social security, for decisions regarding land use in the Amazon. The author finds evidence that social policies contribute towards controlling deforestation by changing such decisions.

In the eleventh article, Mauro Soave Jr *et al.* take on the defence of an alternative social policy: the establishment of sustainable settlements in the Amazon region. The authors argue that since most of the new settlements in Brazil today are in the Amazon region, evidence points to the necessity of curbing deforestation within the settlements themselves. The authors thus propose establishing a model of low carbon agriculture for such settlements. Furthermore, the twelfth article by Donald Sawyer introduces an

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This issue of *Policy in Focus* contributes to the growing literature that aims at analysing human development while also preserving forests in the Global South.

This means examining how to create value, conserve and sustainably use the biodiversity that forest areas have to offer, and how to establish the long-term conditions so that forests are considered to be more valuable standing rather than cut down and commodified.

issue that is important for all other policy recommendations set forth in this issue—that is, the marketing of agro-extractive products, delineating its problems and some proposed solutions.

Finally, the thirteenth article sees Britaldo Soares-Filho and Raoni Rajão return with their modelling of deforestation scenarios for the Northwest region of Mato Grosso. The authors compare three scenarios: business-as-usual, historical tendency and with the establishment of governance. As a result, they demonstrate that if improved governance is not urgently adopted, the region will endure severe losses.

We hope that this issue of *Policy in Focus* can help to further discussions around the halting of deforestation, while also contributing to human development and to the improvement of public policies, in order to prevent any worst-case scenarios from taking place worldwide.

■
Rockström, J., *et al.* (2009). ‘A safe operating space for humanity’, *Nature*, 461 (7263), 472–475.

On the Concept of the Frontier

by Vitor Bukvar Fernandes¹ and Bastiaan Philip Reydon¹

Brazil is one of the only countries in the world that still has an open forest frontier within its borders. Concerns about the advancement of the domestic economic frontier recur with increasing intensity, due to a wide range of issues among the players involved. Some issues at hand include land democratisation, private appropriation of public lands, theft of indigenous lands and rural conflicts, as well as how productive agricultural activities have been expanding over areas of significant native vegetation. In this context, we shall attempt to convey the ideas of thinkers who have delved into the subject of frontiers, juxtaposing them to advance the understanding of what might be called an internal frontier movement in Brazil.

It is interesting to start by exploring the work of Frederick Jackson Turner (1861–1932) and his hypothesis that held the existence of a frontier as an explanation for the type of society that flourished in the United States. According to Machado (1992), Turner endeavoured to explain the genesis of the United States nation as an autonomous process, based on the hypothesis that the interaction between an environment with exceptional geographical features and the collective effort of small independent land owners was responsible for the development of democratic political institutions in the country. The availability of “free land” meant that there was land available that could be appropriated and transformed into private property. Furthermore, in the case of western expansion across the continent, the frontier would have acted as a “safety valve” for the impoverished populations coming from the eastern United States and Europe, who could acquire property rights over land and become independent.

The two caveats to which Machado draws attention are that the lands were not empty—as they were indigenous territories—and that access to land in the Western United States was not really free. This is because, despite

the Homestead Act,² settlement and transport route advancements actually served as the regulators of the private appropriation of land.

José de Souza Martins also opposes the uncritical appropriation of North American ideas by stating that, “precisely because he omitted the struggle for land and the invasion of indigenous territories in their own society, Turner is certainly not the best reference when thinking about complicated frontier conflicts” (2012).

However, the application of these concepts in Brazil was far from systematic. First, this was because the continued expansion of the coffee industry in the Southeast region of the country in the early 20th century drew the attention of domestic and foreign social scientists, given the specificity of this expansion vis-à-vis prior settlement waves in rural areas. Second, this was also due to a particular combination of circumstances that favoured the permanence of European social scientists in the country for relatively long periods of time—especially the geographers Pierre Monbeig and Leo Waibel, who made significant contributions to the conceptualisation of pioneer zones and frontiers in Brazil.

Leo Waibel (1888–1951) was a geographer educated in Germany who specialised in agrarian geography in the tropical Americas. Based on Turner’s ideas, that frontiers, in the economic sense, constitute zones of different sizes located between virgin forests and established populated regions—pioneer zones—he stated that the concepts of ‘frontier’ and ‘pioneer’ must be redefined. From this perspective, the cultivation of land is what constitutes the economic foundation of pioneer zones, not extensive livestock activities (Waibel, 1979).

In his comparative studies between the March to the West in the United States and the possibility of identifying a March to the West in Brazil, Waibel sought to highlight the differences between the Brazilian settlement march that occurred up until 1950. Unlike what happened in

the United States, Brazil’s march expanded linearly or in cores—without forming a continuous band—and established itinerant agriculture as a permanent phenomenon. Waibel focused on the itinerant nature of Brazilian agriculture—since an agricultural system characterised by non-intensive farming techniques makes it easier to sell land—and on the criticism of Brazil’s propensity to dispersed settlement expansions, based on unproductive estates and the predominance of land speculators.

When faced with coffee expansion in the southeast, Pierre Monbeig (1908–1987), a French geographer, noted that the settlement followed a modern conception of colonisation. This “pioneer coffee march” led to the construction of roads and the emergence of small urban centres and trade systems. The practice of urban and rural land subdivision set this pioneer movement apart from earlier forms of occupation. This means that it was irrelevant whether an area had been previously appropriated or whether it was inhabited.

In short, “the dynamism of pioneer zones was the product of a new type of funding, organisation and scale of enterprises, composing a modern capitalist economy [...] Nevertheless, it was not enough to assert that the ‘conquest of new lands’ meant the integration of rural areas into a capitalist-style economy [...] the notion of land ownership is the distinguishing feature of pioneer zones” (Machado, 1992).

Monbeig observed that large pastoral estates in Brazil had already been established in the past on vast tracts of land within the country’s interior, many with legal land titles. These lands, however, had no market value when the activities took place on grasslands and savannahs, with very few changes made to the ‘natural’ landscape. However, in pioneer zones, where agriculture was the main activity, expansion took place at the expense of capital investments required for deforestation and soil preparation—



Photo: UNDP Brazil. Coffee plantation, next to the municipality of Aripuana, Northwestern Mato Grosso.



Frontiers can be loosely defined as the synthesis of that which is defined by anthropologists as ‘expansion fronts’ and, by economists as ‘pioneer zones’, directly coordinated by the capitalist mode of production.

i.e., the work that changed the natural landscape was the same as the work that assigned value to the land and, therefore, to the property.

Thus, in describing the ‘pioneer march’ to expand the frontiers of the coffee industry, Monbeig emphasised precisely the big leap in land prices triggered by the arrival of this crop, allowing for intense land speculation. So intense was the trade in land in the southeast at the time, that “it was concluded that colonisation was a secondary matter to the desire to speculate” (Machado, 1992). This was only possible because the dynamics of the coffee industry expansion relied on the extension of cultivated areas, thus successively displacing the agricultural frontier with few directly productive investments. It follows that access to land and land concentration constituted a ‘condition’—and not a secondary aspect—of coffee production.

Therefore, as pioneer zones expanded, the price of land increased, generating significant speculation and the creation of a land market controlled by large landowners, coffee traders and real estate companies. The control of land access through prices contributed to the creation of a ‘free’ labour market and an excess of labour supply, resulting in only a relative availability of land in these pioneer areas.

Similarly, one may consider the coffee expansion in the southeast at the beginning of the 20th century in relation to the recent expansion of agriculture in

the Amazon region, mostly in the states of Mato Grosso, Para and Piauí. This connection is made possible by the notion of ‘possession’, initially adapted to mobile, predatory and rudimentary agriculture, but which gradually became the main form of land ownership, according to Ligia Silva Osório (2008). Later, it also becomes consistent with the explanation of the determinants of Amazonian deforestation provided by Reydon (2011), which details the sequence of the occupation of virgin land (private or public), the extraction of timber, the beginning of livestock husbandry and, finally, the development of a more modern form of agriculture. This development process can generate income and legitimise the occupation by new owners in the short term, with almost no resources required.

Anthropologists understand the notion of frontier differently. The so-called ‘expansion fronts’ represent frontiers characterised by “the displacement of the civilised population and of economic activities regulated, in some way, by the market [...]. As suggested by Darcy Ribeiro, [...] they constitute the frontiers of civilisation” (Martins, 2012). The contrast between the pioneer zones and the anthropological concept of expansion front is most evident in *Os Índios e a Civilização* by Darcy Ribeiro: “here, the land itself has no value [...] As such, the issue of ensuring legal ownership of the land does not exist [...] And this dominion does not take the form of land ownership, except when it does so accidentally” (1977 *apud* Martins, 2012).

According to Martins, there are two ways of interpreting frontiers: the ‘expansion front’ expresses a conception of territorial occupation held by those who use indigenous peoples as a reference, while the ‘pioneer zone’ takes no account of indigenous peoples and focuses on businessmen, farmers, merchants, modern small farmers, and entrepreneurs. In this sense, Monbeig, for example, defines the indigenous peoples encountered (and massacred) due to the expansion of the pioneer zone in western Sao Paulo as the precursors of that same frontier, “as if they were there only temporarily, waiting for the civilisation that would bring about their end” (Martins, 2012).

From Martins’ perspective, the mismatch between the observations of geographers (and economists) and those of anthropologists is the result of observations made in unequal social locations. However, the mismatch of perspectives is, in this case, an essential expression of the contradictory diversity of frontiers, more than a result of the multiple viewpoints about the concept of the frontier.

Martins (2012) considers the different historical time-frames of frontiers as pioneer zones, highlighting the importance of urbanisation, modern means of communication, economic enterprises, the modern mentality and, especially, the conversion of land into a commodity. In terms of the expansion front, the focal point is the design of the displacement fronts of a Western population to tribal lands, “when

anthropologists speak of an expansion front, they do it basically to save on words when defining what Indians face" (Martins, 2012). An interesting definition is the one by Roberto Cardoso de Oliveira, cited by Martins, which defines an expansion front as a "contact situation, that is, the methodological assumption of totality, as is characteristic of dialectical tradition" (*ibid.*). It is at this moment of 'inter-ethnic friction' that the expansion front becomes a point of contradiction and conflict.

Here, the form of capital expansion, is an expansion of the trade and commerce network from where money is usually absent, appearing only, still according to Martins, as a "nominal reference refereed by those who hold personal power and have control over material resources, in their relationships with those who exploit Indians or peasants" (2012).

Such a market operates through village merchants, in a way that is monopolistic and mediated by "violent relations of personal domination" (*ibid.*), be it in the trade of products or in labour relations (characteristically, bondage or peonage).

As such, frontiers can be loosely defined as the synthesis of that which is defined by anthropologists as 'expansion fronts' and, by economists as 'pioneer zones', directly coordinated by the capitalist mode of production.

It is in this middle ground that we find the diversification of different and interacting historical moments: peasants engaged in surplus agriculture, prosperous small farmers, rural entrepreneurs, integrated and non-integrated indigenous peoples and even gunmen in service of big landowners.

In conclusion, we have seen that the analysis of the frontier movement is complex and can be easily permeated by prejudice and distortions that are extremely harmful, from a scientific analysis perspective, given the potential reductionism they may incur.

Even though this article encompassed only some of the many studies on the topic of land frontiers, we have nonetheless attempted to elucidate important ways of defining what a frontier is, to provide a better understanding of the definition of frontiers in Brazil and elsewhere, as

well as its associated methodological consequences. ■

Machado, L. (1992). 'A fronteira agrícola na Amazônia brasileira', *Revista Brasileira de Geografia*, Vol. 54, No. 2.

Martins, J. (2012). *Fronteira: a degradação do Outro nos confins do humano*, 2nd edition. Sao Paulo, Contexto.

Monbeig, P. (1945). 'A zona pioneira do Norte-Paraná', *Boletim geográfico*, Vol. 7, No. 78.

Reydon, B. (2011). 'O desmatamento da floresta amazônica: causas e soluções', *Economia Verde*, No. 8, June.

Silva, L. (2008). *Terras devolutas e latifúndio*, 2nd edition. Campinas, Editora Unicamp.

Waibel, L. (1979). *Capítulos de geografia tropical e do Brasil*, 2nd edition. Rio de Janeiro, IBGE.

1. Institute of Economics, University of Campinas, Brazil.

2. *The Homestead Act* is an agrarian legislation that was signed by Abraham Lincoln in 1862 within the effort to occupy the American West. In exchange for a symbolic monetary reward, those that ventured west would receive plots of federal land (26.3 hectares) that were already demarked. This flexibility never existed in Brazil. Even to this day the government of Brazil still does not control a large share of its public lands.

Integrated Conservation and Development Projects in the Amazon: an Interdisciplinary Evaluation with Lessons for Forest Frontiers

by Jorge Luis Vivan (in memoriam),¹ Rob Davenport,² Peter. H. May,³ Paulo César Nunes⁴ and Cornelius Prins⁵

As one of the world's most active forest frontiers, Northwest Mato Grosso (NW MT) in Brazil has been a focal point for various pilot projects for conservation and sustainable use of forests and biodiversity following the Rio 1992 conference. These included the Pilot Programme for the Protection of Tropical Forests in Brazil (PPG7) and a major project funded by the Global Environment Facility (GEF) and implemented by the United Nations Development Programme (UNDP).⁶

These projects incorporated support for agro-environmental measures, focused

on mosaics of agro-ecosystems consisting of private forests involving communities living in buffer zones or inside protected areas. These agro-environmental measures comprised technical assistance for soil and water conservation, restoration of degraded areas, tree planting and agroforestry systems, appropriate technology, non-timber forest products and low-impact forest management.

Such a mix of interventions fits the mould of Integrated Conservation and Development Projects (ICDPs). The ICDP approach has been criticised over the past

decade, often due to a lack of empirical evidence regarding its biophysical, socio-economic and institutional impacts (Minang and Noordwijk, 2013; cf. Ferraro and Kiss, 2002). With due consideration of this criticism, and a unique hands-on opportunity, we decided to conduct an interdisciplinary evaluation of the outcomes of ICDP pilots in NW MT.

Methodology

Our case study employed primary and secondary data on biophysical, socio-economic and institutional parameters on small farms and land reform settlements

TABLE 1
Synthesis of Economic Indicators Estimated for 55 Farms of 4 to 250 Hectares *


Northwest Mato Grosso (NW MT) in Brazil has been a focal point for various pilot projects for conservation and sustainable use of forests and biodiversity following the Rio 1992 conference.

	USD/hectare (gross revenue)	USD/PD	Hectare/PYL	Costs (%)
Participants				
Shaded extensive cocoa AFS	377	49	32	0
Shaded cocoa AFS of intensive management	4000	110	5	7
Tree-shaded coffee AFS	1552	33	7	7
Coffee and <i>pupunha</i> AFS	1268	99	5	3
Intensive, irrigated AFS	7176	341	8	3
<i>Cupuaçu</i> extensive AFS	1119	142	42	7
Silvopastoral dairy cattle	504	71	42	16
NTFP (Brazil nut, raw)	13	150	880	0
NTFP (Brazil nut, subproduct dry nut)	63	n.i.	n.i.	60
NTFP (Brazil nut, subproduct oil)	43	n.i.	n.i.	10
NTFP (Brazil nut, subproduct flour)	28	n.i.	n.i.	10
NTFP (Brazil nut, flour and oil)	71	n.i.	n.i.	10
Non-participants				
Cattle (beef)	114	43	97	35
Cattle (mixed beef and dairy)	212	209	39	45
Coffee monocrop	1117	35	6	35

Source: Authors' elaboration. * Synthesis of economic indicators estimated for 55 farms of 4 to 250 hectares evaluated in the municipalities of Juína and Cotriguaçu, Mato Grosso, Brazil, 2010.

