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**Feasibility and legitimacy of land use regulatory instruments in
three agrarian reform settlements in northwest Mato Grosso,
Brazil: the influence and role of integrated conservation and
development projects**

por

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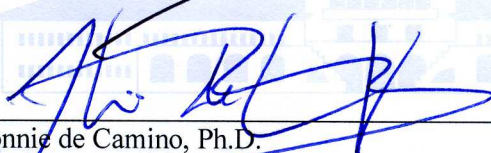
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This thesis is organized as follows:

- I. General introduction
- II. Academic article 1: Feasibility and legitimacy of land use regulatory instruments in three agrarian reform settlements in northwest Mato Grosso, Brazil: the influence and role of integrated conservation and development projects
- III. Academic article 2: Pilot projects and agroenvironmental measures in northwest Mato Grosso, Brazil: impacts and lessons for REDD+ policy "mixes"

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RESUMEN

Este estudio de caso, que se encuentra dentro de la Amazonia brasileña "Arco de la Deforestación", examina las perspectivas de los agricultores pequeños y los impactos institucionales de los proyectos de conservación y desarrollo integrado (ICDP en inglés) promovidos para la conservación de los bosques en el noroeste de Mato Grosso (NW MT). El estudio evalúa las variables institucionales en las explotaciones familiares en los asentamientos de la reforma agraria, en lotes de entre 50 a 100 hectáreas. La región es una frontera forestal comparable en tamaño a Panamá, y presenta las tasas más altas de deforestación en la Amazonía, a pesar de haber experimentado una amplia gama de iniciativas destinadas a detener la deforestación y la pérdida de biodiversidad en los últimos 15 años.

El estudio se basa en una muestra de los agricultores en tres municipios (Juína, Juruena, Cotriguaçu) con mayor o menor exposición a los PICD entre 1995 y 2010. Se realizó un análisis ex post de los impactos ICDP sobre la viabilidad y legitimidad percibida de la regulación ambiental, evaluado a través de encuestas de campo, entrevistas y un taller de grupo. En particular, se evaluó la tenencia de la tierra, el cumplimiento de la regulación ambiental, puntos de vista sobre el Código Forestal Brasileño nacional, y la percepción de las condiciones socio-ecológicas locales.

Los resultados indicaron que el Código Forestal Brasileño en abstracto tenía menos influencia que otros criterios en las decisiones que hicieron los colonos sobre el uso de la tierra. Por el contrario, los ICDPs aumentó la relevancia y la legitimidad de la inscripción de licencia ambiental y los instrumentos administrados por el estado de Mato Grosso. La viabilidad social específico de la regulación ambiental se inserta dentro de los arreglos institucionales locales que incorpora la preocupación por la seguridad del sustento, apoyo a la infraestructura de cooperación y la organización social, y la atención a la reducción de los costos de transacción de agricultores.

Los resultados sugieren que el apoyo a un conjunto integrado de instrumentos e intervenciones en escalas temporales prolongadas y en escalas espaciales más finas pueden ser rutas de éxito para la mejora institucional. Estos logros también pueden proporcionar una base para la aplicación efectiva de otros instrumentos de política orientadas a la conservación como PES o REDD +.

SUMMARY

This case study, located within the Brazilian Amazon “Arc of Deforestation” examines small farmer perspectives and the institutional impacts of Integrated Development and Conservation projects (ICDPs) promoted for forest conservation in Northwest Mato Grosso (NW MT). The study evaluates institutional variables on family farms in agrarian reform settlements, on lots of between 50-100 hectares. The region is a forest frontier comparable in size to Panama, and exhibits the highest deforestation rates in the Amazon, despite having experienced a broad range of initiatives aimed at halting deforestation and biodiversity loss over the past 15 years.

The study is based on a sample of farmers in three municipalities (Juína, Juruena, Cotriguaçu) with varying exposure to ICDPs between 1995 and 2010. We performed an ex post analysis of ICDP impacts on the perceived feasibility and fairness of land use regulation, assessed through on farm surveys, interviews and a group workshop. In particular, we assessed land tenure, compliance with land use regulation, views on the national Brazilian Forest Code, and perceptions of local social ecological conditions.

Results indicated that the Brazilian Forest Code in abstract had less influence on settler land use decision making than did other criteria. In contrast, ICDPs increased the relevance and legitimacy of land use registration and licensing instruments administered by the state of Mato Grosso. The specific social viability of these latter regulatory instruments was embedded within local institutional arrangements that incorporated concern for livelihood security, support for cooperative infrastructure and social organization, and attention towards reduced farmer transaction costs.

The results suggest that support for an integrated set of instruments and interventions over longer temporal scales and at finer spatial scales can be successful routes for institutional improvements. These achievements may also provide a foundation for the effective application of other conservation-oriented policy instruments such as PES or REDD+.

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LISTA DE UNIDADES, ABREVIATURAS Y SIGLAS

ADERJUR	Associação de Desenvolvimento Rural de Juruena (Juruena Rural Development Association)
AFS	Agroforestry systems
AJOPAM	Juina Rural Association for Mutual Assistance Organization
AMCA	Associação de Mulheres Cantinho da Amazônia (Corner of the Amazon Women's Association)
APP	Area de Proteção Permanente (Riparian Protected Area)
BFC	Brazilian Forest Code
CAR	Cadastro Ambiental Rural (Rural Environmental Registry)
CCU	Contrato de Concessão do Uso (Usufruct Contract)
CONAB	Companhia Nacional de Abastecimento (National Food Company)
COOPAVAM	Cooperativa dos Agricultores do Vale do Amanhecer (Sunrise Valley Agricultural Cooperative)
GEF	Global Environment Facility
IBAMA	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (Brazilian Institute of the Environment and Renewable Natural Resources)
ICDP	Integrated Conservation and Development Project/Program
ICV	Instituto Centro de Vida (an NGO)
INCRA	Instituto Nacional de Colonização e Reforma Agraria (National Institute for Colonization and Agrarian Reform)
LAU	Licença Ambiental Única (Unitary Environmental Licence)
MMA	Ministério do Meio Ambiente (Ministry of the Environment)
NTFP	Non timber forest products
NW MT	Northwest Mato Grosso
PA I	Projeto de Assentamento Iracema
PA NC	Projeto de Assentamento Nova Cotriguaçu
PA VAM	Projeto de Assentamento Vale do Amanhecer
PACA	Tree Density Enhancement Consortium Project
PD/A	Type A Demonstration Projects
PPG7	Pilot Program for the Protection of Tropical Forests in Brazil

PRONAF	Programa Nacional de Fortalecimento da Agricultura Familiar (National Family Farm Strengthening Program)
RL (LR)	Reserva Legal (Legal Forest Reserve)
SEMA-MT	Secretaria de Estado do Meio Ambiente, Governo do Mato Grosso (Secretariat for the Environment, Mato Grosso)
TD	Título Definitivo (Definitive Title)
TNC	The Nature Conservancy
UNDP	United Nations Development Program

1 INTRODUCTION: BACKGROUND AND JUSTIFICATION FOR STUDY

This case study focuses on environmental governance and the role of Integrated Conservation and Development Projects (ICDPs) in agrarian reform settlements in the Brazilian Amazon. The specific region under consideration is northwest Mato Grosso (NW MT), a forest frontier landscape. While the case study evaluates the social aspects of forest conservation, environmental policy, and community and individual social interfaces with the state, these issues are embedded within larger ecological concerns.

The Amazon is the world's largest tropical rainforest and is critical for global biogeochemical maintenance, regional hydrological cycles, and biodiversity (Nepstad, D. et al. 2008, Mittermeier, R.A. et al. 2003). Extensive slash and burn practices (to be distinguished from the traditional agricultural practice of small scale swiddens and agroforestry) have transformed large areas of the Amazon basin into open pasture. Land use change and increased human-induced and natural fires threaten the ecological stability of the biome, affect regional hydrological cycles, species diversity, and ecological resilience. (Louman et al. 2010). Climate change science states that there is a high likelihood that regional temperatures may rise by 5 or 6 degrees centigrade by 2100 (Margrin et al. 2007). Combined with local human-induced ecological effects, there is a risk that much of the Amazon could experience ecological change – much of the region would be transformed into savannah. There is an urgent need to conserve the landscape's ecological integrity and resilience.

In the wake of the 1992 Rio Conferences, a series of Integrated Conservation and Development Projects (ICDPs) were implemented in NW MT¹. These ICDPs focused on local scale interventions involving technical assistance and extension for agroforestry, the consolidation of protected areas, and strengthening the institutional reach of the Mato Grosso state environmental secretariat. At the same time, NW MT experienced policies, infrastructure and political economic conditions adverse to these interventions (May et al. 2012). President Lula made a priority of reducing the rate of deforestation in the Amazon. But while the overall rate of deforestation in the Brazilian Amazon has dropped relative to its exceptionally high 2004/5 baseline (Cf. “Cattle agreement” with Marfrig, JBS, Minerva slaughterhouses), NW MT has the highest rate of deforestation in the biome (Vivan 2011).

Small farmers are one type of social actor in this heterogeneous frontier landscape (Pacheco et al 2011). The settlements that this case study considers are federal managed territories under the authority of the Federal Institute for Colonization and Agrarian Reform (INCRA)². INCRA settlements experience high rates of land tenure irregularity, in part due to the federal government’s historical inability to monitor on the ground conditions.

This case study identifies how policy instruments become tangible frameworks for collective action on agricultural frontiers (Cf. Ostrom 2004, Cf. Ostrom 1999). The study considers community and individual interface with the state (Cf. Long 2001), social organization / common pool resource management, and infrastructure.

¹ These ICDPs included: One, Pilot Program for the Protection of Tropical Forests in Brazil (PPG7), especially Type A Demonstration Projects (PD/A), with expected impacts in Juína. This project was implemented between 1995 and 2006 (Pinzón Rueda et al., 2006), mostly through the PACA Project (Tree Density Enhancement Consortium Project, 1996-1998), run by AJOPAM (Juinense Rural Association Organized for Mutual Assistance); Two, "Conservation and Sustainable Use of Biodiversity in the Frontier Forests of Northwestern Mato Grosso", with expected impacts concentrated in Juruena, Juína and Cotriguaçu. The project was funded by the Global Environmental Facility (GEF) and the Secretariat of Environment of Mato Grosso (SEMA-MT), and implemented by the United Nations Development Programme (UNDP-Brazil) between 2001 and 2010 (Vivan et al., 2008); Three, Proambiente, with potential impacts in Juína, PA Iracema. This was a government program linked to the Ministry of Environment (MMA), which operated between 2002 and 2004, having as one of its target areas a Juína pilot project (Proambiente, 2010; Paula, 2005).

² while Mato Grosso state administered settlements also exist, these will not be the focus of this study

Settlements in NW MT are located hundreds if not thousands of kilometers from the physical administration of formal state authority. In this context, ICDPs, unlike the state, could implement a variety of agro-environmental measures at the same time integrating environmental regulatory compliance. In this light, the case study analyzes the effects of ICDPs on local institutional arrangements and the feasibility and legitimacy of environmental governance in settlements.

Forest conservation and management is largely a political economic and institutional question and involves local community relations with the state (Cf. Dove 1995). By institutions, this case study refers to systems of rules— whether formal state rules or informal community-based rules. Understanding local institutional arrangements – how they function, how they interrelate with state-level rules systems, how outside influences affect their feasibility and authority – is critical for to designing, implementing and adapting effective forest and biodiversity conservation. Studies are needed that can indicate how to structure policy interventions in situations of governance failure.