Notes: AFS = Agroforestry Systems; NTFP = non-timber forest product; USD/PD = return in USD per person per day; Hectare/PYL = area in hectares of the system manageable by one year of labour per person. Labour is not included in costs, as farmers do not habitually hire an external workforce; n.i. = no indicator.

in NW MT from 1995 to 2012 in the municipalities of Juína, Juruena and Cotriguaçu. We used databases generated from the three ICDP projects carried out during this period, as well as from fieldwork conducted from 2012–2013.

First, to assess biophysical impacts, we contrasted carbon stocks and sequestration rates with indexes of plant diversity in agroforestry systems. We assumed that the plant diversity indexes constituted an important proxy for habitat quality and biodiversity conditions (DeClerck and Salinas, 2011; Laurance and Vasconcelos, 2004). Second, for effects on land use of individual farms, Vivan (2010) compiled information on 62 farms in Juína and Cotriguaçu in the form of farm-level data and maps. Third, for socio-economic performance data was retrieved from a set of 55 farms ranging from 4 to 250 hectares that were evaluated for land use in Juína and Cotriguaçu by Vivan (2010) as well as in Juruena by Nunes and Rugnitz (2011).

Fourth, a landscape scale analysis of deforestation dynamics was conducted for three land reform settlements in

which ICDP projects could potentially demonstrate impacts, depending on the level of settler engagement (INCRA, 2011): (1) Settlement Project Nova Cotriguaçu of 99,988.5 hectares and 1234 households settled in 1995; (2) Settlement Project Iracema in Juína, of 18,120 hectares and 343 households settled in 1996; and (3) Settlement Project Vale do Amanhecer in Juruena, of 14,400 hectares and 243 families settled in 1998. For these settlements, we tracked and compared Landsat imagery between 1995 and 2011.

Finally, our institutional analysis derived from household questionnaires and semi-structured interviews with 29 farmers from these land reform settlements. Furthermore, we cross-referenced this data with a group workshop conducted with settlers of Vale do Amanhecer, to further understand the historical evolution of land use decision-making and institutional arrangements.

Results and discussion

At the individual farm level, biophysical analyses revealed that agroforestry systems allowed carbon stocks to increase at the farm level from 5 to 8 tonnes of

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One hectare of agroforestry has the potential to employ almost 20 times the workforce and produce 63 times the agricultural revenues of cattle ranching.

carbon/hectare per year, over three to thirteen year cycles, for an average of 2.5 hectares per farm. The analyses also demonstrated favourable indexes of tree diversity and potential habitat connectivity. In terms of land use of individual farms, participants in ICDPs demonstrated 13 per cent greater forest cover than did non-participants.

Considering socio-economic conditions, we identified a small-farm baseline land use of mixed beef and dairy cattle, which uses on average 33 hectares of pasture while obtaining gross revenues of USD212/hectare per year or USD6996/year per household. In contrast, agroforestry systems induced through ICDPs use on average 2.3 hectares and obtain gross revenues of USD4000/hectare per year for shaded cocoa or a total income of USD9200/year per household. This is a 56.5 per cent gain, while using less than 7 per cent of the land area required by mixed beef and dairy operations (see Table 1).

At the landscape level—i.e. considering the entire settlement—deforestation in the Project Vale do Amanhecer did not occur at the same rate as in the Iracema and Nova Cotriguaçu projects. All three settlements were established during the mid- to late 1990s, but in 2011 Vale do Amanhecer had 22 per cent more remaining forest than Nova Cotriguaçu and 39 per cent more than Iracema.

We take particular interest in this result, arguing that Vale do Amanhecer's conserved forest—57 per cent of the settlement's total area—is an outcome of the combination of a series of ICDP interventions. These interventions targeted land use regulations, resource management and economic factors relevant to cooperative production and, more specifically, the marketing of non-timber forest products. Furthermore, the forest area is being managed as a collective legal reserve forest, in which 7200 hectares are managed for 800 georeferenced Brazil nut trees (*Bertholletia excelsa*). Certification for non-timber forest products is tied to maintenance and monitoring of the collective legal reserve.

Two settlement-based cooperatives (one exclusively women-owned and -managed), established in 2008 and in 2010, process oil, pasta, flour and cookies using Brazil nuts extracted from the forest reserve. To meet

market demand, nuts are also purchased from surrounding farmers, five indigenous territories and one extractive reserve in the region. In 2013 the federal National School Feeding Programme provided USD1,160,000 in advance credit. The advance purchase allowed these goods to reach 33,000 people across seven local municipalities.

Institutional fieldwork revealed that these cooperatives emerged in adverse socio-economic and ecological circumstances, in which a variety of factors favoured deforestation throughout the history of the settlement of Vale do Amanhecer. These factors included complex political alliances, widespread use of fire, road building, federal agricultural credit programmes (PRONAF), an illegal gold rush invasion of the settlement in 2004, and varying prices of agricultural commodities versus non-timber forest products.

The PRONAF⁷ programme was perceived as one of the strongest factors encouraging forest clearing: deforestation during the operation of PRONAF in 2000–2001 was nearly four times as high as in 2008. Additionally, ICDPs were forced to cease operations in Vale do Amanhecer in 2004 due to violent threats from gold miners. However, after the federal police forcibly removed miners from the area in 2005, activities resumed to encourage forest conservation.

Settlers observed that pasture-burning practices were continuous from the start of the settlement until 2012. However, unlike the other settlements under consideration, settlers in Vale do Amanhecer recognised the social value and legitimacy of environmental licensing, as this instrument legalised the cooperatives' businesses and established documentation that formally certified products of the settlement.

These findings reinforced our hypothesis that it would be possible to identify ICDP impacts in NW MT using finer spatial scales and longer temporal scales. One hectare of agroforestry system is invisible from a geographic information system (GIS) analytical perspective. However, at the scale of individual farms, one hectare of agroforestry has the potential to employ almost 20 times the workforce and produce 63 times the agricultural revenues of cattle ranching.

At the landscape level, significant biophysical, economic and institutional gains were observed in Vale do Amanhecer, as ICDPs linked cooperatives with institutions and infrastructure supporting alternative livelihoods. However, settlers in Vale do Amanhecer interacted with ICDPs consistently over the course of at least eight years, compared to only two to three years in the Iracema settlement and only sporadically in Nova Cotriguaçu.

Recommendations and closing remarks

We propose additional research at the landscape level to assess the impacts and effectiveness of ICDP interventions, based on the temporal scale of application. The synergies produced by the specific sequencing and combinations of instruments should also be evaluated. If farmers are expected to rely on individual direct payments to access services and markets, they risk being cut off from cooperative livelihood and conservation alternatives promoted by ICDPs and the long-term processes that these alternatives involve. Longer temporal scales may be critical to the effectiveness of projects and programmes seeking sustainability for local economies and land use across the landscape.

As such, the endurance of such ICDP impacts may depend on whether and how local stakeholders are able to access aligned policies and incentives. ICDP projects in NW MT took place in an antagonistic politico-economic setting and in the context of fragile support from federal and state agencies. Nevertheless, results from the Vale do Amanhecer Project, indicate that a combination of instruments could overcome these limitations, if applied in an overlapping sequence:

- setting priorities by mapping the potential of the remaining forest;
- training and technical assistance;
- cooperative social organisation;
- legal certification of sustainable production;
- material investments in infrastructure;
- market development, credit financing and the elaboration of contracts with surrounding indigenous communities;
- contracts with private companies and the National School Feeding Programme;

- public and political exposure through national and international recognition of effectiveness; and
- efforts to expand Brazil nut production.

It is by no means inevitable that all forest frontiers go through the 'boom and bust' transition stages described by Rodrigues *et al.* (2009).⁸ We suggest that managed forests, like the legal reserves inside land reform settlements and in small and medium-sized private farms, represent an important component for the sustainability of regional economies. The projects we analysed may offer opportunities to mainstream successful approaches for both collective and individual incentives, which have proved effective at the level of land reform settlements and smallholder farms, to constitute managed forests as a continuum between protected areas and agro-ecosystems (Wiersum, 2004), thus providing a desired mosaic of sustainable land use in buffer zones around protected areas of forest frontiers. ■

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Special thanks are extended to:

André Gonçalves, Pattrikk John Martins, Luis Henrique da Cunha (consultants); the AJOPAM team and Ildamir Teixeira in Juína, in addition to the Policymix Project - funded by the European Union,⁹ the National Institute of Science and Technology on Public Policies, Strategies and Development (INCT-PPED); Dr. Carlos Castro (UNDP Brazil); Ms. Rosane Beatriz Aguiar and Ms. Ana Cristina Balogh Tripodi (Petrobras); and of course farmers, leaders of associations, trade unions, and indigenous reserves.

1. Federal University of Santa Catarina and Federal Rural University of Rio de Janeiro, Brazil (*in memoriam*).
2. University of California, Santa Cruz, USA, and CATIE (Center for Tropical Agricultural Research and Education), Costa Rica.
3. Federal Rural University of Rio de Janeiro and REDES.
4. Juruena Carbon Sink Project, Mato Grosso, Brazil.
5. CATIE, Costa Rica.
6. A) Pilot Programme for the Protection of Tropical Forests in Brazil, especially Type A Demonstration Projects, with expected impacts in Juína; B) 'Conservation and Sustainable Use of Biodiversity in the Frontier Forests of Northwestern Mato Grosso', with expected impacts concentrated in Juruena, Juína and Cotriguaçu; and C) Juruena Carbon Sink Project/ADERJUR, with impacts concentrated in Vale do Amanhecer land reform settlement.
7. PRONAF - National Family Agriculture Development Programme, a credit scheme available for family farmers.
8. Rodrigues *et al.* (2009) have described an Amazon rainforest frontier development pattern in which development indicators are higher for landscapes transitioning from high (>70 per cent) to low (<30 per cent) forest cover. In this pattern, eventually a frontier development 'boom', supported by abundant resources, shifts to a 'bust' of a resource-poor 'post-frontier'.
9. Policymix project <<http://policymix.nina.no>> funded by the European Commission, Directorate General for Research.

A *Policymix*: Conservation and Sustainable Use of Biodiversity with Poverty Reduction in the Amazon

by Peter H. May,¹ Jorge Luis Vivan,² João Andrade,³ Maria Fernanda Gebara⁴ and Pablo del Arco⁵

This article discusses the pressing issue of how to achieve the conservation and sustainable use of biodiversity while also reducing poverty in the Brazilian Amazon. The existing mix of policies for biodiversity conservation and forest protection is based on traditional command and control policies and institutional and economic instruments, such as integrated conservation and development projects, a state-based ecological fiscal transfer (EFT) instrument, and payment for environmental services. We question how best to define an adequate *policymix* to achieve both environmental and social targets—that is, how to halt the degradation of natural resources, ensuring their sustainable use, while also reducing poverty in the communities where these natural resources are located.

When addressing an issue from a *policymix* perspective, all levels of policy (national, state and local) should be taken into consideration. While command and control policies are established at a national level, they interact with other policies mostly at the regional and local levels.

The location of our study lies within a frontier region of the Amazon, northwest Mato Grosso. Locally, we are interested in the biophysical and socio-economic impacts of the Integrated Conservation and Development Projects (ICDPs) that arose out of the United Nations Development Programme/Global Environment Facility initiative, specifically those within land reform settlements. At the regional level, we analyse how the EFT affects these areas containing the projects, which are contiguous to indigenous territories and conservation units.

Will deforestation continue or stabilise at current levels? What was the role of the existing *policymix* in the reduction of deforestation? Is the prevailing

policymix sufficient to achieve environmental and social targets, or are new instruments required?

Current policies for biodiversity conservation

The main policy for biodiversity conservation adopted in Brazil is primarily associated with land-use restrictions compiled within the national Forest Code, dating from 1965. The public lands of the National System of Protected Areas (SNUC), the rights of forest people over indigenous territories and direct use reserves establish the current framework for protecting biodiversity and traditional culture. The federal constitution devolves responsibility for the licensing of land use and the permits for forest management to the individual states.

The federal constitution also permits the sharing of value-added tax revenue between state and municipal authorities. In some states—including Mato Grosso—such revenues are in part allocated through the EFT instrument ICMS-Ecológico (ICMS-E) to compensate for biodiversity protection.⁶ The ICMS-E is, therefore, an economic instrument that favours biodiversity conservation and intermunicipal fiscal balance.

In relation to ICDPs, another policy currently active in Brazil, it is the contention of recent observers that this type of project has often been grounded in unrealistic expectations (Minang and Noordwijk, 2012). There is little empirical evidence of their effectiveness in reducing deforestation, which prompts a search for a demonstration of the effectiveness of ICDPs as well as for alternative and more targeted economic instruments such as payment for environmental services (Ferraro and Kiss, 2002).

Furthermore, restrictions on credit and government subsidies to municipalities that are poor performers in reducing

deforestation has motivated local governments to become more proactive in preparing for 'green governance'. Tax relief for industries of natural products and voluntary market instruments, such as a sustainable practice certification and a soybean moratorium in forest areas, have apparently been effective in some areas.

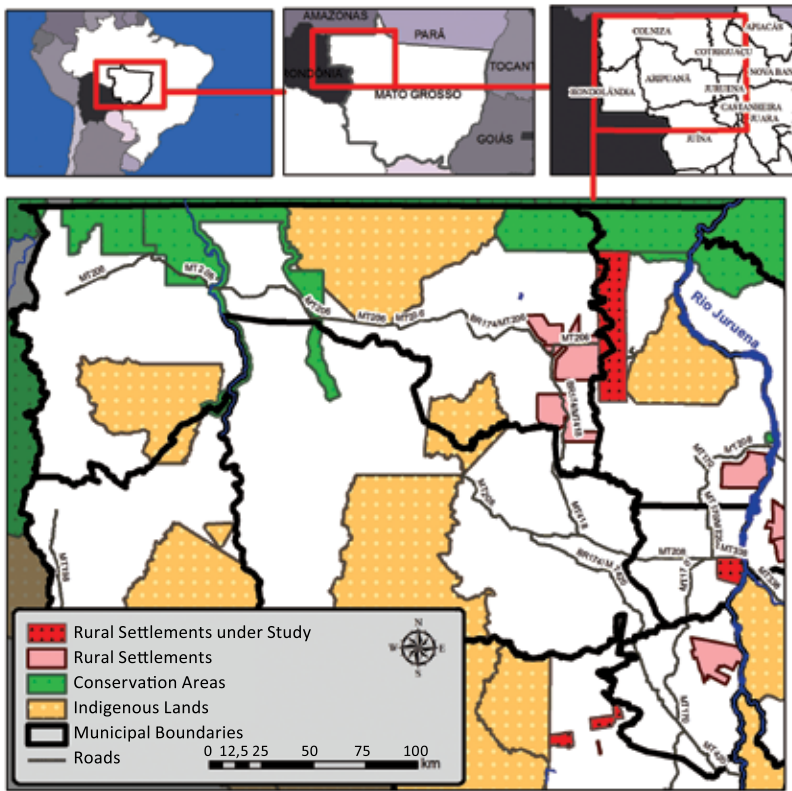
Multi-level instrument interaction in the *policymix*

The instruments at the disposal of decision-makers working at the nexus of agribusiness expansion and biodiversity conservation in the Amazon are potentially complementary but reliant on institutional coordination at all levels to be effective in halting further adverse and large-scale land-use change. Notwithstanding, signals emitted at the federal level regarding the priority for accelerated national growth, with the financing of massive transport and energy infrastructure expansion deep into the Amazon, are at odds with voluntary commitments to reduce greenhouse gas emissions, which are primarily achieved by reducing deforestation. Credit policies that stimulate growth of cattle herds and the slaughter capacity of facilities at the forest frontier are equally contradictory, despite more recent financing commitments under the 'low carbon' agenda.

Land-use management is best achieved at a governance level closest to where the resource is used (Ostrom, 1990). As Brazilian environmental policy is a shared responsibility among different levels of government, a rigorous analysis must pay particular attention to the local, municipal-level capacities needed to implement broader strategies, which rely on inter-sectoral agreement over the desirable scope of land-use control and enforcement. Environmental management on this scale is a very recent assignment to local governments. Additionally, the political will to take on the challenge of

MAP 1

The Northwest Region of Mato Grosso



Source: Authors' elaboration.

land-use control is reliant on extraordinary commitments by mayors and municipal councils, causing significant differences among municipal institutions and their respective environmental performance.