Policy instruments need to be both practically feasible and socially legitimate in order to attain traction in a local social context. Settlements in NW MT have limited to no contact with federal and state government agencies and land tenure is insecure. Such institutional insecurity also holds true for smallholders outside of INCRA settlements. Institutional conditions are particularly precarious for smallholders, not just settlers, and as such ICDPs may be a necessary policy intervention.

The Brazilian Forest Code rule stipulates that privately owned land in the Amazonian biome must conserve 80% of the forest as a legal reserve. In practice, however, there has been very limited compliance with this rule. In agrarian reform settlements, for example, most settlers have deforested their lots well in excess of this limit (Alencar et al. 2013). In this context, Mato Grosso has passed a REDD+ law in the hope of attracting carbon offsets financing. Mato Grosso will keep a centralized repository of REDD+ projects that could involve direct conservation payments or PES to incentivize forest conservation (ICV). But while direct payments could significantly reduce deforestation in theory, the limiting factors are precisely the institutional prerequisites and conditions for such a payments system (Börner et al 2009). Indeed, implementing and governing REDD+ is primarily an institutional problem (Corbera and Schroeder 2010). This is especially an issue for smallholders.

In Mato Grosso, there are environmental regulatory instruments already in existence that seek to bring land owners into compliance with the forest code. The CAR and the LAU are designed to monitor land use in a centralized GIS system and certify sustainable land use, respectively. But settler participate in the CAR and the LAU is limited by the transaction

costs processing geotechnical documents. LAU applications for cooperatives in Juruena dn Juína have taken several years to obtain.³

There are several institutional challenges in which ICDPs might potentially play a role at the level of the locality:

First, the issue of transaction costs, mentioned above, applies to farmers as much as it does to the state agencies. Small farm settlers do not have the resources to dedicate days on end to travel to municipal and regional capitals, contract GIS technicians to make land use maps and to enter into electronic communication with state agencies. ICDPs may help circumvent these transaction costs through cooperative approaches.

Second, implementing a state-administered payments system in settlements would require documentation and coordination with INCRA. But while land tenure situation in settlements in Mato Grosso has improved, there is still a great deal of irregularity. A state-administered payments system linked to INCRA-authorized land tenure would exclude many families who are currently living on the land. ICDPs may be able to overcome institutional bottlenecks, by seeking equity and cooperation in settlements where the possession of formal land tenure documents is not universal.

Third, REDD+ models forest conservation on the basis of deferring land owner opportunity costs (Alpizar). The model is to compensate landowners for not doing something. However, agrarian reform settlements in this case study are already over 50% deforested, such that there is a need to restore and reforest the landscape in addition to conserving the remaining forest. In settlements, incentivizing restoration and reforestation may be as important if not more important than conservation.

Fourth, ICDPs may operate as a governance conduit between the state and settlers, facilitating clear communication.

Fifth, controlling deforestation through the Brazilian forest code does not engage with the issue of the regional cattle economy, commodity markets and livelihood security. The region is dominated by cattle and bank financing for cattle (May et al. 2011). While relatively secure, settler livelihoods from cattle are not optimal. But it is difficult to bring alternative agroforestry and non-timber forest products to scale. In fact, settlers in a CIFOR-sponsored study perceived that they would prefer to receive technical assistance around alternative farm production in lieu of direct conservation payments. (Cromberg in Angelsen et al 2013). However, alternative commodity chains may require infrastructure in addition to technical training: both material infrastructure –equipment, buildings, means of transport – and institutional infrastructure – land tenure, environmental licensing/certification, credit

³ Internationally funding for REDD+ could strengthen these state level instruments (especially the LAU!!) through investing in transaction costs at the state agency level.

financing, market development. If REDD+ were to include strengthening reforestation and conservation through alternative agroforestry and non-timber forest product chains, ICDPs may be necessary to coordinate multi-faceted intervention in support of alternative land use.

Sixth, integrating land use planning with livelihood infrastructure may be the most effective way to strengthen environmental governance in this particular type of social environment. Settlers in NW MT tend not to have a group identity as they have migrated to the region as individual families from distinct parts of Brazil. Some settlements contain viable community associations, but others experience social conflicts. ICDPs may have a role in making cooperative or common pool resource management possible, by integrating social organization with support for cooperative infrastructure.

Finally, there is the question of the social legitimacy and fairness of institutions and policy instruments (Corbera 2007). A policy that is not deemed fair by the population can only be made tractable through state enforcement, which risks overlooking the question of livelihoods.

1.1 Specific relevance of case study

The interest of this case study is to identify current environmental institutional conditions in settlements, the perceptions of settlers on factors influencing land use decisions, and the influence of ICDPs on environmental governance. The case study attempts to locate where, how, when and why ICDPs have made an impact on institutional arrangements, on the basis of institutional and socio-ecological system indicators.

This case study was conducted in collaboration with POLICYMIX – a project funded by the European Union to assess the role of economic instruments in the conservation of biodiversity and ecosystem services in seven countries, including Costa Rica and the states of São Paulo and Mato Grosso in Brazil. The project is of interest to POLICYMIX as it attempts to outline the structure, sequencing and synergies of a variety of interventions (Ring et al. 2012). Interventions may be considered to be “micro policy instruments” as they may be arranged in certain ways to enhance the feasibility and legitimacy of larger policy instruments (e.g. legal or economic instruments such as the CAR or PES). The study thus identifies fine grain aspects of the social and institutional aspects of economic instrument planning, per POLICYMIX working papers 5 and 6. It also attempts to locate these institutional concerns within the broader, coarse grain policy context, e.g. settler perceptions of the Brazilian forest code. As such, the study is interested in identifying the policy “mix.” Indeed, “hybrid regimes are more suitable... to deal with the governance challenges derived from the characteristics of ecosystem services (particularly their common good character and their intrinsic complexity).” (Muradian and Rival 2012) ICDPs may be important for the emergence of hybrid institutional arrangements – legal, economic as well as community-based.

The study should be of special interest to state-level planners and international and national organizations and firms that are seeking to finance REDD+ projects in Mato Grosso. The study takes a hard look at institutional conditions on the ground and at the state level, identifying institutional bottlenecks and transaction costs that REDD+ financing could address. REDD+ is not simply modeling the landscape according to a satellite observed land use dynamic, but involves how to engage stakeholders who are actually living in the landscape in question – i.e. the interface between the state and smallholders, who have an extremely limited capacity to participate in or benefit from state environmental planning or international financial arrangements (Cf. Nepstad et al, Long 2001).

Finally, there is a dearth of research on the impacts of ICDPs, and few (if any?) studies have been conducted in Brazil on the specifically institutional effects of ICDPs. There is an urgent need for ex-post evaluation of ICDPs over the past twenty years (Cf. Vivan et al., in press). Without good science on ICDPs impacts and ICDP interaction with local stakeholders, it is difficult to justify their role and importance in equitable and sustainable development and in policy targeting ecosystem services. This study attempts to make a contribution.

2 CENTRAL RESEARCH OBJECTIVE:

To evaluate the impact of ICDPs on institutional arrangements and environmental governance in agrarian reform settlements in northwest Mato Grosso.

3 RESEARCH SUBOBJECTIVES

For the settlements under consideration in NW MT:

1. Determine and differentiate formal land tenure and environmental regulatory rules, rights and responsibilities involving agrarian reform settlements in Mato Grosso, and assess the current state of the application of these rules.
2. Assess settlers' perceptions of factors that affect and influence land use decisions, including the Brazilian forest code.
3. Evaluate if and how ICDPs have impacted or changed environmental governance conditions and institutional arrangements.

4 RESEARCH QUESTIONS AND HYPOTHESES

4.1 Subobjective 1 research questions

1. What is the formal institutional framework for land tenure and environmental regulation in agrarian reform settlements in northwestern Mato Grosso?
2. Who are the administering authorities responsible for legalizing land tenure, registering land use, and obtaining environmental licenses?
3. How do these institutions/instruments function and interact, both in theory and in practice?

4.1.1 Subobjective 1 hypotheses

In agrarian reform settlements, land rights and responsibilities divide the land use and management rights (settlers) from land alienation rights (INCRA). These rights and responsibilities are not accounted for in the rural land use registry and environmental licensing rules and procedures. Settler colonists by themselves do not have the agency to satisfy rule requirements. INCRA (the federal agency for agrarian reform), the federal authority that originally granted usufruct land rights to colonists, has never regularized or granted formal tenure in the majority of the settlements. In many cases, *de facto* land owners in settlements are not the original settlers (from 20+ years ago). INCRA rules specify that land title can only be granted to persons on the original settlement list. Decisions on environmental licensing, with Mato Grosso's state environmental agency (SEMA-MT), cannot occur without documentation of land title. Thus, different government agencies have different land and environmental jurisdictions over the territory, and both the rural land use registry and the environmental licensing instruments does not account for their interaction or coordination.

4.2 Subobjective 2 research questions

4. How much weight do settlers give the Brazilian forest code and other environmental regulations when making land use decisions?
5. According to settlers, how has the local socio-ecological system evolved? What factors have affected land use and how?
6. How have settlers' perceived ICDP influences on land use decisions?

4.2.1 Subobjective 2 hypotheses

Economic factors are the most significant for settler colonists. Cattle ranching is the best land use option, economically speaking, because of fewer maintenance costs and low financial risk. Other land uses, like extractive industries, are difficult without institutional support (local cooperative arrangements, certification). Precarious economic conditions also make it extremely difficult for families/individuals to realize transaction costs in securing land title (if even possible), in registering land use, or in obtaining environmental licenses.

4.3 Subobjective 3 research questions

7. Through ICDP interventions in settlements, what institutional arrangements emerged and how?
8. How many settlers have land tenure, rural environmental registration, environmental licenses, in a sample of agrarian reform settlements? Can any crude correlation be observed between the presence of ICDPs and these numbers?
9. What are perceptions of the legitimacy of environmental regulation and the Brazilian forest code? Do these perceptions vary between settler colonist communities with distinct ICDP experiences?
10. Are common pool resource management arrangements evident in the settler colonist communities? If so, were ICDPs a factor in their formation?

4.3.1 Subobjective 3 hypotheses

Processing rural land use registry documents and environmental licenses with the Mato Grosso's state environmental agency (SEMA-MT) is a long and costly process. It requires the use of technology, namely computer generated maps and land use plans – tools not possessed by settlers. Even if individual settler families could act on their own, transaction costs are large (>3 years to process environmental licenses, logistics/travel to process documents, computer technology costs). ICDPs in the Vale do Amanhecer settlement in the municipality of Juruena lowered transaction costs for a select group of settlers, but only by investing a significant resources in a particular location; the project did not reduce transaction costs for settlements in general.

Agrarian reform settlements that have obtained environmental licenses have managed to do so by pooling communal resources – i.e. forests – into common areas under cooperative management. These communities are also experiencing economic benefits from sustainable extractive industries under cooperative management, such as the harvesting of Brazil nut oil. The potential of economic benefit from forest extractive practices contributed to family/individual decisions to use the forest rather than to convert it to pasture or cropland.

In certain isolated cases, municipal government interventions or ICDPs have helped to expedite procedures and/or provide technical assistance, thus lowering transaction costs. ICDPs, in certain cases, have strengthened participation and social organization around land use.

In agrarian reform settlements, land tenure, rural land use registration and environmental licensing rules are viewed as illegitimate/unfair systems that criminalize farmers without providing practicable options for compliance or resolving the problem. ICDP interventions into these institutional procedures are viewed as necessary/legitimate because the position of settler colonists has not been considered in the design or implementation of the rules, and the process is currently unfair.

Finally, institutional feasibility and legitimacy in agrarian reform settlements was made possible through prioritizing the issue of sustainable livelihoods. Sustainable livelihoods involve both material and institutional aspects – roads, equipment, land, tools and labor, legal and informal rules systems, state-issued identity documents, land tenure documents, geotechnical maps.

Integrating aspects occurs via material and institutional *infrastructure*. ICDPs are well-positioned to invest in making infrastructure a cooperative livelihood opportunity – as both feasible and socially legitimate. And because infrastructure in settlements is a cooperative questions, infrastructure development is linked with social organization.

5 INSTITUTIONAL RESEARCH IN THE CONTEXT OF REDD+ AND ECOSYSTEM SERVICES CONSERVATION AND MANAGEMENT

In the Brazilian Amazon, direct and indirect drivers of land use change are related to public policies for development: large-scale infrastructure, rural credit programs (e.g. PRONAF), commodity financing and markets (e.g. cattle, soy). At the same time, land use change is affected by policies that are not implemented or enforced, and by the lack of coordination between government ministries (May et al. 2011). To date, very little research has assessed systematically the impact of Brazilian National Development Bank (BNDES) financing for cattle on land use change.

Much of the recent literature on land use policy in tropical forest regions revolves around the concept of ecosystem services or REDD+⁴ It should be noted that “Ecosystem services” is a social as well as biophysical concept. Modeling ecosystem services “markets” involve what

⁴ Reduced Emissions from Deforestation and Forest Degradation + forest conservation, sustainable forest management, and the augmentation of forest carbon stocks (UNFCCC)

are man-made economic values as well as the biophysical characteristics of ecosystems (Muradian and Rival 2012).

Some development studies scholars argue that ecosystem services are best approached through hybrid governance regimes, as ecosystem services are inherently complex and of a common goods character (Muradian and Rival 2012). While some authors caution against the aggressive commodification of ecosystem services (Kosoy and Corbera 2010), watershed services programs in Central America have been managed on the basis of social faith in environmental benefits, rather than on any precise quantification of an ecosystem property in a market (Kosoy et al. 2007).

As such, ecosystem services may be a question of state-locality/community relations and hybrid institutional arrangements, perhaps more so than a question of markets. For example, Costa Rica's PES system for compensating landowners for forest conservation does not conform to the definition of a market. It is rather a tax-integrated system managed by a semi-public agency to incentivize public goods. In addition it could be understood as a compensatory scheme to secure the legitimacy of the 1996 Forest Law (Landell-Mills and Porras 2002). Indeed, conservation and management of ecosystem services is largely an institutional and political economic question (Cf. Muradian et al 2010), involving formal state laws, the structure of economic incentives, infrastructure as well as local community organization.

But comparing Costa Rica and the Brazilian Amazon is like comparing Switzerland with the Sudan. While both landscapes are dominated by tropical humid forests, how the state governs (or fails to govern) its geographical territory varies due to geographical scale, infrastructure and the ability of the state to monitor conditions with "boots on the ground" in addition to satellite-based remote sensing. In the Brazilian Amazon, sheer distances, road conditions and technological limitations complicate communication between the federal and state governments and rural communities. Cuiabá, the state capital of Mato Grosso is approximately 1,000 kilometers from NW MT. North of Juína, the roads are unimproved, making them particularly precarious if not impassable in the rainy season. In Costa Rica one can generally travel by land anywhere within the country within a single day. But from Cuiabá it takes upwards of 16 hours to reach the municipality of Juruena and 21 hours to reach the Nova Cotriguaçu settlement in the municipality of Cotriguaçu. Those times with favorable road conditions.

As such, state-locality relations involve the technical aspects of institutions, or transaction costs (Cf. Angelsen et al 2009). This case study takes up the issue of transaction costs, although it does not attempt to quantify them in any systematic manner. Transaction costs refer to the amount of time and financial or other resources that may be required to engage with an institutional mechanism (or lack thereof) (Paavola 2007). Studies interested in the feasibility of REDD+ identify that direct compensation payments could defer land owner

opportunity costs in theory (Börner et al 2009), but given institutional limiting factors (e.g. insecure land tenure) and transaction costs for both the farmer and for state agencies, only large land owners could participate in such schema without public or cooperative assistance (Cf. Japanese research study of Cotriguaçu). Contracting private GIS referenced document processing services, making multiple trips to the municipality and/or Cuiabá, staying abreast of document processing with SEMA-MT or municipal level interlocutors – transaction costs can make institutional procedures unaffordable for smallholders with limited resources. Cooperative or publicly assisted document processing may be a necessary instrument to ensure equity and effectiveness in land use policy in MT (Vatn 2010).

It takes time to institute collective action at the level of the locality. While Ostrom (1990) has argued for the viability of community-based institutions, not all agrarian or forest dwelling communities exhibit well organized resource management practices. Agrarian reform settlements in the Brazilian Amazon are an interesting case as they are not “traditional” agrarian communities composed of migrant populations with a common identity – but individual family beneficiaries of a federal program who arrived in the Amazon from different parts of the country. INCRA settlements differ in this regard from other forest dwelling communities in the Amazon (traditional riverine, rubber tappers, indigenous, caboclo etc.) who have lived in the Amazon for longer periods and who do have organized resource practices (Nepstad et al 2008). INCRA settlers tend to rely on small-scale cattle raising on individual lots which does not require significant social cooperation or common pool arrangements (Cf. Cromberg in Angelsen et al. 2013).

At the same time, the institution of collective action is not simply an indigenous or local community matter. It depends on the particular resource, the infrastructure of the production system, and the feasibility and social legitimacy of the practices and rules employed. Cooperative resource management may not be able to develop autonomously. Indeed, the social interface between the state and the community is relevant to how community-based institutions or cooperatives evolve or emerge (Cf. Long 2001). Ostrom’s social-ecological systems framework (SES) (Ostrom 2007) is a model for describing environmental governance conditions, but the SES framework is not a method for describing *how* rules systems emerged in a particular place.

While the particular impacts of ICDPs have been understudied in rigorous quantitative terms (Miteva et al 2012), Minang and Noordwijk (2013) argue that “ICDPs can be used as an implementation strategy for REDD+ at multiple levels ... The challenges are about choices or optimal mixes between multiple policies and instruments for addressing drivers of deforestation.” ICDPs have the advantage of being able to combine and connect different policies and instruments at different levels. Social ecological systems “form a multilevel hierarchical structure, but where the different levels are of distinct kinds” (Holling et al 2002). An environmental regulatory system, if it is to become viable within a SES, thus will face

distinct challenges at different governance levels. As such, regulatory regimes or economic instruments can only be made feasible given attention to *interruptions* across scales.

Institutional conditions and arrangements are of key concern in implementing and governing REDD+ (Corbera and Schroeder 2010). This case study attempts to locate ICDPs as a conservation strategy with particular characteristics suitable to multi-level interventions (Blom et al. 2010). REDD+ urgently needs to change land use practices through attention to the multiple drivers of deforestation, in broad political economic, social and ecological contexts. Multiple instruments, i.e. a policy mix, should be of key concern in REDD+ strategies (Enright et al 2012).

6 AVENUES FOR FUTURE RESEARCH

- For smallholders in the Brazilian Amazon, which needs to come first in local institutional development – social organization or cooperative provision of resources and infrastructure?
- Quantitative statistical study to assess ICDP influences on land use, biodiversity, carbon stocks and farm income
- Alternative agricultural and forest commodities – the question of infrastructure-supported sustainable livelihoods on forest frontiers
- Scale sensitive landscape planning / managed forests
- Social organization and common pool resource management in landscapes dominated by cattle production – what does it take to organize?
- The effect of agribusiness financing and rural credit on smallholder economies
- How fragmented land tenure may affect prospects for cooperative organization in settlements
- Integrated PES to incentivize alternative land use (positive externalities) and not only forest/ES conservation (de-incentivize negative externalities)
- Collective action around common properties vs. collective action around individual private properties
- Effects of fragmented landscapes on the reproduction of *Bertholletia excelsa*

Institutional feasibility and legitimacy of land use regulatory instruments in three agrarian reform settlements in northwest Mato Grosso, Brazil: the influence and role of integrated conservation and development projects

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Abstract. This case study, located within the Brazilian Amazon “Arc of Deforestation” examines small farmer perspectives and the institutional impacts of Integrated Development and Conservation projects (ICDPs) promoted for forest conservation in Northwest Mato Grosso (NW MT). The study evaluates institutional variables on family farms in agrarian reform settlements, on lots of between 50-100 hectares. The region is a forest frontier comparable in size to Panama, and exhibits the highest deforestation rates in the Amazon, despite having experienced a broad range of initiatives aimed at halting deforestation and biodiversity loss over the past 15 years. The study is based on a sample of farmers in three municipalities (Juína, Juruena, Cotriguaçu) with varying exposure to ICDPs between 1995 and 2010. We performed an ex post analysis of ICDP impacts on the perceived feasibility and fairness of land use regulation, assessed through on farm surveys, interviews and a group workshop. In particular, we assessed land tenure, compliance with land use regulation, views on the national Brazilian Forest Code, and perceptions of social ecological conditions. Results indicated that the Brazilian Forest Code in abstract had less influence on settlers’ land use decision making than did other criteria. In contrast, ICDPs increased the relevance and legitimacy of land use registration and licensing instruments administered by the state of Mato Grosso. The specific social viability of the latter regulatory instruments was embedded within local institutional arrangements that incorporated concern for livelihood security, support for cooperative infrastructure and social organization, and attention towards reduced farmer transaction costs. The results suggest that support for an integrated set of instruments and interventions over longer temporal scales and at finer spatial scales can be successful routes for institutional improvements. These achievements may also provide a foundation for the effective application of other conservation-oriented policy instruments such as PES or REDD+.

7 INTRODUCTION AND CONTEXT

This case study focuses on environmental governance and the role of Integrated Conservation and Development Projects (ICDPs) in agrarian reform settlements in the Brazilian Amazon. The specific region under consideration is northwest Mato Grosso (NW MT), a forest frontier landscape. While the case study evaluates social interfaces between agrarian reform settlers with the state and ICDPs, this issue is embedded within larger ecological concerns.

The Amazon is the world's largest tropical rainforest and is critical for global biogeochemical maintenance, regional hydrological cycles, and biodiversity conservation (Nepstad, D. et al. 2008, Mittermeier, R.A. et al. 2003). Extensive slash and burn practices (to be distinguished from the traditional agricultural practice of small scale swiddens and agroforestry) have transformed large areas of the Amazon basin into open pasture. Land use change and increased human-induced and natural fires threaten the ecological stability of the biome, affect regional hydrological cycles, species diversity, and ecological resilience. (Louman et al. 2010). Climate change science indicates a very high likelihood that regional temperatures may rise by 5 or 6 degrees centigrade by 2100 (Magrin et al. 2007). Combined with local human-induced ecological effects, large areas of the Amazon tropical rain forest risk being ecologically transformed into savannah. There is an urgent need to conserve the landscape's ecological integrity and resilience, as the biome is critical for the provision of public environmental goods at regional and global scales.

While as a whole the smallholder sector is responsible for a much smaller proportion of deforestation in the Amazon, at certain scales and in certain time periods the influence of settlements on land use conversion is significant. INCRA settlements were responsible for approximately 25% of total deforestation in the Amazon biome in 2005 (Alencar et al. 2013). At the municipal scale, PA Nova Cotriguaçu was responsible for over 50% of deforestation in Cotriguaçu through 2008 (ICV 2011).

In this case study, we surveyed current formal and informal institutional conditions for the application of environmental regulatory instruments in federal agrarian reform settlements. While these settlements were founded by the Brazilian Federal Institute for Colonization and Agrarian Reform (INCRA) in the mid to late 1990s, land tenure has remained insecure, and settlement contact or interface (Cf. Long) with federal, state and municipal governance has been precarious.