Some municipal governments are proactively assuming local commitments to meet deforestation reduction targets by improving governance and adopting better production practices on different scales.

Experience with agroenvironmental measures adopted in southern Europe offers important parallels (Santos *et al.*, 2013). However, in the forest frontiers of northwest Mato Grosso, weak public institutions, as well as poor spatial planning and targeting, will need to be overcome to permit large-scale positive impacts. In this sense, the use of EFTs to compensate and stimulate greater local efforts to protect endangered biodiversity by using management quality indices is an experience that is relevant across continents (Ring *et al.*, 2013).

The effectiveness of the ICMS-E

The Mato Grosso *polycymix* case study sought to assess the effectiveness of EFTs—more specifically, the role of the ICMS-E in municipal biodiversity conservation at the local level—that is, if this instrument resulted in an increase in the area under protection. Our first hypothesis is that at a municipal level, where tax revenue discrimination is mandatory by law, the instrument should have been most effective at stimulating local conservation actions.

The national data on the creation of municipal protected areas were insufficient to test this hypothesis, but in Mato Grosso there was a clear increase in the number of municipal protected areas created immediately after the instrument came into effect in 2002.

However, due to a resurgence of control of the state government via agribusiness lobbying efforts shortly thereafter, protected areas came under fire. This

suggests the need for a detailed appraisal of the effectiveness of such instruments at a municipal level, which guided our site selection and questions raised in interviews with local government officials and stakeholders.

Our concern then focused on mechanisms adopted locally to better allocate resources to reflect and reinforce the benefits obtained from such conservation. In Cotriguaçu, for example, although ICMS-E revenues were significant, local environmental council members were more interested in using these revenues to keep roads open in the rainy season, to promote agricultural marketing, than in better managing protected areas.

When we examined the economic rationale for this intra-municipal allocation of ICMS-E funds, we found that the per hectare revenues from land areas under protection actually exceeded those generated by value added from livestock and timber extraction in some cases (May *et al.*, 2013). Clearly, the failure to earmark such tax revenues for environmental purposes undermines the effectiveness of the policy. It is thus promising that a growing number of local governments have created municipal environmental funds for which ICMS-E revenues are earmarked. Such resources could also help to fortify local environmental governance through capacity-building among municipal councillors and authorities.

Equity and legitimacy of the ICMS-E

Since the ICMS-E also includes indigenous lands in Mato Grosso, our study hypothesises that enhanced revenues from this instrument could improve local governments' relations with indigenous groups and fortify their efforts at environmental management. Our findings in this regard appear promising.

In Juína, where 60 per cent of the territory lies in indigenous lands, the ICMS-E brought significant additional revenues, accounting for 20 per cent of total annual municipal funds from all sources. As a consequence, a progressive former mayor proactively made agreements with indigenous leaders to transfer 5 per cent of the additional ICMS-E revenue to projects aiming to reinforce the integrity of tribal lands and enhance sustainable incomes. Although the procedure was affirmed through municipal legislation, it required annual renewal and



We question how best to define an adequate policymix to achieve both environmental and social targets—that is, how to halt the degradation of natural resources, ensuring their sustainable use, while also reducing poverty in the communities where these natural resources are located.

When addressing an issue from a *policymix* perspective, all levels of policy (national, state and local) should be taken into consideration. While command and control policies are established at a national level, they interact with other policies mostly at the regional and local levels.

thus was undermined when an opposition mayor took office in 2013.

Moreover, surveyed officials in local government generally held the opinion that the ICMS-E represents a top-down policy instrument, which does not reflect local needs. Additional revenues were, therefore, diverted to activities that benefited the population as a whole (road maintenance, health and education), rather than to reward private nature conservation or collective resource management, as had been done in other states, notably Parana in southern Brazil. This result reflects the character of general revenue-sharing attributed to the distribution mechanism, rather than the use of conditional grants.

The effectiveness of ICDPs

Our study on the effectiveness of a series of ICDPs focused on comparative studies of land reform settlements at a landscape and farm level. These projects encompassed a combination of technical assistance, governance capacity-building, provision of seedlings for agroforestry and forest restoration, investments in processing facilities, and the construction of market channels for non-timber forest products.

Our research methodology consists of an analysis of three federally sponsored

settlements in three municipalities in northwest Mato Grosso, including a quantitative-qualitative analysis of ecological and economic data on individual lots, comparing land use, carbon stocks, enterprise diversity and net incomes among participants and non-participants in ICDP activities, both within and outside the settlements. Furthermore, satellite imagery was used to examine landscape responses with the settlement as a landscape unit, to identify possible spillover effects on deforestation rates due to the actions undertaken by ICDP participants.

The integration of environmental objectives with productive goals in land reform settlements entails a large measure of stakeholder participation. In this case, insight is needed into the producers' potential gains from individual or collective property and environmental licensing.

In the case of collective environmental licensing, the possible cost associated with vulnerability to increased enforcement powers also needs to be taken into consideration. This information is not easily captured through conventional interviewing techniques. As a response to methodological and time limitations, we constructed with settler participation a historical baseline of pilot interventions that have been effective in raising the bar on individual land user economic performance vis-à-vis the conservation of remaining forests (Vivan *et al.*, 2013).

Not long ago, land reform settlers taking possession of land in the Amazon were urged by the government to deforest half of their lots if they wished to remain on the land. It would thus be surprising to find forests conserved at the lot level, yet we found that participating settlers have kept on average 13 per cent more native forest area than non-participants, even if their average farm areas were smaller. At the landscape level, settlements were differentiated in terms of remaining forests, with a 39 per cent proportionally greater area protected in the settlement in Juruena versus the lowest rate (the settlement in Juína).

The best performances are associated, among other synergic vectors, with the fact that the forest reserve had been established as a collective property rather

than divided into individual lots. Settlers in Juruena had created a cooperative to manage these forest remnants for Brazil nuts, the basis for a local industry. This suggests that settlers respond to legal restrictions when there is full set of economic incentives present. In the other settlements, the lack of these elements led farmers to capitulate to dominant economic forces in the region promoting land-use change, practically nullifying the demonstration effect of the ICDPs. The existence of contradictory and constantly shifting macro policies exacerbated weak ties among local actors, leading settlers to adhere to the dominant land-use trend in the Amazon and to identify themselves with 'ranching culture'.

A cost-benefit analysis for sustainable cattle raising

To establish an economic rationale for forest retention among settlers and ranchers, research was conducted on the extent to which forest proximity enhances biological control of the pasture spittlebug (*Homoptera: Cercopidae*), a scourge of the cattle industry in the Amazon. Here, we are concerned with valuing this ecosystem service as a means to convince land users to abide by the strictures of the forest code. The probable values involved are significant: with high spittlebug infestations (over 50 nymphs per square metre), pasture mortality is high, and there is a pronounced drop in stocking rates to as low as 25 per cent of the uninfested level (Gallo *et al.*, 2002). Ranchers with high infestation rates have simply abandoned their enterprises or may be induced to deforest in other areas in hopes of avoiding this cost when establishing pastures.

Our method combined economic and biological research on the relationship between forest proximity and spittlebug infestation rates, under different forest configurations (corridors, large patches, small remnants etc.) in Cotriguaçu. Data on spittlebug infestation were gathered during the outset of the rainy season in pastures in random sampling blocks on five properties exhibiting different forest configurations, and the distance to the nearest forest remnant measured using high-resolution satellite imagery.

Our results suggest that pest control benefits from forest retention in all the studied mosaics are superior to the

opportunity costs of avoiding deforestation in these areas. Net losses from spittlebug infestation were found to average USD120 per hectare per year. The corresponding biological control services provided by nearby forests were estimated to range between USD65 and USD117 per hectare per year, in some cases nearly reducing pasture losses completely (Del Arco *et al.*, 2013). These benefits were considerably greater than the opportunity costs of converting the forest to additional pasture.

Additional surveys among a wider group of ranchers in Cotriguaçu pointed to factors which have undermined efforts to avoid deforestation. Cattle ranchers were loath to accept payments as a means to this end but were susceptible to arguments regarding the agroecosystem services provided by forest retention. Such arguments were reinforced by pointing to experience of local producers who had low infestation rates associated with forests. There is now considerable interest in extending the research to include other properties and a larger sample.

Conclusion: institutional opportunities and constraints for economic instruments

In northwest Mato Grosso, institutional capacities to implement a complex set of intertwined policy instruments at a municipal level have generally been called into question by those interviewed for our case study. While the framework of federal and state policies directed toward controlling the rate and direction of land-use change should conceivably guide local decision-making, local governments are rarely able to sort out contradictory policies, public infrastructure investments and commodity price signals and take the lead in regularising private land use.

Although the Brazilian federal structure permits municipalities to assume responsibility for environmental licensing and regulation, they are more likely to offer concessions to large-scale enterprises such as slaughterhouses than to impose environmental constraints. Local political interests are more closely aligned with short-term resource extraction than with sustainable enterprise aiming to benefit settlers and forest peoples.

Given these constraints, it is remarkable that, in the course of our studies, a

number of innovative strategies to effectively apply elements of the existing *polycymix* were documented such as:

- the determination of a progressive mayor in Juína who ensured that Indigenous peoples would receive a share of ICMS-E proceeds to promote territorial integrity;
- the time and resource commitment of an informal army of agroforesters and carbon sinkers (over 1000 families in northwest Mato Grosso now have agroforestry plots on their properties); and
- the non-timber enterprise that orchestrates minimum pricing, school feeding procurement, value-added tax exemptions and the voluntary carbon market to foster resilience and dissuade settlers from deforesting.

As a main conclusion, the cornerstone of an effective *polycymix* relies on a locally constituted municipal environmental council and fund with the capacity required to implement the set of instruments embodied in the new constitutional Forest Code. Furthermore, the ability to assist landowners with environmental deficits to identify and trade surplus forest reserves, and vice-versa, could be facilitated by the development of local GIS monitoring facilities and information management capacities. It is of primary importance that these developments are combined with tenure registration in the newly created Environmental Rural Records. ■

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The authors would like to acknowledge funding from the Polycymix project <<http://polycymix.nina.no/>> funded by the European Commission, Directorate General for Research, as well as the National Institute for Science and Technology on Public Policy, Strategies and Development (INCT-PPED). We would also like to express our thanks to Paulo Nunes and UNDP/GEF project BRA/00/G31.

1. Federal Rural University of Rio de Janeiro, Brazil.
2. Federal University of Santa Catarina and Federal Rural University of Rio de Janeiro, Brazil (*in memoriam*).
3. Instituto Centro de Vida (ICV), Mato Grosso, Brazil.
4. Federal Rural University of Rio de Janeiro and Getúlio Vargas Foundation (Rio), Brazil.
5. Institute of Economics, Federal University of Rio de Janeiro, Brazil.
6. ICMS-E is based on a reallocation of revenues to municipalities from the ICMS, which is the Brazilian sales tax charged on the transaction of consumer goods and services.

Developing Forest-sector and REDD+ Governance: a Multi-stage, Multi-level and Multi-stakeholder Approach in Nepal

by Federico López-Casero,¹ Timothy Cadman² and Tek Maraseni³

This article focuses on the governance of forest carbon emissions projects and policies. It explores how the development of standards through multi-stage, multi-level and multi-stakeholder processes can contribute to ensuring good governance. It argues that a governance standard, which is developed through a multi-stakeholder process at different levels (local, national and international) and in several stages, provides legitimacy to forest carbon emissions trading. It illustrates this approach by presenting the development of a draft voluntary national quality-of-governance standard for Reducing Emissions from Deforestation and Forest Degradation and conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+) through action research in Nepal.

Governance can be defined as the “dynamic interplay between civil society, business and the public sector” (Ruggie, 2003). Governance needs to address an increasing complexity arising from its multi-actor, multi-level (local, national, and

international) and multi-meaning nature: different stakeholders may have different values, interests and views (van Bodegom *et al.*, 2008). Therefore, multi-stakeholder processes and social learning are required for governance to effectively steer and improve societal situations.

The importance of governance in the forest sector and REDD+

Weak governance in the forest sector is one key underlying factor or driver of deforestation. Low levels of participation, transparency and accountability increase the risk of corruption, financial mismanagement and capture of benefits by elites—resulting in conflict over forest resources and illegal logging (WRI, 2009; Menzies, 2007). These governance failings result in government revenue losses of an estimated USD10–15 billion per year globally (ITTO, 2010).

Ensuring good governance is particularly important in the development of a global financial mechanism for REDD+. Most countries are of the view that carbon

markets will make an important contribution to REDD+ by delivering performance-based payments to forest owners and managers in developing countries who protect and/or enhance forest carbon stocks. Millions of people live in and next to forests worldwide, and their involvement in REDD+ development, implementation and governance is key to its success.

The United Nations Framework Convention on Climate Change (UNFCCC) has recognised the importance of good forest governance for REDD+. In 2010 in the Cancún Agreements (Decision 1/CP.16) the 16th Conference of Parties (COP 16) adopted social and environmental safeguards on REDD+ that “should be promoted and supported”—including “transparent and effective national forest governance structures” (COP 16 UNFCCC, 2011). However, the development, operationalisation and institutionalisation of forest governance definitions are largely country-driven in response to specific country conditions, priorities, requirements and opportunities. Internationally consistent governance standards will assist governments in ensuring effective forest institutions at the national level.

REDD+ governance quality

There have been two global-level policy responses to governance problems facing REDD+. One was the agreement on the social and environmental ‘safeguards’ at COP 16 in Cancún, which has led to requirements for stakeholder consultation (FCPF and UN-REDD, 2012). Another response has been the rise of ‘participatory governance assessments’ (PGAs), which aim at undertaking consultations to identify the costs and benefits of REDD+ to stakeholders, and to develop safeguards (UN-REDD, 2011).

A number of social and environmental standards for REDD+ are under development. These include initiatives

TABLE 1

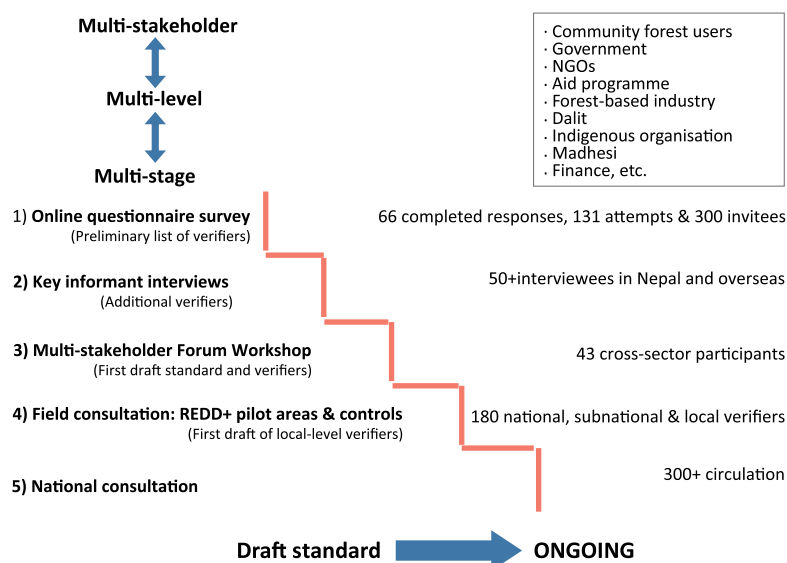
Normative Framework of Principles, Criteria and Indicators for Evaluating Governance Quality

	Criterion	Indicator
'Meaningful participation'	Interest representation	Inclusiveness
		Equality
		Resources
	Organisational responsibility	Accountability
'Productive deliberation'	Decision-making	Transparency
		Democracy
		Agreement
	Implementation	Dispute settlement
		Behavioural change
		Problem-solving
		Durability

Source: Cadman, 2011.

FIGURE 1

Methodology for Developing a Governance Standard for REDD+ and the Forest Sector in Nepal



Source: Authors' elaboration.

facilitated by the Forest Carbon Partnership Facility (FCPF), the World Bank, UN-REDD, and the Climate, Community & Biodiversity Alliance (CCBA) jointly with CARE International.

The effort that these initiatives have put into the development of criteria to ensure certain elements of good governance should be acknowledged, but these are counter-balanced by the extent to which countries are committed to consultation and/or have the capacity to do so. In Panama, for example, indigenous people recently withdrew from the national REDD+ programme because full and effective (i.e. meaningful) participation did not take place (Lang, 2013).

Nepal project: objectives, research questions and methodology

The research project in Nepal is developing a quality-of-governance standard to assist the effective negotiation, development and implementation of REDD+ but with relevance also for forest management and emissions trading schemes in general. The key features of the standard development process are that it is multi-stage, multi-level and multi-stakeholder. The project uses a common framework of principles, criteria and indicators (PC&I) of governance that:

- ensure consistent and comprehensive governance in REDD+ development and implementation; and
- reflect national circumstances and stakeholder requirements (see Table 1).

The primary method for the standard development project has to involve key forest-sector and REDD+ stakeholders, typically including government, forest user groups, other civil society organisations, minorities and international aid programmes. The multi-stakeholder approach ensures the representation and involvement of all key sectors of forestry and REDD+ in developing the standard. The stakeholders are engaged throughout a number of stages to identify site- and context-specific verifiers of governance quality at the local, subnational and national levels.

The active involvement and participation of a diverse range of stakeholders demonstrated that many key groups and individuals were able to experience the value of developing such a standard in a collaborative environment, which fostered meaningful participation and resulted in productive deliberation around a whole series of core governance challenges including inclusiveness, equality, transparency, accountability, decision-making and implementation. Particular



The need for a comprehensive analytical framework or standard to assess, monitor and report on forest governance in REDD+ countries is increasingly recognised at the international level.

emphasis has been placed on facilitating the involvement of marginalised groups who seldom have the opportunity to participate in such processes. The approach creates governance standards that are likely to have a high degree of local ownership and relevance (see Figure 1).

The need for a comprehensive analytical framework or standard to assess, monitor and report on forest governance in REDD+ countries is increasingly recognised at the international level, including the UNFCCC. Ensuring emissions reduction through good governance is vital for the longer-term viability of REDD+.

Several initiatives have developed governance standards for REDD+, but they have not been developed through genuine multi-stakeholder processes, in the sense of stakeholders providing the contents of the standards as active participants throughout all stages of the process.

Rather than making the stakeholders the 'subjects' of governance, the Nepal project has ensured that all major stakeholder groups have had the opportunity to identify what they felt was needed to ensure good governance. Context-specific standards have the advantage of making it easier for all participants to determine what they require in a given local, subnational

or national situation before policies and projects are developed. The governance framework and involvement methodology used, however, can also be applied for the development of governance standards elsewhere in the world. ■

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The Necessity of Land Governance: Sustainable Development in the Amazon

by Bastiaan Philip Reydon¹ and Vitor Bukvar Fernandes¹

There are many dimensions to sustainable development in the Amazon, but prevention of primary forest deforestation is undeniably the most important. The Brazilian Forest Code has demonstrated that Brazil is unable to establish clear policies about deforestation and that debates have been superficial and ideological in nature. The preservation of the Amazon rainforest requires deeper and more significant changes, which should be more comprehensive than difficult-to-enforce laws and regulations.

It is undeniable that the strong command and control policies² implemented in the last few years have played a crucial role in reducing deforestation. Due to their nature, command and control policies depend on direct state intervention and can hardly be enforced for a long period of time. This is because the main causes of deforestation—activities such as livestock herding, agricultural production and power

generation—will continue to exist; therefore, permanent solutions must be adopted.

A greater use of economic incentive policies³ to avoid deforestation, such as those proposed in the Forest Code, is one of the alternatives that has been discussed the most, both in literature and in social movements.⁴ The most important economic instrument in this regard is payment for environmental services (PES).

Studies indicate that the main opportunity cost to be compensated by PES relates to the productive gains associated with the land.⁵ Andrade (2007), using a literature review as a basis, and Fasiaben (2008), relying on studies conducted in Acre, came to the conclusion that the approximate average amount paid per year as compensation to avoid deforestation was USD100 per hectare.

Wunder *et al.* (2009) propose an opportunity cost based on the alternative use of the

forest (traditionally timber, livestock and grain) converted into equivalent carbon dioxide, using the carbon market as a basis, and reaching values up to BRL671 (approximately USD288)⁶ per hectare. Nevertheless, both Fasiaben (2008) and Wunder (2008) highlight the importance of suitably regulating/controlling land ownership in order to use PES to preserve the forest.

As demonstrated by Reydon (2007), one of the most important incentives for deforestation is the increase in land value as a result of forest clearing.

Data from AgraFNP⁷ initially reveal, as shown in Table 1, that the prices of land with forest coverage vary from state to state, costing from BRL108 per hectare in the state of Acre to BRL546 in Mato Grosso.

It is also noteworthy that in less deforested states (Acre, Amapá and

TABLE 1
**Average Prices for Forest areas and Pastures—
Amazon states—in Current BRL/ha in 2008**

State	Forest	Pasture	Variation %
Acre	108.00	1571.80	1455.4
Amapá	141.00	800.00	567.4
Amazonas	132.43	1243.91	939.3
Pará	457.73	1509.40	329.8
Rondônia	358.50	1762.50	491.6
Mato Grosso	546.13	2083.69	381.5
<i>NORTH Average</i>	<i>416.53</i>	<i>1832.39</i>	<i>439.9</i>

Source: AgraFNP (2009).

Amazonas) the price of land is lower than in Mato Grosso, Para and Rondonia, which have higher rates of deforestation.

Despite this, the most significant conclusion drawn from Table 1 is that deforestation always significantly increases the value of land. Moreover, on average, prices are four times higher in cleared areas. This occurs because land pricing is essentially a consequence of the expectations of obtaining productive gains from farming activities undertaken in those areas. This rationale is based on the fact that deforested areas may be used immediately, with no need to incur additional clearance expenses.

In the most extreme case (Acre), these prices are 14 times higher for deforested areas, and in the state of Amazonas they are almost 10 times higher. Few investments yield results as high as these.

Reydon and Fernandes (2011) used a case study containing primary data from the municipality of Cotriguaçu to demonstrate the significant increase in land prices as a result of deforestation. Amounts varied from BRL878.12, using primary data, to over BRL1000, according to secondary data.

Thus the laws that prohibit deforestation (the Forest Code and the Environmental Crimes Act) are ineffective, given that deforestation still occurs and generates extraordinary profits from the appreciation of land. This happens because of impunity, particularly in this area.

Consequently, it may be concluded that the most important mechanism to avoid

deforestation is the elimination of land speculation, both in deforested areas and areas undergoing forest clearance.

This means that the State must enforce clear land policies to control land use and prevent the predatory and speculative use of these areas, as demonstrated by Deininger (2003), Reydon (2007) and FAO (2009), among others. In the case of Brazil, Reydon (2011) also shows that the integration and improvement of the different property registries maintained by a variety of institutions is the first step that must be taken to implement a comprehensive, integrated land policy.

The existence of a single land governance system capable of integrating all competent entities—the registry offices (public notaries), the National Institute of Colonization and Land Reform, the state land institutes and other agencies such as the Department of Federal Revenue—may trigger a process to control land property and use in the country, including mechanisms to monitor deforestation and illegal public land appropriation, especially in the Amazon rainforest.

Therefore, apart from focusing on PES to reduce deforestation, we must also forestall the arbitrary use of land and prevent owners from clearing these areas to obtain illegal profits.

In summary, land regulation and governance are the first few measures to be adopted when implementing any type of policy meant to preserve forests. Therefore, the way forward is to create clear and

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objective land regulations and governance mechanisms to reduce the speculative use of land. Only then can solutions to enable PES be effectively structured. ■

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1 Institute of Economics, University of Campinas, Brazil.

2. The main command and control policies, direct state interventions that modify the behaviour of those who deforest, were: a) Operations Curupira (2005) and Arco de Fogo (2008), which fought illegal logging; b) Decree 6321/07, which restricts bank credit and forces land owners in the municipalities with the highest levels of deforestation to re-register; c) the creation of Conservation Units (UCs) adding over 20 million ha to the 80 million ha already in existence, amounting to a total of 273 UCs; d) the ratification of 87 Indigenous Territories and approximately 18 million

ha; and e) restrictions on produce originating from properties located in municipalities with the highest levels of deforestation.

3. The economic incentive policies, which are initiatives that use economic mechanisms (pricing or others) to encourage economic agents to reduce deforestation or to prevent their action, included Operation Arco Verde (2008), a special credit line from the regional development funds for the Northeast (FNE), the North (FNO) and the Central-West (FCO) meant to promote the recovery of degraded areas, reforestation, management and environmental regularisation in the Legal Amazon.

4. See Andrade (2007) Fasiaben (2008), Wunder (2008) and others for a good review of the literature.

5. Margulis (2002 and 2003) shows that livestock activities generate significant earnings in the Amazon and, as such, are some of the major causes of deforestation. This finding opposes most of the literature on the topic, which indicates that livestock gains were associated only with subsidies.

6. Exchange rate as of 25 March 2014: USD1 = BRL2.32847.

7. A leading business information specialist focusing on agriculture and food policy.

Integrating Livelihoods and Land-use Change at the Frontiers of Deforestation

by Aldicir Scariot¹

The conversion of areas of native vegetation into agricultural land is the main driver of immediate change in land-use, which in turn negatively affects biodiversity, ecosystem services and water resources and contributes to climate change.

Environmental degradation affects the natural environment's capacity to recover and to sustain future production processes, which ultimately depend on functioning ecosystems. Smallholder farmers, indigenous peoples and traditional populations, who depend significantly on natural goods and services for their livelihoods and income, are the most affected. In this context of rapid and intense loss of biodiversity and ecosystem services, the debate over strategies that reconcile food production, biodiversity conservation and ecosystem services has focused on two alternatives treated as incompatible.

Proponents of a *land sharing* strategy argue that biodiversity conservation and food production can be integrated in the same area, using more environmentally friendly farming methods. The contrasting alternative would be *land sparing*, with the separation of the areas for production from the areas for conservation. In land sparing, agriculture would be intensified, targeting high yields and increased productivity. In this strategy, the intensification of

agriculture would use smaller areas for production, thus saving areas to protect the remaining natural habitats from agricultural expansion.

This debate has focused mainly on biodiversity conservation versus food production, but has neglected the existence of indigenous peoples, traditional extractivists and family farmers. Indigenous peoples occupy 22 per cent of the land surface of the world and 11 per cent of forested areas (Sobrevila, 2008).

Smallholder farmers and traditional and indigenous peoples supply their subsistence needs and generate income from family farming and harvesting of forest products, hunting and fishing. These peoples depend on functioning ecosystems and natural areas with which they interact and which they affect.

Management proposals which state that saving land is more suitable for the tropics, where vast areas of intact forest are threatened by agricultural expansion, ignore the number of people who live in such forests and those who, although they do not live within, depend on forests for their survival. About 1.6 billion people in rural areas depend on forests to different degrees (FPP, 2012). According to the World Commission on Forests and Sustainable Development, 350 million of

the world's poorest people depend almost entirely on forests for their subsistence and survival. A further 1 billion poor people depend on remnant woodlands, trees in homestead gardens and agroforestry systems for fuel wood, food and fodder needs. Worldwide 60 million indigenous peoples and other communities live and depend on forests for subsistence (Krishnaswamy and Hanson, 1999).

In Brazil, the largest tropical country, where indigenous people make up a small proportion of the population, indigenous lands—which collectively cover 12.5 per cent (106.7 million hectares) of the country's surface area—are home to more than 300 indigenous groups speaking more than 250 different languages. In these regions, most of the indigenous land habitats are preserved, generally characterised by marked biodiversity, and part of the area cultivated with crops, managed for hunting and the extraction of timber and non-timber forest products.

Governments are beginning to recognise that different people interact in different ways with the environment, and are implementing actions to ensure that these differences are recognised in public policy through access to and use of land and resources. In Brazil, public policies recognise the existence of more than a



Photo: Laercio Miranda. Village of Barranco Vermelho, Erikbaktsa Indigenous Land; Sorting of Brazil nuts, storage shed in the background.

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dozen traditional peoples, with special arrangements for the granting and tenure of land. Traditional peoples are defined according to the way they occupy a territory, use natural resources as part of their identity and whether the exploitation of natural resources is sustainable and adapted to local ecological conditions.

More than 17 per cent of Brazil's territory is dedicated to the conservation of biodiversity through the federal conservation system. Of this area 51.6 million hectares, 6.1 per cent, are spared for integral protection, where commercial use or natural resource extraction activities are prohibited.

The sustainable use category covers 11.1 per cent (94.4 million hectares) of the country, and denotes areas where traditional people can hunt, fish, harvest non-timber forest products and cultivate crops, conserving biodiversity and ecosystem services. In addition, 5.2 million private farms in the country, covering 330.2 million hectares should, by law, allocate 20–80 per cent of their area for sustainable use and conservation, according to the ecosystem in which they are located, with intensive agriculture allowed on the remaining area.

This mixture of shared land-use, represented by the sustainable use and conservation of land and strictly protected areas, is the foundation of land-use in Brazil. Given its large availability of arable land and the potential for yield

improvements, Brazil can contribute a large fraction of the increase in production to meet the world demand for food until 2050 (Lapola *et al.*, 2014). Furthermore, Brazil has the opportunity to promote a new land-use paradigm for tropical countries that are heavily dependent on agriculture, safeguarding a considerable fraction of the world's biodiversity in intact forests and savannahs while guaranteeing significant food production to meet world demand. It is, therefore, crucial that land-use change be guided by solid sustainability principles.

Nowhere is this challenge more daunting than at the development frontiers, such as the northwest of the state of Mato Grosso in Brazil, where rapid land-use changes are associated with intense environmental degradation and social conflicts. But how could such future land-use be sustainably conducted if this challenge is not confronted where it is most intense?

Protecting areas and sharing the land are equally important and should be used as complementary strategies at the landscape level. Recognising the complex relationship that rural communities have with the natural areas in the tropics is critical to succeed in planning and implementing public policies that aim to conserve biodiversity and ecosystem services and respect the livelihoods of indigenous, traditional communities and family farmers. The conservation of biodiversity in tropical agricultural landscapes requires a combination of

land sharing and land sparing, and should be shaped by the relevant socio-cultural conditions. It is, therefore, dependent on the context. This mixed strategy is particularly important in the frontier areas, where there are opportunities for intelligent management of the landscape that integrates the various economic and conservation activities while respecting local ways of life.

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Beyond the Panacea: a Critical Assessment of Instruments of Deforestation Control

by Raoni Rajão,¹ Britaldo Soares-Filho,² Camilla Marcolino,¹ Richard van der Hoff¹ and Marcelo Costa¹

Since the late 1980s the Brazilian government has adopted various instruments aimed at controlling deforestation in the Amazon. Despite marked differences from a conceptual and practical perspective, when these instruments were introduced, the government often considered them to be effective and inherently superior solutions to those previously used to control deforestation. In this article we shall assess these instruments critically, to emphasise their results, potential and limitations.

This analysis is based on 84 interviews and extensive direct observations of the procedures conducted by different Brazilian government entities between June 2007 and July 2009. In addition to qualitative data, this study also drew on quantitative geographical data provided by INPE (the National Institute for Space Research), IBAMA (the Brazilian Institute of Environment and Renewable Natural Resources) and SEMA-MT (the Secretary of the Environment of the State of Mato Grosso).

The following three sections will present and evaluate institutional, economic as well as command and control instruments, respectively. The final section will highlight the need to use these tools in an integrated fashion, to unite their strengths and mitigate the weaknesses of each type of deforestation control modality.