7.1 Research questions

1. What is the formal institutional framework for environmental regulation in agrarian reform settlements in northwestern Mato Grosso?
2. How do settlers perceive various factors affecting land use decisions in settlements, including the Brazilian Forest Code and associated environmental regulations?
3. Through ICDP interventions in agrarian reform settlements, what institutional arrangements emerged and how?

7.2 Theoretical justification for study

One interest for this case study was to contribute to recommendations regarding policy “mixes” for managing and governing landscapes through the integration of economic instruments (Vivan et al. in press). Better understanding of how ICDPs impact settler perspectives and dispositions toward formal regulatory instruments could contribute to planning and implementation of REDD+ or PES (Blom et al 2010). We chose to locate the case study in agrarian reform settlements because settlements face particular governance challenges: tenuous coordination between government agencies, land tenure insecurity, and limited communication with the state.

We assume that the security of land tenure and other institutional arrangements are critical for ensuring sustainable land use and the continued provision of public environmental goods (Cf. Börner et al 2009, Corbera et al 2011, Duchelle et al 2013). Secure land tenure need not be a prerequisite for conservation-oriented policies such as REDD+ or PES; in fact it is possible for the former economic instruments to make provisions for strengthening tenure through processing geo-referenced land use documents (Duchelle et al 2013).

Land tenure and other documentation systems can affect if and how collective action can develop in coordination with formal or state rules’ systems (Cf. Ostrom 2004). But while secure land tenure can help to integrate local collective action with state administered institutions, secure property rights do not by themselves ensure that collective action develops or is sustained (ibid). For example, resource users need to be in agreement about the problem at hand, and the community of resource users must have a certain degree of autonomy to organize cooperative decisions that can benefit from policy instruments (ibid).

As such, the design of formal institutional rules and the effectiveness of communication with government officials influences participation in policy instruments (Kosoy et al 2008, Long 2001). If there is a conflict between how resource users understand their “naturally

acquired” rights and responsibilities versus the state’s definition of the same, there may be a need for mutual accommodation between distinct values to ensure social legitimacy. This may be especially true in frontier contexts where the state has a limited ability to enforce rules.

Also, transaction costs are technical points upon which the feasibility of local participation rests (Angelsen et al. 2009). Transaction costs accrue at the level of state agencies as well as at the community or individual level. Unmanageable transaction costs can effectively prevent institutional administration or resource user compliance.

Finally, institutions are scale dependent, in the sense that institutional arrangements may or may not exhibit comparable processes across levels of social organization that range from the local to the global (Young et al. 1999 in Corbera et al. 2009). The Brazilian Amazon presents significant logistical challenges for environmental governance institutions. We expected that ICDPs would have scale-sensitive characteristics and as such might influence particular institutional arrangements at local levels of social organization.

Our supposition was that by considering settler experiences in the context of ICDP interventions, it would be possible to observe variation in how settlers perceived formal state administered instruments and in terms of institutional interfaces with the locality. Attention to how settlers perceive the practicality and legitimacy of policy instruments may indicate potential routes for ensuring effective, equitable and efficient environmental conservation in the Brazilian Amazon (Springate-Baginski and Wollenberg 2010, Cf. Corbera et al 2007.).

7.3 Northwest Mato Grosso (NW MT)

ICDPs were introduced in an effort to inspire a shift in public policies in northwest Mato Grosso in the wake of the 1992 Rio conference. The Brazilian Amazon is one of the more active land-use frontiers in the world, accounting for nearly half of all tropical forest loss worldwide during 2000-2005 (Hansen et al., 2008). However, in the 7 years since that period, deforestation in the Amazon declined by an impressive 75%, more than reaching the nation’s voluntary target for CO₂ emissions reductions announced at COP15 (May et al., 2011). Even so, deforestation persists along a wide swath of municipalities in the so-called “Arc of Deforestation”, which includes all of NW MT. In 2009, nearly 80% of its original 104 thousand km² of forest cover were inside 11 indigenous areas (37%) and in 9 Conservation Units (5.5%), while 6 isolated indigenous peoples⁵ have been identified in the region. The remaining 57.5% of forests were constituents of rural land uses on private properties and agrarian reform settlements (Fig. 1) in a region consisting of seven municipalities: Aripuanã,

⁵ Isolated indigenous people are not contacted by FUNAI (Indigenous Peoples Federal Agency), which identify their territorial range in order to define protection measures for them and for their territory.

Castanheira, Colniza, Cotriguaçu, Juína, Juruena, and Rondolândia (Vivan, 2011). This case study focuses on the municipalities of Cotriguaçu, Juruena and Juína.

Deforestation in NW MT between 1990 and 2010 followed a pattern common to frontier areas throughout the Arc of Deforestation, involving infrastructure investments (opening roadbeds or paving of highways) and a surge in commodity prices (May et al. 2011). MT has the largest cattle herd population in Brazil (28.6 million), and Juína (over 543 thousand) has the sixth largest herd among Brazilian municipalities, harboring a major slaughterhouse installed with BNDES (Brazilian National Development Bank) funding. Commodity prices played a major role as vector for deforestation between 2001-2005, when soy production increased by 81% in the state of MT. In 2005-2009 productivity increases contributed for 22% of the growth of soy production, while a total of 91% of the expansion occurred on previously cleared land, mostly old pastures in the Cerrado region, pushing cattle ranching from there into the Amazonian biome, where it became the principal vector for new forest clearing.

7.4 Deforestation in Mato Grosso (MT) and the national Brazilian Forest Code

The federal Brazilian Forest Code (BFC) and associated Mato Grosso (MT) state regulatory regime have gone through many changes and political contestations. While the Brazilian Forest Code is one of the first attempts to regulate public goods on private lands in the tropics, it has been met with political resistance and has lacked enforcement authority, especially in MT (Stickler et al. 2013).

Reasons as to the drop in deforestation rates in MT after 2005 remain somewhat unclear (Nepstad et al. 2013). Threat of BFC enforcement was probably not the determining factor for the drop in the rate of deforestation, given levels of compliance with the BFC in the period 2001-2012. Stickler et al. (2013) found no evidence that making the BFC more restrictive in 2001 had inhibited deforestation. The level of compliance with the BFC declined to 12% in 2001 and stabilized at 10% from 2005 to 2009.

In 2000, MT developed an environmental licensing process for private rural properties (Sistema de Licenciamento Ambiental para Propriedades Rurais; SLAPR). However, although INPE had been monitoring deforestation in the Amazon since 1988, the SLAPR state system was unable to discriminate legal and illegal clearing for want of cadastral data. Even when violators identified by the system were fined, only a small fraction (1 % or less) of those fines were collected. Often, the fines were cancelled or remained pending under legal challenges for several years for reasons ranging from unclear land title to graft to regulatory error.

The SLAPR system did, however, include an innovative instrument for the environmental licensing and certification of sustainable land use, through the Licença Ambiental Única (LAU), or unitary environmental license. This instrument legalized properties through land

use plans specifying specific agricultural or forestry activities, varying from sustainable forest management to extraction of non-timber forest products (NTFP). However, the transaction costs for registering in the SLAPR system have been shown to be prohibitive for many landowners (Azevedo AA 2009, Rajao et al 2012, Guimaraes J et al 2007 in Stickler et al 2013)

In 2008, MT developed the MT-Legal system for the simple registering of properties – the Cadastro Ambiental Rural or CAR. The CAR registers properties in a central state GIS database, SIMLAM. Unlike the LAU, the CAR is a precursor to licensing or certifying sustainable activities. It does not authorize any particular land use activity, so much as it gives the state a geo-referenced map of the property that identifies the water courses (for the sake of establishing the permanent riparian conservation areas or APPs) and existing land use at the time of registration. Registration in the CAR is a simpler and less costly process than processing the LAU, although the CAR does not certify specific sustainable land use activities, e.g. sustainable forest management.

The CAR was designed to work in conjunction with other instruments that specify directives to the landowner on restoring the legal reserve per the Brazilian Forest Code. However, in practice the instrument functions by registering current land use as a threshold – the property may have already deforested well beyond the 20% legal limit and the landowner would be expected not to deforest any further. After registering in the CAR, landowners are to sign an agreement to restore their legal reserve over a several year period⁶. However this rule has currently been dropped for smaller properties, at the same time that the 80% rule may be reduced to 50% in certain cases that are still under consideration in MT.

Given that the BFC was not the primary impulse for post 2005 reduction in deforestation rates in MT, one hypothesized factor for the drop have been restrictions on rural credit financing for cattle and soy (Assunção et al 2013). Brazil's national development bank BNDES has historically financed agribusiness in MT – this financing has reached upwards of 10 billion dollars from roughly 2000-2010 (May et al 2011???) . Assunção et al (2013) found that a decrease in rural credit curbed deforestation especially in municipalities where cattle ranching is the main economic activity. Other factors involved civil society campaigns and alliances for sustainable soy and cattle, and a federally maintained 'black list' of municipalities for which agricultural credit would be suspended (Nepstad et al 2013, Stickler et al 2013).

Many properties in MT have registered for the CAR without being in compliance with the forest code. There was significant registration in the CAR by larger size properties in MT from 2008 to 2011; much less involving small properties (ICV). Participation in the CAR by

⁶ Under the MT-legal system, to attain legal compliance, properties have to sign an TAC – contract for land use adjustment and a PRAD or land use plan for the recuperation of the APPs and LRs.

larger landowners may have to do with political organization around agribusiness interests. Large agricultural producers are well represented in MT and are also represented in the Brazilian National Congress by the *bancada ruralista* – or rural agribusiness caucus – which has legally challenged the requirement to restore the 80% legal reserve continuously since the rule's inception. In 2010, the ruralistas finally succeeded. While certain aspects of the code were vetoed by President Rousseff, the new forest code was signed into law in October of 2012. (Government of Brazil. 2012 *Código Florestal, Lei No. 12.727 de 17 de Outubro de 2012*. Brasília, DF: Diário Oficial).

The new forest code is more flexible for rural landowners. Significantly, it grants amnesty on the obligation to pay fines for deforestation that occurred before July of 2008 (in the Amazonian biome). Amnesty for fines is conditioned on the landowner registering in state cadastral systems (CAR) and on eventual compliance with the forest code, including the restoration of forest legal reserves. Also, the 2012 forest code removes the obligation to restore forest legal reserves for small properties of under 4 fiscal units in size (between 120 and 400 ha in size, depending on their location in MT state).

Individual lots in settlements fall within this range of under 120-400 ha. This implies that not only are settlers to be forgiven for deforestation before July 2008, but in addition they will not be liable to restore forests on their land. On the other hand, settlers who deforested in excess of 20% of their land after July 2008 are still subject to fines and obligated to restore the forest legal reserve to July 2008 conditions.

The new regulations exempt properties from having to restore their LRs to 80% if landowners have either complied with the requirements of older BFC iterations, e.g. maintaining 50% as opposed to 80% for the forest legal reserve, and / or are less than 4 fiscal units in size (between 120 and 400 ha in size, depending on their location in MT state). In the new forest code, these properties are not required to restore their LRs, but they may also not clear more forest.

At the time that this research was carried out (August 2012), these rules were still being contested at the level of the federal government. Settlers in agrarian reform settlements had little to no knowledge of their implications. In addition, many institutional stakeholders at other governance levels lacked clear information about the current state of the BFC and its implications for MT state regulatory instruments.

In synthesis, while the pre 2012 Brazilian Forest Code stipulated the maintenance of an 80% legal forest reserve on private property, the rules have changed. Small property owners (<4 fiscal unites) are now liable only for maintaining forest that has remained standing after July 22, 2008. Between 80% and 100% of the deforestation in the three settlements under consideration has become legal, although the question of the actual documentation of legality for settlers with insecure land tenure remains an unresolved issue.