Command and control instruments

Command and control instruments are undoubtedly the most widely used environmental governance modality in the Amazon. In addition to serving as guiding principles for IBAMA's activities since the institution was created, the instruments were also adopted by various environmental agencies at the state level (Órgãos Estaduais do Meio Ambiente—OEMAs). A mechanism is considered a command and control mechanism when the government first 'commands' the development of a given environmental law and then 'controls' its enforcement

through inspection activities (Stewart, 1996). Although widely used for controlling deforestation in the Amazon since the Programa Nossa Natureza ('Our Nature Programme') in 1988, it was not until the 2000s that these instruments reached the scale needed to produce an effect on reducing deforestation (Mello, 2006).

The hiring of additional IBAMA personnel in the form of environmental analysts with university degrees—and the creation of DETER (a real-time deforestation detection system), by INPE, played a key role on this front (Rajão and Vurdubakis, 2013).

According to INPE data, the period between 2004 and 2012 registered an 83 per cent decrease in Amazon deforestation. Although this decline occurred concomitantly with two editions of the Plan for the Prevention and Control of Deforestation in the Legal Amazon area (PPCDAm), it has not yet been possible to determine the precise role played by that policy in the decline of deforestation. In any case, the preliminary results of our study of the impact of IBAMA's actions on the decline in deforestation showed a statistically significant correlation between the number of fines levied by IBAMA in a given municipality and the decline in deforestation in that same location in the following year.

Despite these positive results, it is important to highlight the financial and regulatory limitations of command and control instruments in the region. From a financial standpoint, IBAMA's enforcement actions carry a high operational cost and rely on the skills of inspectors to be effective and successful (Rajão and Vurdubakis, 2013). For example, we may consider the total number of infraction notices issued by IBAMA across the country between 2004 and 2007 and the budget spent by the institute to develop a rough indicator. This amounts to BRL204,805 (about USD90,000) per infraction notice (IBAMA, 2008). Although this amount is just

an approximation and does not include other activities carried out by IBAMA (e.g. licensing, environmental education etc.), the magnitude of this figure suggests that command and control actions do indeed entail high transaction costs.

Consequently, any attempt to expand these activities will meet budget and infrastructure constraints and will be hampered by the inability of inspection bodies to cover the entire territory. For example, the sum of all areas fined by IBAMA for illegal deforestation amounts to only 17.21 per cent of the total area deforested between 2004 and 2008. Given that only a small fraction of offenders eventually suffer sanctions, inspection activities are seen by fined farmers as arbitrary and unfair. This means that the command and control instruments come into conflict with the notions of justice and fairness considered central to enabling modern forms of governance (Foucault, 1977; Weber, 1922/1968).

Furthermore, since the amount of people fined is very low, the deterrence effect this action should have does not manifest itself satisfactorily. Thus, it is unfeasible to promote a legitimate and stable order in Amazon land management based solely on command and control.

Institutional instruments

Institutional instruments constitute another branch of environmental governance mechanisms widely discussed in the context of the Amazon. This type of instrument has a broad definition that often overlaps with command and control as well as economic mechanisms. Despite this challenge, we can characterise institutional mechanisms as a typology of environmental governance conducted through a set of rules and political and administrative structures that indirectly contribute to policy objectives. As such, while command and control mechanisms directly enforce

environmental laws and punish those who disobey them a posteriori, institutional mechanisms try to offer a legal and administrative context to encourage compliance with the law, to avoid fines before they are imposed. Examples of such mechanisms in the context of the Amazon include land regulation programmes (e.g. Terra Legal, Decree 6992/2009), socio-economic environmental zoning (Ab'Saber, 1989) and the establishment of special protection areas, such as indigenous, extractive and environmental conservation reserves.

The creation of protected areas was undoubtedly one of the most effective measures to control deforestation in the last decade (Nepstad *et al.*, 2006). Regarded as one of the main pillars of the PPCDAm, a sizeable number of protected areas were created by the government between 2004 and 2009, covering 54 per cent of remaining Amazon rainforests. Consequently, Soares-Filho *et al.* (2010) estimate that the creation of protected areas accounted for 37 per cent of the reduction in deforestation witnessed between 2004 and 2006.

Environmental licensing and registration are other types of institutional instruments used widely in the Amazon in recent years. These tools are based on geo-referencing and the use of satellite imagery to determine the environmental status of rural holdings. Using these records, government control entities are expected

to carry out farm inspections using satellite images and to hold offenders accountable for environmental crimes.

Conceptually, environmental licensing and registration instruments can be considered ideal forms of social control, due to their potential to carry out inspections that are both universal (i.e. everyone in the system may be subjected to it) and have low transaction costs (i.e. the use of satellite imagery abolishes the need for on-site visits when issuing notices for illegal deforestation activities). As such, these systems could, theoretically, provide a foundation for the development of a disciplinary type of environmental governance—they are, therefore, seen by the population as modern and legitimate systems (Foucault, 1977).

However, an analysis of the effectiveness of the licensing system for rural properties (SLAPR) in the state of Mato Grosso has shown that these objectives are not always achieved. In particular, a comparison between deforestation inside and outside the system suggests that this instrument has contributed to increasing—rather than decreasing—deforestation within licensed properties.

One of the reasons for this may be the registration strategy, which leaves it up to owners to choose which properties will be included in the system, leading to the exclusion of properties with environmental liabilities and the inclusion



Photo: UNDP Brazil. Aripuana River, Northwestern Mato Grosso.

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The creation of protected areas was undoubtedly one of the most effective measures to control deforestation in the last decade.

of properties with vegetation coverage, for purposes of obtaining deforestation approval. Moreover, the state agency has not systematically used the ability to remotely control deforestation throughout the duration of the study. (Rajão, Azevedo and Stabile, 2012).

Economic instruments

Finally, the third type of mechanism is characterised by encouraging environmentally sustainable behaviours by providing positive incentives, usually of a financial nature (Juras and de Araújo, 2008).

Some of the policies that use economic mechanisms are: the ecological ICMS, which transfers funds to municipalities according to ecological indicators (Ring, 2008); the clean development mechanisms (CDMs), created by the Quito Protocol of 1997 (Austin *et al.*, 1999); carbon credit for reducing emissions from deforestation and forest degradation—commonly known as the UN-REDD;³ and incentive programmes for sustainable production (Le Tourneau and Greissing, 2010; Lederer, 2011).

These mechanisms are based on the notion that economic players who deliberately decide to reduce their environmental impact should be financially compensated, directly and indirectly (Fearnside, 1997; Kaimowitz, 2008; Olsen, 2007).

Such cases can already be found in existing literature, where economic incentives to sustainable development have become viable and long-term alternatives for local populations (Le Tourneau and Greissing, 2010). For example, the Project for Conservation and Sustainable Use of Forests in North-western Mato Grosso (the UNDP/GEF project) showcases the multiplying nature of these initiatives, which bring together an increasing number of local stakeholders and disseminate sustainable economic practices related to the extraction of latex and Brazil nuts (Tito, Nunes and Vivan, 2011).⁴ However, two important limitations of these initiatives are their relatively small scale and the pressure put on these areas by domestic and international markets to increase the production of, mostly, beef and soybeans—which, historically, have been linked to deforestation (Hargrave and Kis-Katos, 2013). In this context, REDD was seen by several stakeholders as a way to obtain

enough funding to offset these economic pressures and encourage the preservation of the forests (Kaimowitz, 2008; Nepstad *et al.*, 2009.).

However, expectations of receiving large amounts of funds through REDD have not yet materialised. Several factors could explain the difficulties faced by REDD, the most apparent of which is the lack of consensus within the several Conferences of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) about the mechanism and the financial crisis in Europe and the United States.

There are also internal inconsistencies within the mechanism—while some players see REDD as an economically efficient market instrument, others see it as a government policy detached from the market. Furthermore, there are profound differences in issues related to the methodology used in monitoring and calculating credits and in fund allocation, and well as in the protection of biodiversity and indigenous rights (IPAM, 2011).

Even within existing REDD projects related to the voluntary carbon market there are problems in the criteria used to calculate the credits, since the future baseline methodology used by such projects tends to project future deforestation levels well above historical figures, to achieve a higher level of 'avoided' deforestation and, consequently, increase profits from the sale of credits (Lang, 2013; Leach and Scoones, 2013). In addition, current models do not consider the fact that deforestation trajectories can change dramatically according to national and international contexts (Soares-Filho, Lima, Bowman and Viana, 2012).

These methodological controversies are compounded by the emergence of local movements against REDD, reflecting the existence of deeper concerns about the negative consequences of this mechanism, such as increased social inequality, for example (Arsel and Büscher, 2012).

Final thoughts

In short, all of the deforestation control instruments currently enacted—to a greater or lesser extent—by the Brazilian government have their limitations. In particular, we have seen that when

command and control instruments are scaled up, they quickly run into logistical, financial and legitimacy limitations. Similarly, institutional instruments cannot, by themselves, bring about behavioural changes—and can even be used for adverse purposes.

Despite being greatly emphasised in recent years, economic instruments have had trouble expanding their local sustainable development activities to regional levels and securing substantial financial resources—from REDD or other mechanisms.

On the other hand, each of these instruments also has its strengths, and they have been key in bringing about positive advances. For example, IBAMA's inspection activities have had a significant effect on the decline of deforestation. Likewise, the creation of protected areas has contributed to curbing deforestation by creating obstacles to the possession of public lands without a clearly defined purpose. Moreover, local projects to promote the production of latex and Brazil nuts, even on a small scale, have made it possible to combine a higher income and better quality of life within environmental conservation activities.

As such, by combining different approaches to controlling deforestation one can arrive at a "policy mix" where the weaknesses of the different instruments can be mitigated, thus building synergies. Particularly, a reduction in the opportunity cost of environmental preservation can also be observed in areas with effective command and control structures. Similarly, even though the licensing of rural properties has not had the expected effect, these records facilitate inspection work and lower the transaction costs of enforcement.

Finally, the existence of economically viable alternatives to deforestation—along with improved command and control policies—changes the risk-reward relationship of environmental crimes and contributes to the establishment of sustainable practices. This analysis suggests that the search for an "optimal" solution to deforestation is an ambition doomed to fail. Therefore, one must adopt a comprehensive strategy that takes into account the need to integrate a heterogeneous set of public policies. ■



Photo: Laercio Miranda. Village of Barranco Vermelho, Erikbaktsa Indigenous Lands; Brazil Nuts Integrated Programme (PIC). Experience interchange meeting.

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The existence of economically viable alternatives to deforestation—along with an improved ability to command and control—changes the risk-reward relationship of environmental crimes and contributes to the establishment of sustainable practices.

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3. The United Nations Reducing Emissions from Deforestation and Forest Degradation (REDD) is an initiative to produce a financial value for the carbon that is stored in forests by providing incentives for countries to reduce emissions from forested areas and to invest in low-carbon pathways of development.
4. Also see Vivan et al. in this issue.

Deforestation in the Himalayas: Myths and Reality

by Jean-Marie Baland¹ and Dilip Mookherjee²

Deforestation in developing and middle-income countries is an urgent global problem, affecting climate change, soil erosion, changes to major river basins and the livelihoods of poor households living near forests. Public discussions of the problem are frequently dominated by widely held beliefs concerning the extent of deforestation (that it is large and growing over time) and its impacts on local livelihoods (that these are adverse and also significant). Views concerning determinants of deforestation include economic growth, local poverty and inequality, all of which are generally believed to accelerate the process. Of possible remedies, the one most widely discussed involves property rights over forests: that local communities should be granted ownership and management autonomy in order to adequately arrest deforestation.

There are many good reasons as to why these propositions could be true, informed both by economic theory and casual empiricism. Human populations use forests for household energy, as an excess food resource for livestock, and timber for wood products. Forest areas are often cleared to extend agricultural cultivation, increase mining exploration, create residential construction projects or expand urban and peri-urban areas. Economic growth that increases demand for food, energy, mineral resources, furniture and housing could thus naturally increase deforestation. Among those living near forests, the poorest households rely the most on forests for firewood, fodder as well as other forest products and resources. They rely more on livestock grazing, are less able to afford commercial fuels or timber and have numerous family members (especially women and children) with a low opportunity cost of time who can collect forest products. Hence increased poverty among neighbouring

populations could increase human pressure on the forests.³

Increased deforestation could, therefore, have a severe impact on local poverty, possibly generating a vicious cycle wherein this increased poverty may in turn accelerate deforestation. Women and children, the principal collectors, are likely to be the most adversely affected. Greater socio-economic inequality of local communities could undermine their capacity to engage in collective action to impose and enforce limitations on forest use. Shifting ownership rights over forests to local communities away from the State might, therefore, enhance the scope and power of such collective action.

These views are commonly expressed in numerous anecdotes, media reports, academic research, and policy documents of national governments and international organisations. However, to what extent are they upheld by results of empirical ground-level research? Do they apply equally to different countries or continents?

In collaboration with various researchers over the past decade, we have undertaken a study of the mid-Himalayan region spanning Nepal and northern India, using a variety of detailed micro-level data sets. For Nepal we have relied on three successive rounds of the nationally representative household Living Standards Measurement Survey (LSMS) between 1995 and 2010. For the Indian states of Himachal Pradesh and Uttarakhand, which fall in the same geo-climatic zone as Nepal, we carried out detailed household, community and forest surveys between 2001 and 2004. The findings turn out to be similar across Nepal and the two Indian states, as well as with studies in these regions by a number of other researchers.

Increasing deforestation?

There is no clear evidence that deforestation in this part of the world is

accelerating. For India as a whole, Foster and Rosenzweig (2003) use aerial satellite data on forest biomass and find the opposite phenomenon of reforestation. Our detailed ground-level forest surveys in Himachal and Uttarakhand indicate that the key problem is degradation rather than deforestation. Tree branches are heavily lopped, stunting tree growth and limiting foliage. Some 61 per cent of forest areas sampled exhibited canopy cover below the ecologically sustainable threshold of 40 per cent. In contrast, measures of tree biomass were not alarmingly low: mean basal area exceeded the sustainability threshold of 40 m² per hectare. While forest areas have receded owing to growing encroachments, this accounts for a relatively small fraction of the increased time taken by households to collect firewood. Over the past quarter of a century, firewood collection times have increased by 60 per cent on average, but walking time to the forest increased by only 10 per cent. The bulk of the increased collection time was due to the declining quality of the forest, with households taking longer to find firewood because trees were being more heavily lopped.

These facts imply that a feasible research strategy for testing various hypotheses concerning determinants of forest degradation is to study their effects on household firewood and fodder use, and on the quality of neighbouring forests. In this regard, the main findings are the following:

Effects of economic growth

Here what we find depends on the precise way that 'growth' is measured. If it is measured in terms of household consumption levels, the evidence (based on estimated household Engel curves) shows that economic growth aggravates degradation: rising consumption levels (up to the 95th percentile) are associated with increased firewood collection/use. However, the same is not true when growth is measured in terms of key household productive assets rather than consumption levels. Only

growth in livestock assets seems to have a strong positive impact on the demand for firewood. The effect of land ownership is negligible, and education and non-farm assets have a negative effect. Indeed, in villages of Nepal, per household collections of firewood fell between 1995 and 2010, explained mainly by rising education and non-farm assets, shrinking livestock numbers and greater outmigration. Hence the nature of growth matters. If it is accompanied by occupational changes, with local populations shifting from traditional livestock or land-based occupations to modern non-farm occupations, a reduction in forest degradation can occur. The opposite may happen if growth in living standards is driven by rising income transfers from the government or remittances, or by rising livestock assets.

Far more important than economic growth in explaining trends in forest degradation in the Himalayan region were demographic factors, such as the rise in population and increasing fragmentation of rural households. Shrinking household size, a growing population and slow rates of permanent out-migration have translated into fast growth in the number of rural households, increasing forest degradation. A 10 per cent growth in productive assets in the two northern Indian states was estimated to raise household firewood use by less than 0.2 per cent, while a 10 per cent growth in population was estimated to raise it by 9.9 per cent.