7.5 Mato Grosso state level environmental regulation

Under the authority of SEMA-MT, land tenure documents e.g. usufruct rights contracts (“Contrato de Concessão de Uso,” or CCU) are prerequisites to being processed in the Cadastro Rural Ambiental (CAR), or rural environmental land use registry. Joint SEMA-MT / INCRA procedures specify procedures for processing the CAR on individual settlement lots. INCRA has formal authority to process the CAR, although it may enter into cooperative technical agreements with other entities such as municipal governments or NGO-managed projects. For example, in Juína, the municipality was authorized to process the CAR for settlers in PA Iracema.

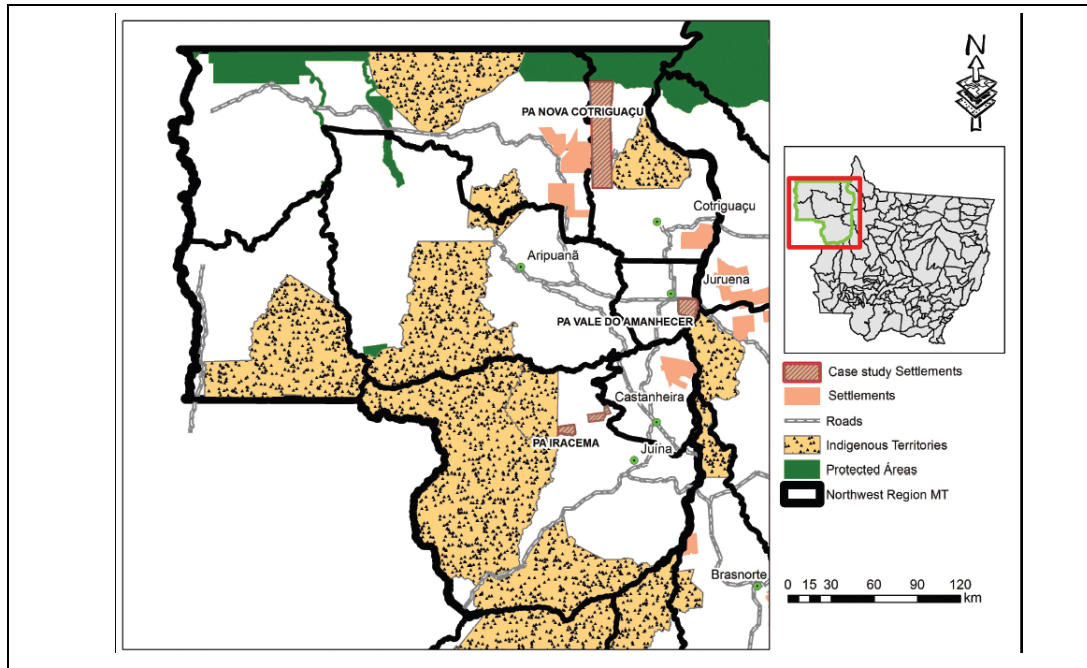
In 2012 it was unclear whether INCRA was committed to processing the CAR on individual lots, given tenure irregularity and the resources that would be required to process geo-referenced for the approximately 70,000 lots in INCRA settlements in MT. On a national level, December of 2012 saw the announcement of technical cooperation agreements between INCRA and the Federal Ministries of the Environment (MMA) and Rural Development to process the CAR in settlements, in the context of the rural development program “sustainable PRONAF”.⁷ The actual institutional ramifications of such announcements remain to be seen. (besides the agreement in MT INCRA is under SEMA’s rules because of Pacto Federativo, another agreement where MMA – IBAMA passes on SEMA the duty(?) to do the environmental licensing of most activities).

Before 2011, compliance and participation by INCRA settlements compliance with the BFC had been practically nonexistent. Before 2011, the onus for compliance lied with INCRA as opposed to with individual settler families. The federal institute for the environment and natural resources (IBAMA) fined INCRA on an annual basis. In 2011, INCRA superintendence in MT issued a technical memorandum on authorized processes for processing the CAR on individual lots in settlements. Settlers would have to present INCRA authorized land tenure documents. However, INCRA did not specify specific rights and responsibilities as to which federal or state agency, municipal authority or non-governmental organization could do the work of producing geo-referenced documents for the tens of thousands of settlement lots in MT. There are 480 INCRA managed agrarian reform settlements in Mato Grosso.

⁷ <http://www.incra.gov.br/index.php/noticias-sala-de-imprensa/noticias/12594-pepe-vargas-assina-termo-de-cooperacao-para-cadastro-ambiental-rural>

7.6 Location and ICDP project characteristics

(a)



(b)

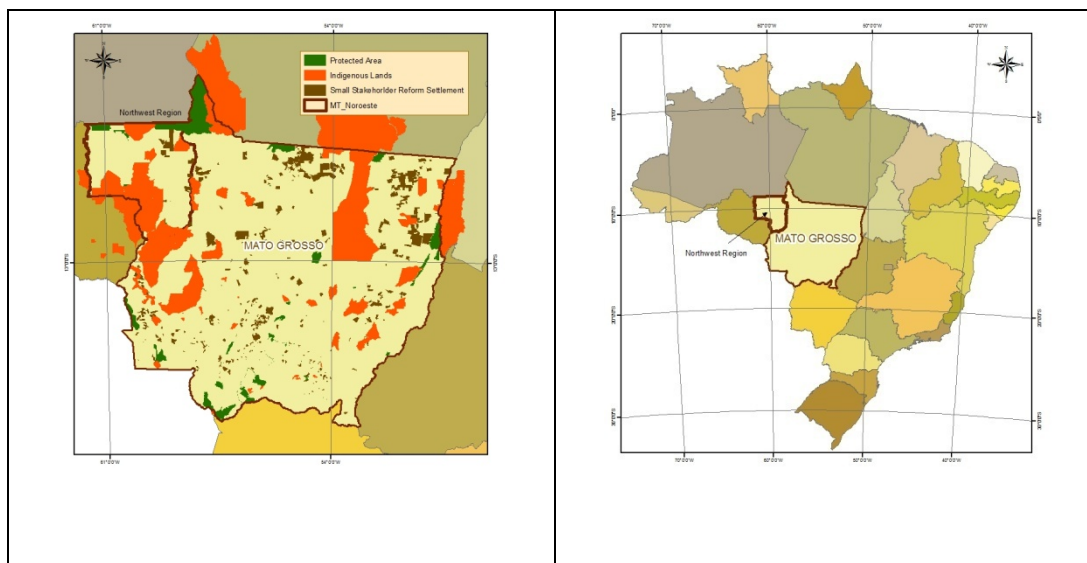


Figure 1: (a) Case study settlements in northwest Mato Grosso (NW MT) and (b) Protected Areas, Indigenous Lands and Settlements in Mato Grosso; location of Mato Grosso in Brazil

The three settlements under consideration in this case study were chosen because they contained farmers who had been contacted in a small farmer study carried out by the GEF-

UNDP Project in 2007/8 (Vivan 2010). The 2010 study included small farmers on lands both inside and outside of federal agrarian reform settlements. It had assessed land use on these individual farms and had drawn up land use maps and forest restoration plans according to the Brazilian Forest Code, and had included a full assessment of restoration costs.

We chose to focus on small farmers specifically in the INCRA settlements in order that all the small farmers would be subject to the same land tenure (INCRA) and environmental regulatory authority (SEMA-MT, IBAMA). For example, while land tenure inside of settlements is often insecure, it can be even more precarious on private lands outside of settlements.

The three settlements chosen for the study were the Projeto Assentamento (PA) Nova Cotriguaçu in the municipality of Cotriguaçu, PA Vale do Amanhecer (Sunrise Valley Settlement) in the municipality of Juruena, and PA Iracema in the municipality of Juína. Projeto Assentamentos are the most traditional INCRA settlements, which do not include any particular provisions for sustainable land use, and are based mostly on the cattle model.

In general, these settlements have a slightly hilly topography and contain rock outcroppings that do not support large scale mechanized agriculture such as soy or cotton farming. There is more variation in infrastructural conditions. It only takes 30 minutes to reach PA Vale do Amanhecer (PA VAM) as it is located 17 km from the municipal seat on relatively maintained roads. PA Vale contains two very viable cooperatives COOPAVAM and AMCA, which receive financial credit through CONAB, a federal food procurement program for organic school lunches. The settlement is 14,715 ha in size, and contains 245 families. The settlement is only 43% deforested in 2011, mostly due to the fact that the settlement maintains a collective legal reserve forest on its southern and eastern border. It is bordered by the Juruena river on the east, where the municipality established a small public beach and access road inside the settlement's collective reserve, without asking INCRA permission. Members of the Rikbaktsa indigenous group who sell Brazil nuts to the two cooperatives use the Juruena river for transportation.

In contrast, the southern tip of PA Nova Cotriguaçu (PA NC) is 80 kilometers from the town of Cortiguaçu over more precarious roads. In dry road conditions, it takes two hours to reach the village of Nova Esperança on the southern end of the settlement from the town on Cotriguaçu. The settlement is quite large – just under 100,000 hectares – and contains 1,237 families. In early 2013, only 40% of PA Nova Cotriguaçu had electrical service. The settlement contains a small town, Nova União, with some services, however the settlement has no operative cooperative factories or businesses. Land tenure in PA NC is irregular, especially in the central to northern areas of the settlement. The settlement was 65% deforested in 2011. It is bordered by a Indigenous Territory to the east and a Protected Area to the north.

PA Iracema (PA I) is the most deforested settlement of the three (82% deforested in 2011), but has more favorable infrastructure than does PA Nova Cotriguaçu. It is divided into three sectors, is 18,603 hectares in total size and contains 354 families. PA I is located 70 kilometers from the Juína county seat on roads that are relatively well maintained. The settlement is 100% served by electricity. It contains a cooperative sugar cane refinery in sector 1, and is served by a cooperative heart of palm processing factory (AJOPAM) that is located in the town of Juína. Sector 1 (??) is bordered by an Indigenous Territory on the west.

PA Vale do Amanhecer is the only INCRA settlement out of 480 in MT that has been legalized. As a “model settlement” PA Vale was subject to a series of integrated conservation and development projects from 1999 more or less continuously through 2013. These ICDPs were Pronatura, the GEF-UNDP-SEMA project, Aderjur-INCRA (a partnership involving the outfitting of a Brazil nut processing factory), and the currently operating Juruena Carbon Sink project.

While we surveyed environmental regulatory compliance and settlers’ perceptions on social interface and communication in all three settlements, in PA Vale we chose to do an in depth participatory evaluation of land use change factors and on settlers’ historical experience with ICDPs. This was because PA VAM had had the longest exposure time to ICDP interventions (upwards of 8 years), compared to only a few years of continuous exposure in PA I from 2005-2008 and only sporadic exposure in PA NC.

7.6.1 Specific institutional characteristics of PA VAM

Unlike other INCRA settlements in Mato Grosso, PA Vale do Amanhecer has a collective environmental license, formally signed in May of 2012. This Licença Ambiental Única (LAU), predates current SEMA-MT rules for processing the CAR on individual settlement lots. In current SEMA-MT, which were updated in 2008, the CAR is a prerequisite to processing the LAU. The CAR is a land use registry integrated with the SEMA-MT maintained GIS database SIMLAM, whereas the LAU is designed to authorize particular sustainable extractive or productive activities.

The LAU held by PA Vale therefore documents more than does the CAR and is a comprehensive environmental license that encompasses long-term environmental planning for the settlement as a whole, at the same time that it certifies the production of Brazil nut oil and other productive activities. Furthermore, the LAU allows the settlement to access credit finance.

While the CAR is more has been implemented in other Amazonian states, the LAU is a particular institutional innovation designed by SEMA-MT. It does not only apply to INCRA settlements, but to sustainable timber operations and any other enterprise seeking to certify environmental legal production on private land (Cf. May et al. 2012). The CAR, on the other

hand, does not document or certify particular land use actions, rather it only determines the extent of compliance or non-compliance with the Brazilian forest code.

PA Vale is the only settlement in Mato Grosso with a LAU. As a “model settlement,” PA Vale do Amanhecer was accompanied through a long-term institutional process with the LAU that took nearly 6 years, and which involved significant investments and commitments by the UNDP-GEF project, SEMA-MT and INCRA.

8 METHODOLOGY

8.1 Interviews with key informants

To assess the formal institutional rules for land tenure and environmental regulation in agrarian reform settlements, interviews were conducted with key informants in Cuiabá and the three municipalities under consideration in 2012. Secondly, a document review of laws, procedural regulations and internal and inter-agency memorandums was conducted.

The following government bodies and non-governmental agencies were interviewed: INCRA, SEMA-MT, ICV, TNC, municipal agricultural and environment offices in Cotriguaçu and Juína.

8.2 On-farm surveys and semi-structured interviews with individual farmers

To assess settler interpretations of factors affecting land use and socio-ecological conditions, as well as the institutional arrangements that emerged through ICDP interventions, household questionnaires and semi-structured interviews were conducted with 29 farmers on lots of between 50 and 100 ha in federally administered (INCRA) agrarian reform settlements in the municipalities of Cotriguaçu, Juruena and Juína. This sample included consistent year-to-year participants in ICDPs, occasional participants, and non-participants. As mentioned above, we identified these particular farmers through their participation in a GEF-UNDP study to analyze restoration costs for small farm with varying land use characteristics. That study had generated land use maps with which we could collate and compare interview responses on the history of the farm’s land use, as well as the decision making around land use and the underlying logic.

Through the structured questionnaires, researchers recorded farmers’ historical experience with ICDPs (if any). Based on this data the researchers created a value scale for participation for each farmer. (+1 value for year participating in an ICDP, -0.1 discount value for each year passed without participation after the end of a project). We designated participants to be

settlers with a participation value of 1.9 or higher. Settlers with participation values of under 1.9, i.e. who had participated for less than two years or who had participated minimally in the past without continuity were considered controls.

The questionnaires also documented the current land tenure status and current environmental legal status in terms of the “Cadastral Rural Ambiental” (CAR). The CAR is Mato Grosso’s state system for registering land owners’ compliance with rules established by the national Brazilian forest code.

Semi-structured interviews with individual farmers were designed to record the historical experience of farmer interaction with various government and project entities. This took three approaches:

1. Interviews elicited a scale-value that each farmer associated with four broad criteria (legal, economic, community/cultural, ecological) when making land use decisions.
2. Interviews were used to draw out farmers’ experiences of their communicative relationships with six actors, each with distinct if interrelated mandates in terms of land use conservation and management: INCRA, IBAMA, SEMA-MT, the municipality, local associations, and ICDPs (Cf. Long 2001).
3. Interviews prompted responses in terms of perceived legitimacy or fairness of distinct components or instruments making up the Brazilian forest code (Cf. Corbera et al 2007).

Survey and interview results were cross referenced with land use maps that had been generated in the context of a GEF-UNDP sponsored land use survey with 61 small farmers in 2008. We used the land use maps to track how settlers differed in their land use and to see if participation in ICDPs could be correlated with distinct land use patterns.

Figure 2: Land use maps for two settler farmers in the case study sample. Areas in red indicate deforestation beyond the 20% legal limit per the pre-2012 Brazilian Forest Code. The settler on the left was considered to be a participant in ICDPs; the settler on the right had not participated in ICDPs.

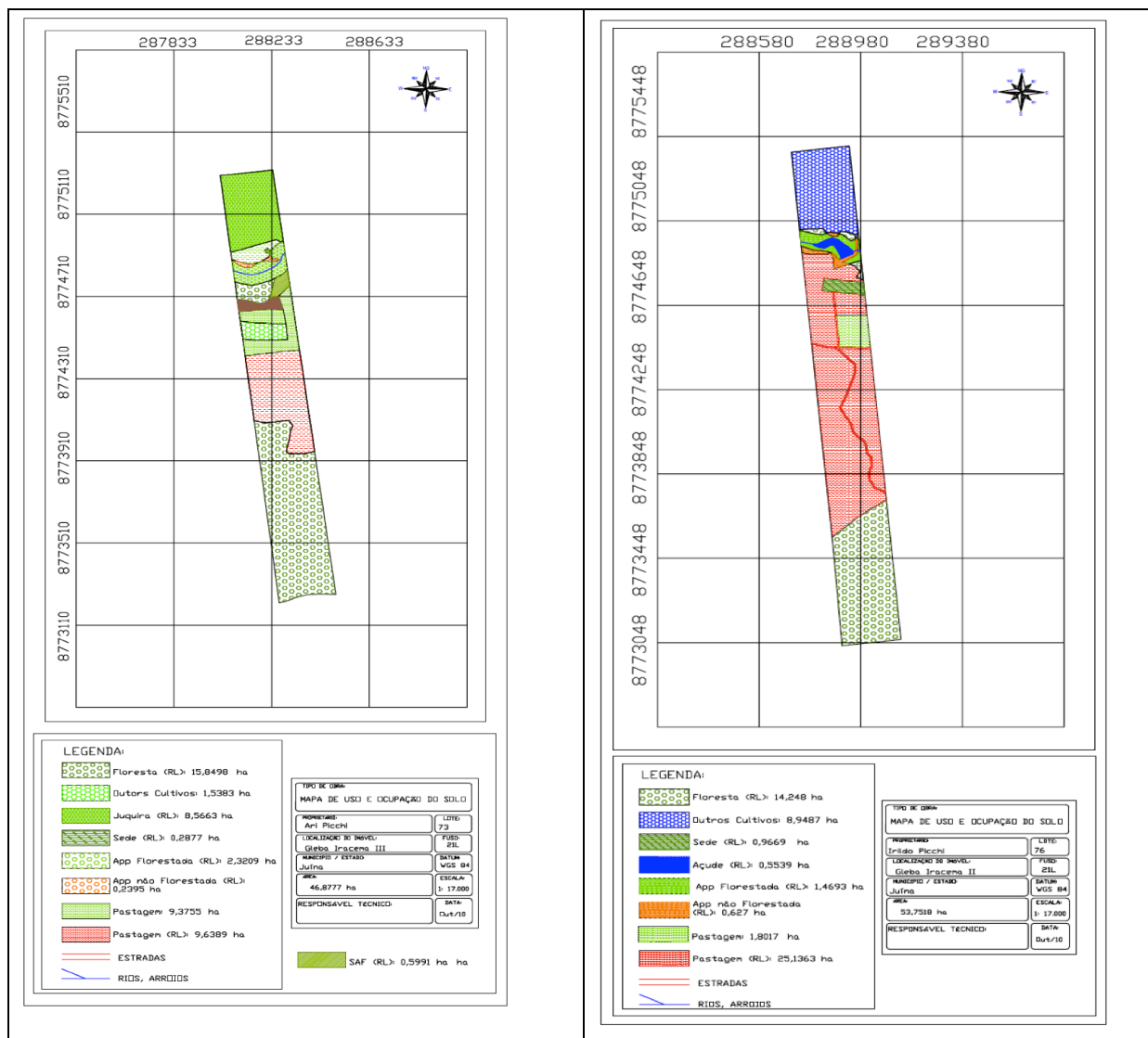


Figure 3: Researchers pose with a settler family in PA Nova Cotriguaçu, Cotriguaçu, MT, August, 2012



8.3 Group workshop

Survey and individual interview responses were collated and compared with group workshop data, in order to further understand the historical evolution of land use decision-making processes and institutional arrangements. Researchers then held a group workshop with farmers in the Vale do Amanhecer settlement in the municipality of Juruena. This group workshop entailed: First, the participative construction of a socio-ecological timeline of vectors and factors affecting land use decision-making and deforestation in PA Vale do Amanhecer over the 15 year time period since the first ICDP activities in the region; Second, a group evaluation of the perceived practicality and land use influence of specific project instruments in PA Vale do Amanhecer during the same period; Third, a group evaluation of governance in terms of participation and perceived institutional legitimacy for the same specific project instruments, also for the same 15 year period.

In terms of the first activity in the group workshop, farmers debated factors affecting their land use decisions, in the face of deforestation dynamics data brought in by the researchers. Visual techniques developed by Geilfus (2002) were used to engage farmers in the

participative construction of a socio-ecological timeline documenting land use decision-making.

Secondly, workshop participants established values for distinct project instruments or tools that were promoted and/or implemented by ICDPs and governmental institutions over the past 15 years in the region. These include stand-alone ICDPs as well as federal and state policy instruments (credit, command and control, subsidies, tax exemptions). The methodology was focused on the elicitation of a valuation matrix, in which farmers assessed the practicality and land use influence of distinct project instruments in terms of a scale (1-10).

Thirdly, the above land use decision-making and project component valuation activity was complimented with a third group evaluation of governance in terms of participation and perceived institutional legitimacy, year by year for the same 15 year period. This also took the form of a valuation matrix, in which farmers assessed distinct project instruments in terms of a scale (1-10). This was designed to draw a more complete illustration of the institutional settings and arrangements that form the background for local farmer decision-making (Cf. Polski and Ostrom 1999).

Figure 4: Group workshop with settlers from PA Vale do Amanhecer, Juruena, MT, April 2013



9 RESULTS AND DISCUSSION

9.1 Current formal institutional conditions for the application of environmental policy instruments in agrarian reform settlements

The INCRA superintendent's office responsible for federally administered settlements in NW MT is located in Cuiabá, the Mato Grosso state capital, a distance of 1,100 km from PA Nova Cotriguaçu in the municipality of Cotriguaçu, and just under 1,000 km from PA Vale do Amanhecer in the municipality of Juruena.

Key informant interviews at INCRA indicated that INCRA has in 2011 and 2012 attempted to regularize, or at least document, the situation of land tenure in northwest MT settlements (see table below).

Table 1: Current formal land tenure conditions in INCRA settlements

Name of settlement	Municipality	# lots measured and marked	# lot occupants authorized to receive usufruct land tenure document (CCU)	Notes
PA Vale do Amanhecer	Juruena	250	170	68% of the settlers are regular and authorized to receive a CCU document.
PA Iracema	Juína	325	230	71% of the settlers are regular and authorized to receive a CCU document.
PA Nova Cotriguaçu	Cotriguaçu	1503	692	46% are regular and authorized to receive a CCU document; 448 of the lots are irregular: the lots may be occupied but the occupants are not authorized by INCRA; 54 were regular but were not authorized for the CCU for lack of other documents.

source: interview with INCRA personnel on August 3, 2012

In 2011 and 2012, INCRA's sole representative for NW MT spent months visiting individual family lots in various settlements in the region, attempting to determine if current lot occupants were actual INCRA beneficiaries. The above table represents INCRA's assessment of land tenure the three settlements under consideration. In the case of PA Iracema

and PA Vale do Amanhecer, approximately 70% and 68% of the lots, respectively, were documented as being occupied by INCRA authorized tenants. In the case of PA Nova Cotriguaçu, only approximately 46% of the lots were determined to be occupied by a recognized INCRA beneficiary.

Based on questionnaire responses in the field in PA Nova Cotriguaçu, PA Vale do Amanhecer and PA Iracema, all farmers in the sample had been living in their respective settlements for at least 10 years, some for as long as 18 years.