Effects of local poverty

There is no evidence that poor households collect more firewood than non-poor households. In reality it is the other way around. Non-poor households have greater energy needs, related to house size, consumption of cooked foods, and of heat during the winter. This result is robust with respect to estimation methodology and applies to both Nepal and northern India. Declining poverty is, therefore, unlikely to arrest forest degradation.

Effects of forest degradation on local poverty

The data also show very limited evidence for the reverse link between forest degradation and current living standards of forest neighbouring populations. An increase in firewood collection time by an hour in northern India (comparable to the extent observed over the past

quarter of a century) was estimated to lower household consumption by less than 1 per cent uniformly across poor and non-poor households. The reason is that the opportunity cost of households doing so time-wise is low, since they accumulate firewood during lean agricultural seasons. It is possible, however, that there will be some adverse effects on local livelihoods in the long run, if current degradation trends continue.

Effects of local inequality or collective action

Neither is there any evidence that increased inequality of consumption or land ownership in forest neighbouring villages is associated with greater pressure on adjoining forests. Informal collective action to regulate forest use in northern India is conspicuous by its absence, except in a few locations. This does not reflect a general inability to engage in collective action, as indicated by functioning informal cooperatives in the context of other local public goods, such as irrigation or temples. Part of the reason could be the fact cited above: a more degraded forest has a negligible impact on current household livelihoods. So local communities do not worry about the condition of neighbouring forests nor do they try to regulate the use of forest products.

Effects of local community ownership and management

Both Nepal and India have transferred ownership and responsibility for the management of forests to local communities, in the form of forest-

user-groups (FUGs) in Nepal and Van Panchayats (VPs) in northern India. These local organisations have created and enforced rules for firewood and fodder use by their members, and engaged in reforestation programmes. While estimating the impact of these changes raises a number of methodological problems, the most detailed studies available find a 10–20 per cent reduction in household firewood use in either region. In northern India these findings are corroborated by reduced lopping of forests transferred to VPs, compared with neighbouring state and open-access forests.

Effects of varying costs of household energy substitutes

Our studies in northern India show that household use of firewood is sensitive to the cost of alternate modern fuels, especially liquid petroleum gas (LPG). A subsidy of INR100 (approximately USD2, one third of the cost in the early 2000s) of an LPG cylinder was estimated to reduce household firewood use by around 20–27 per cent.

In summary, many commonly held views—such as the effects of economic growth, poverty reduction or local inequality on forests, or of the reverse effects of forest degradation on local livelihoods—turn out either to be invalid or require serious further qualification in the Himalayan context.

What appears to be true instead is the following. Forest degradation is a serious problem, from the standpoint of its



Photo: Sandesh Timilsina. Collecting Forest Fodder. Rokuwa, Nawalparasi, Nepal.

larger, non-local ecological and climate change impacts, as well as possible long-term impacts on local livelihoods. It results mainly from firewood and fodder use by households that live near the forests. Informal collective action by neighbouring local communities is unlikely to offer a meaningful solution for the problem. Transfer of ownership and management to local communities is, however, likely to help moderate firewood use and encourage forest regeneration. Subsidies and increasing availability of modern energy substitutes will reduce household reliance on the forest.

In the long run, the most effective means of limiting degradation will be policies that control population growth and promote education, growth of non-farm occupations and permanent out-migration. ■

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3. *Editor's note:* One should keep in mind that this is a salient issue in the forest frontiers of Asia discussed in this article, which have a very high population density. Therefore, some of the issues discussed here should not be automatically applied to all forest frontiers, especially in the Amazon frontier case, which has a very low population density and is dominated by agricultural commodities.

Property Rights, Deforestation and Violence: Problems for the Development of the Amazon

by André Albuquerque Sant'Anna¹ and Carlos Eduardo Frickmann Young²

In Brazil the loss of forested areas has historically been connected to the process of land occupation and to the production methods established at the beginning of the colonial era (Young, 2006). From this historical perspective, despite the change in the type of goods that generated the dynamics of the colonial economy and, subsequently, the imperial and republican economies, one notices a 'rise and fall' movement resulting from the direct or indirect exploitation of natural resources.

The abundance of a specific resource causes its rapid predatory exploitation, which consequently leads to a long-term decline caused either by the growing scarcity of what was once plentiful, or by an abrupt increase in the supply of a given product, prompting a trend of continuous price depreciation in domestic and international markets.

Based on this analytical perspective, a theory concerning the economic cycles

covering the period between the 15th century and the beginning of the 20th century (*pau-brasil*, sugar, cattle, gold and coffee) can be devised, despite the enormous differences in the modes of production and distribution for these products. All these activities were associated with the predatory use of natural resources, causing severe damage to the environment without, however, creating sustainable methods to overcome the economic and social contradictions.³

Nevertheless, conservative groups with considerable influence in the Brazilian National Congress and other entities still advocate that the expansion of the agricultural frontier is paramount for the development of remote areas of the country. According to this mindset, the transformation of the forest into pastures or plantations would enable economic gains because of the increase in farming activities. Moreover, the process of territorial occupation would intensify

the presence of the State in areas of the country that still lack public goods.

The argument stating that the geographical expansion of agriculture leads to development is neither new nor exclusive to Brazil. In the USA, for instance, there are those who maintain that the expansion of the frontier in the march towards the West was crucial not only for the economic growth of the country but also for the promotion of a democratic society.

In fact, according to Turner, "American democracy is fundamentally the outcomes of the experiences of the American people in dealing with the West" (1920).

From this standpoint, called the 'Turner Thesis' or 'Frontier Thesis', the success or failure of the frontier expansion policy depends on the level of institutional development of the country. The empirical exercise by García-Jimeno and Robinson (2009) endorses the hypothesis, referring

to the 'conditional frontier'. On the one hand, in countries where political institutions were weak during the period of frontier expansion, there is a negative relationship between the frontier and current per capita income.

On the other hand, in countries with more advanced political institutions—such as the USA and Canada, for instance—the result is precisely the opposite: there is a positive association between frontier expansion and per capita income. Nevertheless, these countries still maintain a high percentage of forest coverage (54 per cent coverage in Canada and 33 per cent in the USA), indicating that if, in fact, deforestation played a role in these countries' development, this was only true until the middle of the 20th century.

In light of this scenario, it is quite important to understand the role of institutions, especially with regards to property rights, in the advance of deforestation in Brazil and its consequences for development. Our position stems from the assumption that the inadequate definition of land property rights is a key factor for deforestation and its perverse social and economic effects.

In frontier areas there is no formal definition of land ownership. Additionally, Brazil follows a tradition in which land ownership can only be claimed based on the productive use of the land. In this context, land deforestation is almost considered mandatory to increase the chances of obtaining land ownership. Be that as it may, once property values rise, land grabbers usually claim ownership rights.

Usually the dispute between land-appropriators and land-grabbers leads to intense conflicts: literature reveals that in municipalities where levels of deforestation are high, there is also more violence, as measured by the homicide rate (Sant'Anna and Young, 2010). Therefore, it may be concluded that ongoing violence is the clearest result of an inadequate definition of land property rights in the expansion of the Brazilian agricultural frontier.

In a scenario of intense land concentration, the expansion of the agricultural frontier towards forest areas has been used historically as a safety valve to accommodate the surplus population

that resulted from the mechanisation and demobilisation of family farming (Sant'Anna, 2012). Consequently, initially the Atlantic rainforest and subsequently the Cerrado region and the Amazon rainforest were reduced to accommodate land conflicts. However, no land reform was implemented in previously occupied areas. Nonetheless, newly occupied areas reproduce the same land concentration pattern. Thus, after some time, the inability to absorb this new surplus recreates the conditions for a new migration flow towards unconverted forest areas (Young, 2006).

Since the way in which the land economy is organised in Brazil poses limits to the capacity of obtaining 'natural' land surpluses to accommodate social problems, the use of frontier lands as an element to mitigate this issue is far from a definitive solution. Therefore, this is an expansion model that inevitably leads to deforestation, violence and land concentration.

On the other hand, the expansion of pasture lands and plantation areas has a devastating impact on native forests, while failing to produce a socially desirable situation: most of the poverty-stricken areas of the country are located in rural regions where deforestation is already consolidated.

Empirical studies demonstrate that deforestation is not associated with an increase in the Human Development Index (HDI): Young and Neves (2009) show that in the municipalities in which the Atlantic rainforest was more severely deforested in the period between 1985 and 1996 the HDI growth was lower than in most other cities. Celetano *et al.* (2009) also reveal that there is no relationship between the percentage of deforested areas in a municipality in the Amazon region and any increase in its HDI.

Social instability and the absence of suitable infrastructure for basic services, such as education and health, are also consequences of an unbalanced expansion caused by the 'production of property rights' through deforestation.

Health problems are quite severe, given that the loss and degradation of the native vegetation increases the risk of the spread of disease (UNDP, 2010). Literature shows that deforestation contributes to the spread

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Land property rights in Brazil—and especially in the Amazon region—are structured in a perverse manner.

Social instability and the absence of suitable infrastructure for basic services, such as education and health, are also consequences of an unbalanced expansion caused by the 'production of property rights' through deforestation.

of infectious diseases such as malaria, dengue fever, Chagas disease, leishmaniasis and the hantavirus. This situation is made worse by climate change. Consequently, there is a direct rise in public expenditures because the costs of mitigation and eradication strategies are higher than those of preventive actions. It is estimated that expenses to fight malaria in the Americas amounted to over USD500 million between 2004 and 2007 (UNDP, 2010).

It becomes clear in this context that land property rights in Brazil—and especially in the Amazon region—are structured in a perverse manner. The process of land concentration, associated with the mechanisation of agriculture, forces a considerable part of the population into moving to the agricultural frontier.

The confusing institutional framework leads to the process of 'production of property rights', which entails continuous deforestation and violence associated with land conflicts. Thus, public policies must be improved so as to reduce incentives for deforestation and make better use of consolidated lands. ■

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1. BNDES - The Brazilian Development Bank. The author is exclusively responsible for the opinions expressed in this article.

2. Institute of Economics, Federal University of Rio de Janeiro, Brazil.

3. See Dean (2004) for a complete description of the process of occupation of the Brazilian territory and its socio-environmental impacts.

Social Policies and Forest Frontiers: the Consequences for Agricultural Land-use in the Brazilian Amazon

by Gabriel Henrique Lui¹

Rural populations around the world are currently experiencing a process of livelihood transition. Especially for smallholder farmers, this process is characterised by diversification and a disconnection between rural livelihoods and agricultural yields. In general, this scenario is a result of factors such as: (1) unequal competition with large-scale farmers; (2) low profitability of subsistence farming; (3) new job opportunities and off-farm activities; (4) proximity to cities and urban culture; (5) a lack of interest among younger generations to continue agricultural activities; (6) environmental degradation; and (7) the lack of available land (Bryceson, 1996; Graziano da Silva, 1997; Rigg *et al.*, 2001; Rigg, 2006).

As a consequence, income from agricultural activities has been shown to be decreasing in importance among smallholder farmers, whereas income from other activities, such as part-time jobs, services, government jobs, family remittances and other benefits, are becoming more important. In Latin America, for example, Reardon *et al.* (2001) indicated

that up to 40 per cent of rural households' income comes from non-agricultural activities. In South Asia, Gordon (1999) found that this figure can reach upwards of 60 per cent.

In Brazil there are two significant variables in this scenario of livelihood diversification among low-income smallholder farmers: the *Programa Bolsa Família* (PBF) and rural retirement schemes. The PBF is a federal government programme that undertakes conditional cash transfers to 13 million families—about 53 million people or 27 per cent of the Brazilian population. The main goal of the PBF is to reduce poverty and ensure food security among the programme beneficiaries. The PBF targets families who have a monthly per capita income of up to BRL140 (about USD62), and conditionality is related to both health care and school attendance. The amount received by each family can vary between BRL32 and BRL306 per month, depending on the number and age of children (Brazil, 2012a). Besides the large proportion of the population served by the programme, the

impact of additional resources becomes clearer when considering changes in income. Families in the programme have experienced an average increase of 48.7 per cent in per capita income (BRL48.69 to BRL72.42), and the benefit represents about 33 per cent of total household income on average (*ibid.*).

Another factor that is bringing about significant changes to incomes in rural areas of Brazil is the broader access to social security benefits, such as retirement plans, pensions and temporary assistance (maternity, death, unemployment etc.). The number of such beneficiaries in the country grew from 22 million in 2003 to 28 million in 2010 (Brazil, 2012b). In rural areas, specifically, the number of beneficiaries grew from 7 million to 8.4 million throughout the same period. More than the number of individuals served by social security programmes, it is interesting to note the amount of resources available from such benefits. The minimum wage, which is the basis for calculating payments, increased from

BRL240 per month in 2003 to BRL545 per month in 2011, representing a real growth of 49 per cent. The higher number of beneficiaries, coupled with the rise in the value of benefits, increased the economic importance of these income sources. For example, in the region of Santarém, in the eastern Amazon, the annual amount of resources transferred from retirement benefits and pensions grew from BRL96 million in 2003 to BRL242 million in 2010 (*ibid.*), which represents more than 13 per cent of the GDP in this area.

Faced with new income sources such as the PBF and rural retirement benefits that do not require the mobilisation of labour, what type of decision-making logic would households follow? Would there be a movement to reinvest additional income in agricultural activities? Or would these external income sources contribute to the further detachment of these families from agriculture? Consequently, how do such decisions affect land-use?

To address such questions, two primary data surveys were conducted by researchers from Indiana University (USA) and the University of Sao Paulo (Brazil) in the region of Santarém, in the state of Para. The surveys were undertaken in 2003 (n = 488) and 2011

(n = 83), seeking demographic, economic and spatial information for the same properties on both occasions. Data were collected through questionnaires and semi-structured interviews. Land-use change was analysed through satellite imagery for 1997, 2001, 2005 and 2010. Quantitative data were analysed using descriptive statistics, correlation analysis and hypothesis testing. Furthermore, qualitative data were analysed by categorising the content of interviewees' responses (D'Aantona et. al, 2006; Lui, 2013; Lui and Molina, 2013).

Results show significant changes between the two periods, such as a reduction in average household size (from 4.6 to 3.86 people), a growth in monthly income (from BRL443.97 to BRL1463.17) and expenditures (BRL344.12 to BRL933.60), a decrease in the production of annual crops, especially rice (-82 per cent), beans (-73 per cent) and corn (-63 per cent), and an acceleration in the rate of deforestation on large properties, especially after the arrival of large-scale soybean producers.

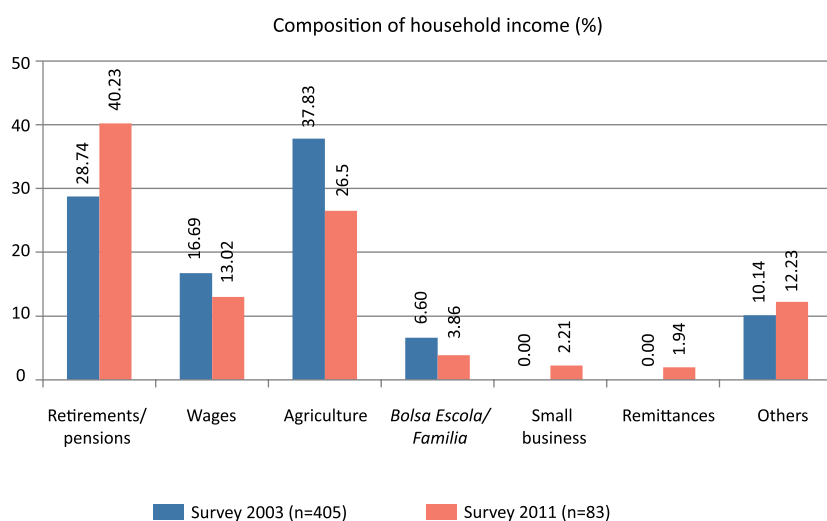
The growing importance of non-agricultural income sources for households, especially from retirement benefits and pensions, was one of the most prominent results of this work. Besides being an

essential source for family subsistence, as evidenced by income data (Figure 1), the movement of resources generated by retirees and pensioners has fundamental consequences for the local economy and represents a significant part of municipal GDP.