While tenure irregularity was a factor in the three settlements specifically under consideration for this study, it was more prevalent in PA Nova Cotriguaçu. While all of the settlers in the sample had lived in or near their INCRA assigned lot for between 10 and 18 years, none had been granted private tenure rights (“Título Definitivo,” or TD). In fact, INCRA was still in a process of devolving temporary 5 year usufruct rights contracts (“Contrato de Concessão de Uso,” or CCU). While twenty-three farmers in the sample were officially recognized as usufruct rights holders, 15 possessed and 8 did not possess a CCU from INCRA. Six out of the 29 the settler farmers, however, had been deemed invalid beneficiaries, due to strict INCRA rules about the beneficiary profile, even though these farmers were all living on their assigned lots or in the community, and were all actively managing their assigned lots.

Tenure irregularity has many institutional repercussions for settlers. It is impossible on a formal basis for individual farmers without TD to sell their land. Without CCU or TD, it is impossible to access bank loans, or to register their land in the Mato Grosso state land use database SIMLAM. However, Many informal land sales or swaps occur in lieu of the possession of actual tenure documents and settlements contain many families who have never been in formal communication with INCRA. In Nova Cotriguaçu, through such informal land markets, ranching operations have sometimes accumulated several continuous INCRA lots, and maintain what are essentially illegal cattle ranches without INCRA authority.

Tenure irregularity essentially limits land use activities (aside from subsistence) to producing market goods that don’t require certification and can be marketed locally without investments in infrastructure, i.e. beef cattle and dairy farming.

As mentioned above in the context section, while there are innuendos of INCRA shifting its policy priorities and taking more responsibility for the CAR through the “Assentamentos Verdes” (Green Settlements) program, the specific institutional arrangements for simultaneously documenting land tenure and environmentally legalizing land use remain to be seen. While INCRA has the final authority on tenure in the settlements, it is IBAMA and SEMA-MT which have environmental authority. Formal tenure documentation is essential for environmental legal and regulatory procedures, but there is poor coordination of shared institutional responsibilities for these state agencies. The three municipalities in this study have taken some initiative through the assistance of The Nature Conservancy (TNC) and the

Instituto Centro de Vida (ICV), but to date no formal institutional arrangements have been articulated in the region regarding technical or fiscal coordination between entities at the federal, state, municipal or NGO level.

Meanwhile SEMA-MT has been underfunded as a state agency, in part explaining the 6 year duration of the LAU licensing process (Cf. Vivan et al. in press). Other sustainable production operations in NW MT, for example, a long existing sustainable timber operation bordering PA Vale do Amanhecer on the south, in 2012 had been waiting two years for an updated and authorized LAU from SEMA-MT. In Juína, a cooperative heart of palm production factory AJOPAM had struggled to finally obtain an environmental license in 2012 (??) after several years of SEMA-MT delays. These delays put long term holds on cooperative efforts initiated in 2006.

Formal institutional communication between state and federal agencies, NGOs, municipalities, not to mention with local communities, is often less than flawless in the context of federal agrarian reform settlements in northwest Mato Grosso. Clear information about institutional rules is not always available, nor does it circulate in a manner that creates easy understanding and access for all stakeholders in this environmental regulatory regime.

Tenure irregularity in the settlements has to do with many factors, including the somewhat limited ability of INCRA to monitor land occupancy over time, the physical remoteness of this region, difficult environmental conditions and local social organization and conflicts. When first colonized in the 1990s, rural settlements in NW MT were often extremely difficult if not life threatening places to live. For example, PA Nova Cotriguaçu, settled in 1994, suffered from widespread malaria and dysentery in its early years. Without a proper road, settlers had to literally walk upwards of 60 kilometers from the municipality just in order to reach the southern tip of the settlement. In such precarious conditions, many original INCRA settlers moved on or adapted – they abandoned, sold or exchanged lots without INCRA authority. Certain individuals accumulated several demarcated lots over time, loggers came to illegally occupy lots and exploit timber, etc. This has resulted in continued insecurity in land tenure, albeit efforts and significant improvements in INCRA documenting the current tenancy situation in NW MT.

Tenure insecurity varies between settlements. In this case study, the most insecure and least land tenure documented settlement was PA Nova Cotriguaçu. Land tenure insecurity in PA Nova Cotriguaçu overlaps with other infrastructural issues, such as poor roads, lack of electricity, poor health services, and the like. PA Vale do Amanhecer is the exception to a pattern of the precariousness of institutional and infrastructural arrangements – it is the only federal settlement in MT with full environmental legal compliance. But PA Vale do Amanhecer also benefits from electricity, good roads, schools and health clinics. Unlike PA Iracema and PA Nova Cotriguaçu, it is located less than 20km from the municipality. Both institutional and infrastructural factors have contributed to Vale's development. Today,

several factories inside the settlement process products made from Brazil nuts (oil, pasta, cookies) and a women's association that produces textile garments.

9.2 Legal influence on land use decisions

Based on a simple average tally of responses across the sample, semi-structured interview responses suggested that legal considerations, in the abstract, had less importance in settlers' decision-making around land use.

The results in the table below suggest that environmental laws and regulations have less of an influence on land use decisions in settlements than do other factors. The responses are organized by municipality and by participation / non-participation in ICDPs. We asked respondents to weigh four different factors on a scale of 1 to 10, where 1 meant that the factor had limited to no influence, and 10 where the factor was deemed to have maximum influence on land use decisions. "Community" refers to local social pressures or informal rules. "Ecological" refers to land use decisions being affected by characteristics of the land itself regardless of economic considerations: soil characteristics, water availability, current vegetation. By "controls" we mean those respondents that had not participated in ICDPs or had participated minimally (see methodology – individual farm survey/interview).

Participants in ICDPs attributed a higher value to legal factors in land use decisions than did non-participants. While for non-participants in ICDPs, economic factors were considered to be of most significance, participants in ICDPs specified ecological factors as being most relevant in their land use decisions.

Table 2. Simple average values (1-10) attributed to broad factors or criteria affecting farmers' land use decisions. 1 = minimum influence, 10=maximum influence. N=29 interviews.

	Legal	Economic	Community	Ecological
By municipality/settlement				
Cotriguaçu / PA Nova Cotriguaçu	4.3	7.9	7.2	8.3
Juruena / PA Vale do Amanhecer	6.6	7.1	7.7	9.0
Juína / PA Iracema	4.8	8.4	8.0	7.1
By participation/non-participation in ICDPs				
ICDP participants	5.9	7.0	7.5	8.4
Controls (non participants)	4.4	9.0	7.8	7.8

Below, we discuss this non-statistical result in relation with other indicators. We suggest that poor contact with federal and state agencies is reflected in the low value attributed by settlers to legal considerations in making land use decisions. However, in PA Vale do Amanhecer, legal factors were valued higher. The higher perceived value of legality may have been tied to settler awareness about the settlement's collective LAU and the meaning of the LAU in terms of management of the settlement's collective reserve and in marketing Brazil nut products. Results suggest that enhanced importance and influence of legal factors in settlements may be tied to how formal institutions have or have not integrated with livelihood opportunities.

9.3 Settler perceptions of the Brazilian forest code

What is also key to consider is the inconsistency between the perceived or historically acquired rights of settlers, and the outsider imposed formality of the 80% forest reserve rule in the Brazilian forest code. Settlers perceive the 80% forest reserve rule as arbitrary, designed by outsiders, with limited social or material relevance given the history of settlements. At least in the cast of agrarian reform settlements, if satellites are helping to build legal models of the landscape, these legal models and their official interlocutors are not the primary consideration for the humans who actually reside in these landscapes.

Farmer interview responses around the question of perceived legitimacy or fairness of the Brazilian forest code, indicated that farmers perceived the 80% forest reserve rule ("Reserva Legal," or RL) rule in the Brazilian Forest Code to be inappropriate, unreasonable, and unfair. Settlers offered many various reasons for the illegitimacy of the 80% forest reserve rule in the

Brazilian forest code. One is that prior to 2000 land owners in the Amazon biome could legally deforest 50% of their land. A second reason is that INCRA originally directed settlers to deforest their lots to establish and secure their rights and to prove that they were using the land productively. Another is that it would be difficult if not impossible, under current market conditions, to secure a livelihood if settlers are limited to cattle ranching as their main economic activity, to be undertaken on only 20% of their land (resulting in 10-20 ha of pasture).

In contrast, “área da proteção permanente” (APP) riparian buffer protection rules were considered to be appropriate, reasonable and fair. This did not mean that farmers were actually in compliance with APP rules or that farmers had geo-referenced documents indicating compliance, but that there was, in general, perceived legitimacy of the APP rule as a stand-alone instrument.

In fact, some settlers perceived forest code compliance and livelihood security to be in direct opposition to each other. Some suspected that being processed in the CAR could lead to fines or sanctions for environmental irregularities per the 80% reserve rule. No settlers seemed to be knowledgeable of changes in the Brazilian forest code that might grant amnesty for deforestation in excess of 20% that occurred before July 22, 2008 on properties of under 4 fiscal modules.

However, while across the three settlements settlers perceived that the 80% reserve rule to be illegitimate, perceptions toward the CAR (in Juína) and the LAU (in Juruena) were more positive. Settlers with experience with ICDPs in Juruena and Juína tended not to be as suspicious about the state. Our results suggest that a more positive view towards and understanding of these instruments were linked to ICDP interventions and increased trust between settlers and the municipality. Below, we discuss these indicators: how settlers had participated in ICDPs over time, and how settlers perceived the quality of communicative contact with ICDPS, the municipalities and agricultural credit programs, and how settlers perceived the quality of contact with the municipalities and INCRA. It was also indicated in the history of these interventions and their institutional and political ramifications.

In PA VAM, for example, legal considerations were valued higher, and this seems to have been because the settlers understood that the LAU was a legal document that legalized the settlement in environmental terms and which defined rights and responsibilities around a collective resource. Settlers recognized a collective responsibility in terms of monitoring and protecting the forest reserve against outsider invasions. As such, local collective action and informal institutional rules were consolidated concurrently with the formal legalization of the settlement (Cf. Ostrom 2004).

9.4 Communication with the state, ICDPs, municipalities and local associations

Results indicated variation across the three municipalities in terms of settlers' perception of and experience with government agencies, community associations/cooperatives and ICDPs. Settlers' historical participation in ICDPs varied from having never participated in ICDPs, to having participated in one or more projects in every year consecutive from 1999 to 2012.

Results from individual interviews in the three settlements indicated that settlers had almost no personal contact with state and federal environmental agencies except in unusual circumstances (such as the instance of IBAMA being involved in federal action to expel illegal gold mining invasion from PA Vale do Amanhecer in 2005). One settler in PA Vale do Amanhecer related that his only experience with IBAMA took the form of IBAMA personnel issuing him a hefty fine for cutting down a single tree. On the other hand, another settler in PA Nova Cotriguaçu, who in 2004 had lost many hectares of agroforestry systems in a fire, had determined to participate in the IBAMA fire prevention program PREVFOGO. But in general settlers in our sample had little to no contact with IBAMA or with SEMA-MT.

In PA Nova Cotriguaçu settlers were most positive about their contact with agricultural credit programs compared to contact with state entities or local associations. Local associations, IBAMA and SEMA received the lowest values in terms of quality of contact. While INCRA had spent resources on the settlement, given the sheer size of PA Nova Cotriguaçu settlers felt minimally served. INCRA had only one technician to attend to the needs of thousands of families. On the other hand rural credit programs such as PRONAF (Programa Nacional de Fortalecimento da Agricultura Familiar, or National Family Farm Strengthening Program) had provided financial credit and agricultural tools, although unfortunately PRONAF provided fertilizer had been inappropriate for local soils.