The continuous increase in the minimum wage and the value of retirement benefits tends to further reduce the share of agriculture in the composition of household income. The same logic applies to off-farm jobs, with the increase in the minimum wage making them more attractive than the income generated by agricultural activities.

The effects of the PBF and rural retirement emerged, therefore, as one of the components that contribute to the broader phenomenon of a reduction in subsistence agricultural activities in the Amazon region. However, this phenomenon is also strongly influenced by internal dynamics, such as the reduced availability of family labour, the depreciation of agricultural work, and the search for educational opportunities elsewhere as well as external jobs. It is also affected by external dynamics, such as low cash returns for the main annual crops produced by subsistence farming, competition with large, mechanised farms,

FIGURE 1 Composition of Household Income in 2003 and 2011*



Source: Author's elaboration. Note: * Composition of household income in 2003 and 2011, showing an inversion in the proportion of retirements/pensions and agriculture in the period.



The effects of the PBF and rural retirement emerged, therefore, as one of the components that contribute to the broader phenomenon of a reduction in small-scale agricultural activities in the Amazon region.

the increased occurrence of agricultural pests, transportation costs of production, and the role of middlemen in the process of commercialisation.

Most families interviewed did not observe advantages in continuing agricultural activities. It makes more sense to choose other activities, since the opportunity cost of labour increases when facing the possibilities of formal employment, which then reduces the prospect of choosing agriculture as a primary source of income. For families who are still engaging in agriculture, effective technical assistance seems to be the difference, as it is able to increase the potential of cash returns, possibly to the same level as wages from formal employment. The role of technical assistance was highlighted both in the results of statistical tests as well as by interviewees.

Despite this scenario of detachment from agriculture, improvements in infrastructure, especially the increased access to energy and water, have encouraged families to continue living in rural areas. There is also a feeling of belonging and of appreciation for rural life, especially among elderly people. Most rural landowners show no interest in moving to urban areas. New income sources and improved infrastructure in rural areas has led to a disconnection between living standards and agricultural activities.

Considering the processes in progress, the short- and medium-term prospects for smallholder farmers will depend on a scenario of economic growth, specialisation of agriculture and the influence of urban culture and values, especially among younger individuals. It will be necessary to promote effective technical assistance, aimed at reducing costs, increasing production efficiency and added value so that households can remain landowners. Furthermore, it is important to appreciate the social and economic role of smallholder farmers in offering food to the broader population, and their environmental role in resisting the complete commodification of these rural regions, which would certainly accelerate deforestation. These actions, however, cannot ignore that non-agricultural activities are a fundamental part of the livelihoods of the rural population in Brazil, noting that the interest and welfare of the families cannot be underestimated. ■

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Sustainable Settlements in the Amazon

by Mauro Angelo Soave Junior,¹ Osvaldo Stella Martins,¹ Paulo Roberto de Souza Moutinho¹ and Simone Mazer Rodrigues¹

The challenge of transitioning family farming into a low carbon economy

Greenhouse gas emissions caused by land-use change are responsible for about 12 per cent of global emissions or 1.2 billion tons per year (Le Quéré *et al.*, 2009). In Brazil, 55 per cent of greenhouse gas emissions are linked to land-use change, and take place mainly in the Amazon (MCTI, 2013). These emissions are mostly linked to the process of conversion of forest areas into croplands.

Although deforestation in the Amazon has decreased dramatically in the last decade, obvious difficulties remain in preserving the rainforest. In this sense, the Amazon poses a great challenge: to build a rural development model that is aligned with the prospect of zero deforestation and improved quality of life for farmers.

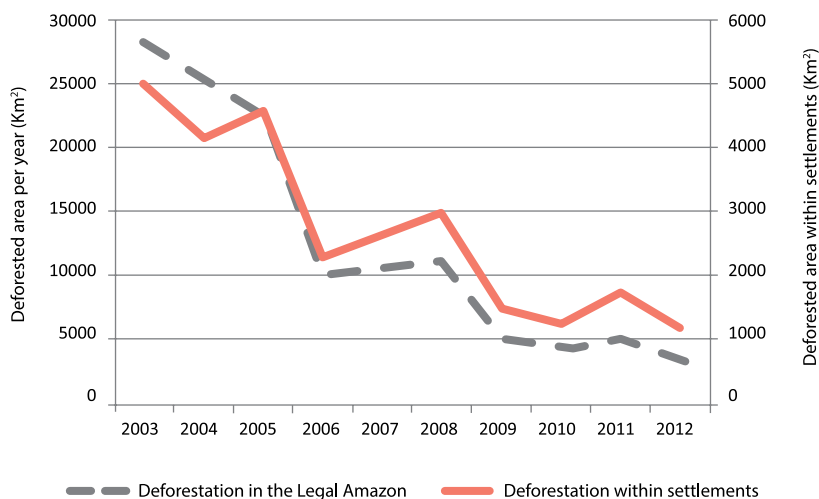
One of the key elements in this process is that of agrarian reform settlements.

Deforestation in agrarian reform settlements in the Amazon

Currently, about 78 per cent of settlement areas in Brazil are located in the Amazon. These settlements cover an area of 35.7 million hectares and have the capacity to accommodate approximately 400,000 families (IPAM, 2012). The establishment of settlements in the Amazon region has been growing significantly since 2005.

In 2010, in the western region of the state of Para, there were 216 recognised

FIGURE 1 Comparison of Deforestation Trends in the Legal Amazon and in Agrarian Reform Settlements



Source: Authors' elaboration.

settlement projects, of which 212 were federal projects and four were state projects. These settlements are coordinated by the office of the Instituto Nacional de Colonização e Reforma Agrária (INCRA—National Institute for Colonisation and Agrarian Reform) in Santarém, its three advanced units (Altamira, Itaituba and Monte Alegre) and the Instituto de Terras do Para (ITERPA—Land Institute of the State of Para); they have the capacity to accommodate up to 108,300 families, occupying a total area of 97,800 km² of forest and floodplain areas.

A study conducted by the Instituto de Pesquisa Ambiental da Amazônia (IPAM—Amazon Environmental Research Institute), in partnership with INCRA, compared deforestation data from PRODES² (INPE, 2012) with data from 1868 settlements in the Amazon biome. IPAM considered these settlements as one large group, without taking into account internal boundaries, since such data were not available. By 2012, 36 per cent of the settlement area (12.8 million hectares) had been deforested.

However, most of these areas were already deforested before being included in agrarian reform projects. On average, the settlements created since 1997 had already had 38 per cent of their area deforested (IPAM, 2012). The study also showed that

the declining deforestation trend observed in the region as a whole is also observed in the agrarian reform settlements (Figure 1).

The challenge of a productive transition towards a low carbon economy

In general, settlements in the Amazon are located in areas abundant in forest resources, and as such, are constantly subject to dispute over the timber and non-timber resources they contain. For the forestry sector, logging in the settlements is an easy way to obtain timber legally, considering that command and control actions have been restricting the supply of illegal timber to the local market, and that forest concession policies have been advancing very slowly in the region.

In the context of the region's sustainable development, a current major challenge is to consolidate a policy of sustainable settlements. To this end, strategies need to be adopted to fight the drivers of deforestation and forest degradation by implementing a new productive model that reduces pressure on the remaining forest and increases regional economic potential.

There are currently two key drivers of the deforestation process in settlements in the Amazon: uncontrolled logging and extensive agricultural production.

The threat of misuse and depletion of forest resources within settlements, caused by uncontrolled logging (which is illegal and has a high environmental impact), is present either prior to the settling of families, when the areas are vulnerable to be looted by illegal loggers, or even after settlement. Due to poor infrastructure, precarious facilities and a lack of planning within settlements, families are left without basic living conditions and resort to selling or exchanging their forested lands for road developments and other benefits, or even abandoning the area completely.

In turn, agricultural practices that dominate the settlements are still marked by the low productivity of the extensive raising of livestock and a slash-and-burn system of agricultural expansion. Yet, in such 'primitive' production systems that still prevail in much of the Amazon, the forest plays the role of a 'farm subsidy', providing nutrients and acting as a control mechanism against crop pests, diseases and weeds.

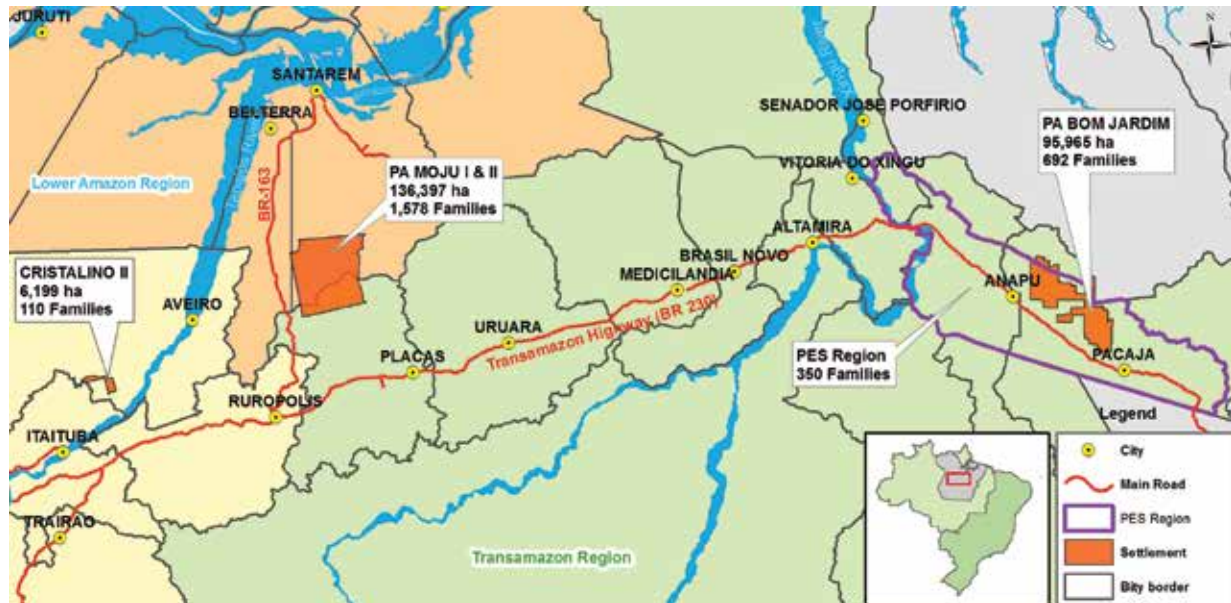
Therefore, encouraging forest management and intensifying agricultural production in areas that have already been cleared and are abandoned, or areas under extensive production systems, are strategic actions to tackle forest degradation and deforestation in Amazon settlements.

The project 'Sustainable settlements in the Amazon: the challenge of transitioning family farming into a low carbon economy', the result of a partnership between IPAM, Live Produce and Preserve Foundation (FVPP) and INCRA, aims to promote a transition of production systems of agrarian reform settlements in the Amazon. The goal is to turn the predominant production systems currently characterized by high carbon emissions and low profitability into low emission systems that are also profitable for local farmers. The aim is to implement systems that maintain the carbon stocks of forest cover within the settlements, to increase the profitability of areas already cleared and to promote the improvement of the environmental quality of the region.

The project, which receives financial support from the Amazon Fund, operates in three agrarian reform settlement

MAP 1

Settlement Projects in the State of Pará



Source: Authors' elaboration.

projects located in western Pará (PA Bom Jardim, PA Moju and PA Cristalino II), assisting approximately 2700 families in an area of 230,000 hectares (Map 1).

It is scheduled to run until 2017. To meet the project's objectives, activities focus on the following areas: environmental and land regulation; strengthening of shared management (co-management); transition of production systems; processing and marketing of forest products; payment for environmental services (avoided deforestation); sustainability indicators and monitoring; and dissemination of project activities (communications).

The legalisation of the environmental situation contemplated by the land regulation activities, coupled with the strengthening of the capacity of settlers to manage their own property, means and resources, is a way to promote their empowerment, so that when the project comes to an end its results can be replicated and improved over time. This is a starting point for changing the implementation models of agrarian reform

settlements in the Amazon and their connection with deforestation.



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2. Project for Satellite Monitoring of Deforestation in the Legal Amazon, which has been producing annual deforestation rates since 1988.

Marketing of Agroextractive Products: Problems and Solutions

by Donald Sawyer¹

The following analysis and recommendations are based on the experience of the Programme of Small Ecosocial Projects (Programa de Pequenos Projetos Ecosociais PPP-ECOS) with small grants to local communities over the past 20 years for projects for the sustainable use of biodiversity in the Cerrado, Caatinga and Amazon regions of Brazil.²

The article identifies the main problems and proposes practical solutions, to support the appropriate design of new initiatives to promote the marketing of agroextractive products in frontier regions in the tropics. Agroextractive activities include wild harvesting, non-timber forest products, forest management, agroforestry systems and small-scale agroindustries.

Under the PPP-ECOS the most successful experiments so far have been with native fruits, dried flowers, *babassu* palmnuts, *baru* nuts, medicinal herbs, spices, handicrafts, honey from native and exotic bees, fish farming and the breeding of wild animals (ISPN, 2005). Other possible alternatives that seem promising include fishing, ornamental plants and small wooden objects, among others.

Producers include small farmers, settlers in agrarian reform projects, Maroons (members of former slave communities) and indigenous peoples.

Using a sustainable livelihoods approach, the programme seeks to relieve poverty and improve quality of life through the use of the environment for social inclusion. At the same time, alternatives are sought to the destruction caused by deforestation, ranching, monoculture, erosion and pollution. Maintenance of ecosystem functions related to water, biodiversity and climate, combined with economic viability and social justice, requires reaching a scale far beyond families and communities, although they are the immediate target. Marketing of agroextractive products is generally a seasonal and complementary activity that is insufficient in and of itself

but which makes it possible for people to stay in the countryside rather than migrate to cities that opens the way for cattle ranches and monoculture. Only peasant macro-landscapes, with people and production, can produce development that is economically, socially and environmentally sustainable at the system level. To reach that objective, it is necessary to influence public policy, formal and informal educational systems and the practices of producers, intermediaries and consumers.

Nearly all the experiences supported so far continue to generate positive results. No alternative has been discarded. On the other hand, none of the experiences have gained sufficient scale to generate positive impacts on a permanent basis. A possible exception would be the production of frozen fruit pulp, although the existing factories in Minas Gerais, Maranhão and Mato Grosso still rely on subsidies which would not be replicable elsewhere on a larger scale.

Problems

Many lessons have been learned from practical experience. Useful knowledge is generated not only by researchers but also by communities themselves, the support organisations and the government agencies involved. The main problems encountered in regards to practical experience so far relate to:

- *The lack of scale, quality and regularity:* there are many markets, but not enough products. While some buyers want containers delivered every month, communities can hardly produce enough for local supermarkets. Due to natural variations and social contingencies, it often becomes difficult to comply with contracts.
- *Small scale of social and environmental impacts:* domestic production for self-consumption in local communities contributes to food

security and nutrition, but the impacts are very localised.

- *Amateurism in production and marketing:* processing of products and interaction with markets beyond the community level demand professionalism, not just strong social or political leadership.
- *The lack of entrepreneurship:* few smallholders and their leaders have business acumen. At the same time, social movements are characterised by goals and processes that are hardly compatible with the agile negotiations required by the market.
- *Investment requirements:* the formalisation of production and marketing requires investment in equipment and qualified personnel, which also increases the cost of production. The scale that is possible with products that are widespread rather than densely concentrated rarely justifies large investments.
- *Unfavourable government regulations:* health standards, environmental, tax and professional regulations favour conventional industrial and agricultural production and marketing making the formalisation of family production difficult or impossible (Simone, Sawyer and Almeida, 2011).

Despite good intentions, international cooperation projects, as well as consultants with strong social and environmental commitments, the development of databases and preparations of business plans have not solved these problems.

Possible solutions

The practical experience of the PPP-ECOS over the years suggests that the problems identified above could be solved by adopting or adapting the following approaches:

- *Support through selling products and services:* the growing shortage of

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New initiatives to promote the commercialisation of agroextractive products should have a strong focus on the real needs of peasants and artisans, ecosystems and society as a whole.

donor resources and the difficulty of spending and accounting for government funds according to existing rules and regulations mean that community organisations will have to sustain themselves, at least partially, by selling products and services and participating in markets, even when they are non-profit.

- *Need for subsidies and incentives:* some subsidies and incentives, be they direct or indirect, explicit or not, from government or donors, are required for agroextractive enterprises, especially in the investment phase, and are justified because of environmental multifunctionality that generates benefits at a macro scale.
- *Appropriate level of processing:* since final processing for consumers in accordance with government regulations often requires operations at a large scale, local initiatives should seek an intermediate level of processing—one that is feasible given the availability of infrastructure as well as human and financial resources.
- *Prioritising nearby markets:* the markets to be targeted should start at the local level and proceed to regional, national and international levels, in that order. Entrance to distant markets, when feasible, requires improvement in quality and provides greater visibility.
- *Search for opportunities in normal trade:* apart from fair or solidary trade, which can occupy certain significant niches for small producers, local communities should seek inclusion in increasingly larger segments of conventional markets, so as to achieve sufficient scale.
- *Training and guidance:* buyers of agroextractive products should provide feedback for producers regarding appropriate procedures, consumers' perceptions and regulators' requirements.
- *Diversification and specialisation:* each community should seek to combine a set of three to five complementary yet diverse products, without excessive variety, but also without accumulating risks.
- *Producer organisation:* the social organisation of producers is essential for greater bargaining power in negotiating with buyers and social control to avoid abuses by uninformed or irresponsible individual producers. However, perfect unity should not be expected, since communities always have internal divisions. Associations should not be imposed.
- *Collective bargaining with external support:* local social organisations should seek external support from regional or national organisations that have greater bargaining power with buyers.
- *Recognition of mutual benefits:* buyers should recognise the competitive advantages of offering agroextractive products to consumers, without giving the impression that they are engaging in philanthropy.
- *Organisation of buyers:* the organisation of buyers of agroextractive products, adhering to ethical principles and sustainability, is important to ensure social control within the business sector.
- *Exemptions for handmade products:* original peasant and artisan products on a small scale, should be exempt from regulations that apply to production and marketing on a large scale.

Conclusions

New initiatives to promote the commercialisation of agroextractive products should have a strong focus on the real needs of peasants and artisans, ecosystems and society as a whole. With appropriate policies, agroextractive production can meet those needs at low costs. The local communities require cooperation and support, without unrealistic impositions that could defeat their purpose.

■

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1. Instituto Sociedade, População e Natureza (ISPN) and retired Professor, Center for Sustainable Development, University of Brasília. The author is grateful to colleagues for their inputs and comments.

2. This Programme, originally the Brazilian version of the Small Grants Programme of the Global Environment Facility and UNDP, also receives or received support from the European Commission and the Brazilian Banco Nacional de Desenvolvimento Econômico e Social for the arc of deforestation in the Amazon. None of the donors are responsible for the views expressed herein.

Modelling of Deforestation Scenarios for the Northwest of Mato Grosso

by Britaldo Soares-Filho¹ and Raoni Rajão²

The northwestern region of Mato Grosso, located 740 km from Cuiabá, takes up 112,000 km² and encompasses the municipalities of Aripuanã, Colniza, Cotriguaçu, Juruena, Castanheira, Rondolândia and parts of Brasnorte and Juaraá. The city of Juína is the region's main economic hub. This region has attracted attention for two contrasting aspects.

First, it is the final border of the Amazon rainforest in the state of Mato Grosso, with rainforest covering 87 per cent of its area.

Of this total, 93,000 km² is covered by dense and open rainforests (MME, 1973), making the region particularly relevant both for conservation purposes and for the economic use of its significant forest resources. To this end, the region has been the target of efforts to create conservation units and consolidate its vast network of indigenous reserves, occupied by diverse peoples and cultures and comprising 34 per cent of the region.

Second, despite its scarce population of about 100,000 inhabitants, the region is notable as one of the main areas of deforestation and associated conflicts, such as illegal logging and rural murders, which confer on Colniza the sad title of the Brazilian city with most murders per capita.

The municipality was also negatively highlighted recently as one of the main areas of deforestation in the Amazon (INPE, 2008). This fact is well illustrated by the analysis of the spatial dynamics of deforestation in Mato Grosso, which shows the shifting of the deforestation frontier towards this region in recent years.

This article presents the main results of a study conducted in the context of a United Nations Development Programme (UNDP) and Global Environmental Fund (GEF) programme for conservation and sustainable use of biodiversity in forests in the northwest of Mato Grosso.

In particular, this article presents an analysis of the recent dynamics of deforestation in the northwest, and calculates modelled deforestation trajectories in the region until 2035 under trend, business-as-usual and governance scenarios.

Deforestation scenarios

A first step in the development of deforestation trajectory modelling is an analysis of its historical trend. To this end, data from the PRODES³ time series of satellite monitoring (INPE, 2008) were cross-referenced with data from the Secretary of the Environment of the State of Mato Grosso (SEMA).

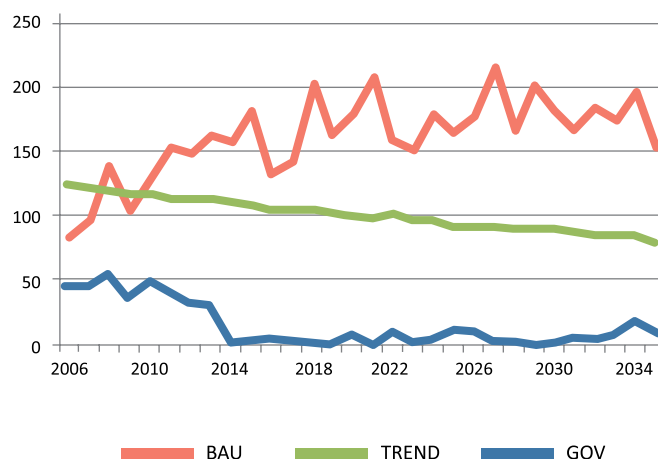
Accumulated deforestation up to 2005 represents a total of 13 per cent of the northwest region's 112,000 km²—or 21 per cent if the protected areas that comprise 40 per cent of the region are subtracted from this total. Both series

highlight an acceleration of deforestation at the beginning of this decade, reaching a maximum of 300,000 hectares per year in 2004/2005, according to PRODES, or 180,000 hectares per year according to SEMA (INPE, 2008). However, in 2005/2006, there was a sharp drop in the deforestation rate in northwestern Mato Grosso. The causes of this decline are still under discussion but are generally recognised as a combination of two factors:

- a drop in soybean production due to the appreciation of the Brazilian Real and a reduction in the international market price for soybeans, which had an impact on agricultural investments, including not only agriculture but also livestock. This resulted in a decrease in the opening up of new areas. However, this trend was reversed after 2007; and

FIGURE 1

Deforestation Trajectories (thousand of hectares) in Northwest Mato Grosso in Various Scenarios (2006-2035)



Source: Authors' elaboration.



The region [Mato Grosso] has been the target of efforts to create conservation units and consolidate its vast network of indigenous reserves, occupied by diverse peoples and cultures and comprising 34 per cent of the region.

- the increased fight against deforestation and illegal logging by the State, with the launch of several field campaigns in conflict areas and police operations against corruption networks (e.g. Operation Curupira).

In terms of possible future deforestation trends, three scenarios were modeled, namely: a) trend (TREND); b) business-as-usual (BAU); and c) governance (GOV).

The TREND scenario is known as such because it employs the historical rate, estimated by SEMA for the year 2005/2006, to project future deforestation in the next 30 years—i.e. around 125,000 hectares per year or equivalent to the net rate of 1.33 per cent per year.

This scenario can be regarded as conservative, given the more recent trend of accelerating deforestation. The TREND scenario was calibrated for the northwest region using a series of SEMA deforestation maps with a set of variables used to represent the spatial determinants of deforestation—for example: altitude, distance to roads, rivers, urban patches and previous deforestation, the historical effect of protected areas and classes of licenses, slopes and soil conditions.

The methodology used is described in Soares-Filho *et al.* (2006). In short, it consists, as a first step, of calibrating the effect of these determinants on the spatial allocation of deforestation, using the weight of evidence method. Then, as a second step, the architecture of the simulation model was adjusted to the resolution of one hectare and

set up to reproduce the spatial pattern resulting from the arrangement of the different actors—large farmers and small settlers—and distributing the historical deforestation rate according to their occupation of the landscape and adjusting the transition functions to form patches with sizes ranging, on average, from 10 hectares to over 100 hectares.

One can thus say that deforestation in the region is a combined process of small and large farmers, with the former occupying 55 per cent and the latter 45 per cent of the area already cleared outside the protected areas. As a result, while small settlers deforest areas smaller than 10 hectares per year, large farmers can deforest areas of more than 100 hectares in a single year.

Deforestation trajectories under the BAU and GOV scenarios were defined based on the modelling architecture described in Soares-Filho *et al.* (2008), responding to the main determinants of deforestation—i.e., on the one hand, the expansion of livestock and agriculture, migratory movements and paving of regional highways and, on the other hand, the creation and implementation of protected areas and compliance with the forest code (Figure 1).

Both BAU and GOV scenarios employ the same population growth scenario. Regarding the expansion of livestock farming, the BAU scenario estimates strong investments in infrastructure as provided by the Growth Acceleration Programme (PAC) and the MT+20 Plan⁴ (SEPLAM-MT, 2005), with the paving of the MT 170, 208 and 206⁵ and other federal highways surrounding the area. The state's herd, currently at 1.8 million cattle, is growing at an average rate of 8.7 per cent per year, and is expected to reach 15 million cattle in 2035. Furthermore, in the GOV scenario there would be an expansion of the protected areas in the region from the current 40 per cent to 60 per cent.

Finally, the GOV scenario assumes an 18 per cent per year increase of the effectiveness of the municipal systems of licensing and environmental control (SIMLAM), while the rate of illegal deforestation in the BAU scenario is kept constant at the 2005 level. Both the deforestation simulation model and all the others presented here were created with the Dinamica

EGO computing platform (Rodrigues *et al.*, 2007; Soares-Filho *et al.* 2013).

Based on the results of the model, very different trajectories for these three scenarios can be observed. In the BAU scenario there would be an expansion of agricultural areas that presently occupy about 30,000 hectares (300 km²) in the region to more than one million hectares (10,000 km²), with an average annual growth of 14.4 per cent, essentially leading to the occupation of the entire area fit for mechanised agriculture in the region.

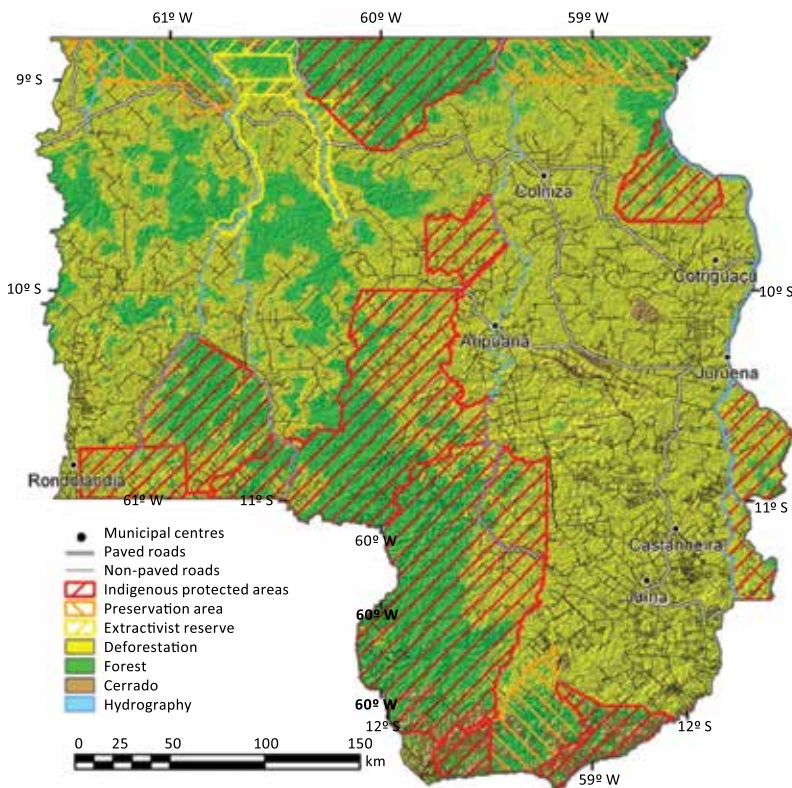
On the other hand, in the GOV scenario the cattle herd would expand by 2.1 per cent per year, resulting in 3.1 million cattle by 2035. The agricultural areas would reach 85,000 hectares (850 km²) at an expansion rate of 4.4 per cent per year. Thus, in the TREND scenario there is a slight decrease in annual gross deforestation due to the fixed annual net rate. In the GOV scenario, deforestation drops to almost zero at the end of 2013. In contrast, in the BAU scenario deforestation increases and may even exceed 200,000 hectares (2,000 km²) per year.

This figure was surpassed in the recent past, when it reached 300,000 hectares (3,000 km²) annually between 2004 and 2005, according to data from PRODES (INPE, 2008). While the GOV scenario forecasts a further increase of around 500,000 hectares (5,000 km²) of deforestation, the increase will be four million hectares (40,000 km²) in the trend scenario and 5,800,000 hectares (58,000 km²) in the BAU scenario. The two latter scenarios involve, respectively, 33 per cent and 52 per cent reductions from the current 9,300,00 hectares (93,000 km²) of the region's forests.

The prevalence of either the trend scenario or the BAU scenario for the region will have devastating consequences, with almost complete extermination of forests outside protected areas (Map 1). Yet the trend scenario was considered conservative, since it uses the 2005 deforestation rate, which is much lower than that of more recent years. If the BAU scenario prevails—which has in fact been happening in the recent past—protected areas will substantially lose their forest cover, especially the Escondido, Jaruíra, Arara do Rio Branco, Serra Morena and Sete de

MAP 1

Extent of Deforestation in Northwest Mato Grosso in 2035 Under the BAU Scenario



Source: Author's elaboration.

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Deforestation in the region is a combined process of small and large farmers.

While small settlers deforest areas smaller than 10 hectares per year, large farmers can deforest areas of more than 100 hectares in a single year.

Setembro indigenous lands, which are the most threatened. So, unless measures are taken to establish effective governance in the region, there will be severe losses of environmental resources and services. ■

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2. Centre of Remote Sensing, Federal University of Minas Gerais, Brazil.

3. PRODES (Projeto de Monitoramento do Desmatamento na Amazônia Legal) is a satellite monitoring system intended to measure the deforestation in the Amazon, developed by INPE (Instituto Nacional de Pesquisas Espaciais – National Spatial Research Institute); this project has been ongoing for around 25 years.

4. The MT+20 is a Development Plan for the Mato Grosso State (spanning 20 years, 2006 – 2026).

5. The MT 170, 208 and 206 are the names of different expressways in Brazil.

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It is always a great challenge to assure opportunities to the most vulnerable populations living in areas characterised by a great expansion of agricultural commodities production and cattle ranching, while respecting people's livelihoods and protecting the environment.

Carlos Ferreira de Abreu Castro

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This issue contributes to the growing literature that aims at analysing human development while also preserving the forests in the Global South.

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The existence of economically viable alternatives to deforestation—along with an improved ability to command and control—changes the risk-reward relationship of environmental crimes and contributes to the establishment of sustainable practices.

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