In contrast, settlers in Juína (PA Iracema) were much more positive about the benefits of environmental regulatory compliance and documentation of land ownership. Settlers in PA Iracema were most positive about the quality of institutional contact with local associations and the municipal agriculture and environment office.

In Juruena, settlers in PA Vale do Amanhecer were especially positive about the quality of contact with ICDPs at the same time that settlers took legal considerations more seriously than in other settlements.

9.5 Settler understanding of and perception of state level environmental regulations (CAR and LAU)

Settler farmer perspectives regarding formal land tenure and environmental regulatory procedures varied greatly across the three settlements.

In Cotriguaçu, interviews revealed that settlers did not have a good sense of the government's intentions in terms of environmental regulation. Some settlers simply did not want to receive any land tenure document at all, because they believed they would be forced by the state or federal authorities to obey environmental regulations without any attention to their livelihoods. None of the farmers interviewed in PA Nova Cotriguaçu possessed a CCU document; 7 out of 9 told us that INCRA had authorized the emission of the CCU for their lot.

It was common in PA Nova Cotriguaçu to view the question of livelihoods and survival as a matter of what they themselves could manage without the help of the state. Only ICDPs and to a lesser extent INCRA were viewed positively because they shared practical knowledge or tools and equipment that could be applied on individual farms.

According to interviews with the municipal agricultural office in the municipality of Cotriguaçu, even when the occupants have been identified and are eligible to receive the CCU, many settlers in PA Nova Cotriguaçu were reported to have refused the receipt of these documents.

While the reasons are unclear, this may be due to lack of trust of the state's intentions. According to key informants, the phenomenon that settlers reject the receipt of CCU land tenure documents may be because settlers do not trust the government's intentions, or wish to conceal instances of informal or irregular land occupancy.

Similar to Juína, but without formal INCRA authority, the municipality of Cotriguaçu has initiated a lower cost process for settlers and small farmers to be registered in the CAR. In PA Nova Cotriguaçu, however, the municipality is limited in its ability to assist with the state mandate to register properties. On one hand many lots lack INCRA tenure authorization.

In contrast, settlers in Juína (PA Iracema) were much more positive about the benefits of environmental legal compliance and documentation of land ownership. Settlers in PA Iracema were most positive about the quality of institutional contact with local associations and the municipal agriculture and environment office. There was special municipal government consideration for small farmer's transaction costs in processing the CAR.

The mayor in 2012, Altir Peruzzo, had been involved in the ICDP project Proambiente, and had a loyalty to the needs of small agricultural producers in his jurisdiction. Staff or intern technicians in the municipal agricultural and environment office had helped 7 out of the 10 farmers in our sample, all of whom possessed their CCU document, to initiate their registration via the CAR. Transaction costs for farmers had been minimized, to a total cost of approximately 120 reais and two visits to the municipal office.

However, Altir Peruzzo was voted out of office in October of 2012, and in late 2012 those staff that had been tasked to facilitate processing of the CAR with settler farmers were replaced in the municipal government transition. The incoming mayor, Hermes Bergamin, did

not share this policy priority. Online document checks in March of 2013 were not able to confirm if SEMA-MT had in fact registered these individual settlers' CAR documents.

In Juruena, settlers were less conscious about the CAR and its relationship with the settlement's collective LAU. Some settlers had been contacted by a technician in the municipal agricultural office who had provided misleading institutional information – namely that settlers in PA Vale do Amanhecer were to be required to process the CAR on their individual lots, at a cost of approximately 500 reais. INCRA representatives confirmed that there was no legal requirement that settlers process the CAR in PA Vale do Amanhecer, as would households in other INCRA settlements.

In PA VAM, settlers assessed their contact to be positive not only with local ICDPs, but also with INCRA, who had in fact partnered with local ICDPs in making investments in infrastructure in the settlement

Whereas in Juruena the settlers interviewed had a higher perception of legal factors and of ICDPs, in Juína there was a higher perception of local government and community organization – i.e. the municipality and local associations. There was a positive perception of the quality of communication between the municipality and the settlement. The municipal agricultural office sponsored extension courses and there was much more contact between the municipality and the settlement. Certain settlers were surprisingly aware of the formal structure of the formal tenure and environmental regulatory system.

Settlers in Juína understood registration in the CAR as a path toward legality. 7 out of 10 farmers said they had had entered into municipal processing of the CAR system for land use registration. We suggest that this enhanced perception of governance may have had to do with previous ICDP projects focused on PA Iracema, especially the Proambiente project. Particular technicians in the municipality's agricultural extension office had previously been employed with the Proambiente project from 2005-2008. The municipal agricultural office sponsored extension courses and there was much more contact between the municipality and the settlement.

Some settlers perceived the institutional synergies between the possession of formal land tenure, environmental registration/licensing, cooperative livelihoods, and collective settlement sustainability. But this latter group was composed of settlers that had participated in ICDPs in Juruena or in Juína where cooperative production chains had been involved.

Below, we suggest that the ICDP intervention in PA Vale in essence surmounted the issue of individual farm interfaces with the state, by substituting a collective institutional arrangement, which lowered transaction costs at the same time that it built cooperative infrastructure around alternative agricultural commodities.

9.6 Settler perceptions of historical social ecological conditions in PA Vale do Amanhecer

The group workshop, conducted in PA Vale do Amanhecer in the municipality of Juruena, was designed to elicit group perceptions on the evolution of the social ecological context. The group developed a socio-environmental timeline for the period 1998 to 2012 that identified factors and vectors for each year.

In PA VAM, factors affecting land use and land use change involved a complicated patterning of political alliances, fire, road building, federal agricultural credit programs (PRONAF), a violent gold rush invasion, infrastructure development, the formation of local cooperatives, and the price of agricultural commodities, among other factors. The settlement's relationship with the municipality was not consistent in time but changed from one particular mayoral administration to the next.

From 2002-2004, PA VAM was subject to a violent invasion by gold miners, which required a federal police intervention and the temporary cessation of the GEF-UNDP project's local activities in 2005⁸.

The use of fire and burning practices were perceived from the initiation of the settlement continuously year to year until the observed end to fires in 2012. In two particular years, there were severe fires spreading across the settlements (“incêndios”). Fire was perceived by settlers as a major impediment to alternative land use such as silvopastoral or agroforestry systems. One interviewee had on two separate occasions planted scores if not hundreds of castanheira – Brazil nut – seedlings – only to lose them all, twice.

The federal agricultural credit program PRONAF was perceived as one of the strongest influences or incentives to clear forest. Based on the LAU document (which has gauged land use in the settlement over time) PRONAF coincided with the peak of deforestation in PA VAM in 2001. Deforestation in 2000 and 2001 was almost four times as high as it was in 2008.

9.7 Emerging institutional arrangements and instrument “mixes”

Settlers also identified and valued specific program and project interventions in the settlement in terms of their perceived practical influence. The settlers focused on 4 specific years (2001, 2005, 2008, 2011) in which distinct program or project influences were apparent, and conducted a participative assessment of specific activities and approaches. Table 8 below collates the settlers' responses and organizes the identified interventions by type.

⁸ Paulo C. Nunes, pers. Communication.

Table 3. Value of different agricultural and ICDP interventions in terms of practical influence (1 = low practical influence to 10 = high practical influence) as perceived by agrarian reform settlers in Vale do Amanhecer settlement, Juruena, Mato Grosso, Brazil, 2013.

Timeline	2001	2006	2008	2011
Project	Pronaf	GEF-UNDP	Aderjur/Incra	C Sink Project
Perceived Value				
Capacity building				
<i>Courses/training</i>		10	8	8,5
<i>Visits and exchanges</i>		6	8	5,5
<i>Workshops</i>		7		7,5
Services				
<i>Deforestation 10h bulldozer</i>	4			
<i>Portable saw mill</i>		10		10
<i>Technical assistance</i>				9
Cooperative organization				
<i>Social organization (COOPAVAM)</i>			10	
<i>Social organization (AMCA)</i>				10
Institutional supporting services				
<i>Community management of NTFP</i>		8		
<i>CONAB: financial support</i>				8
<i>Brazil nut factory and purchase of machinery</i>			9	
<i>Credit application</i>	9			
<i>Elaboration of contracts with indigenous</i>				8
<i>Environmental license (LAU)</i>		9		
<i>Mapping NTFP trees and production study</i>		8		
<i>Market development</i>				10
<i>Soil analysis</i>	8			
Provision				
<i>Chick starter kit</i>	1			
<i>Chicken wire</i>	1			
<i>Coconut seedlings</i>	0			
<i>Fruit trees</i>	7			
<i>Horse drawn cart</i>	3			
<i>Manual seed planter</i>	1			
<i>Coffee seedlings</i>	6			
<i>Dairy cattle</i>	8			
<i>Fencing wire</i>	9			
<i>Fertilizer</i>	5			
<i>Line trimmers</i>				7
<i>Trees seedlings</i>		6	6	7
<i>Water reservoir</i>	2			

Source: Workshop with PA VAM settlers, Juruena, April 2013.

In each year analyzed, a different program or project was operating in the settlement: PRONAF in 2001, GEF-UNDP in 2005, Aderjur/INCRA in 2008, and Carbon Sink Project in 2011. Aderjur/INCRA was a ICDP partnership led by a rural development organization (Aderjur) founded through the initiative of the UNDP project leadership. Aderjur's partnership with INCRA organized the construction and outfitting of the Brazil nut processing factory.

Top rated interventions identified and valued in Table 8 included training, credit, technical assistance, social organization, the elaboration of the LAU, portable saw mill services, the installation and outfitting of the Brazil nut factory, and market development. We note that many of the top-rated instruments are synergic, and would have limited viability in isolation. For example, investments in infrastructure and equipment would have little impact without social and cooperative organization (and vice versa), and social and cooperative organization would be of little interest without the ability to engage specific markets or develop new markets. Likewise, new market development is severely limited without legal documentation.

ICDPs in PA Vale do Amanhecer introduced multiple instruments and incentives. There was attention to the institutional as well as to the infrastructural framework that could make alternative land use an institutional as well as a social and technical reality. Thus the GEF-UNDP invested in legal documentation, the LAU, as an instrument itself. This was an investment to overcome transaction costs. Indeed, "documentation" is itself an instrument, inherent in any institutional economic framework. In the case of PA Vale, documentation was a prerequisite to the operation of subsequent instruments, namely certification and marketing, or for the settlement to be able to cooperative seek financing for sustainable activities from banks or federal programs such as CONAB.

Enhanced compliance in the environmental legal and regulatory regime in Juína and Juruena was not the result of federal command and control combined with enforcement. We observed that it was the result of an attention to cooperative livelihoods opportunities, to institutional transaction costs, and to the temporal sequence and continuity of institutional technical assistance.

9.8 Implication for REDD+ policy mixes and local implementation

Policy design for REDD+ or PES tends to follow a model based on compensation for forfeited opportunity costs (Cf. Gregerson et al 2010). However, All 29 farms in our sample (with one exception) had far surpassed the 20% deforestation allowed by the Brazilian forest code. The settlers in our sample had already been living on their INCRA assigned lots for 10 years or more and the majority of intended land use conversion on individual lots had already occurred. As such, PES or REDD+ designed to incentivize conservation alone would be mismatched with the majority of resource users in this context.

The other issue to consider is that settlers are interested in livelihood security (Cf. Scott 1976), rather than risky investments that may or may not provide sustainable cash returns. It is extremely difficult if not impossible for individual settler families to manage alternative productive activities without assistance, due to lack of infrastructure or access to credit financing. Cromberg (Angelsen et al. 2013) in a CIFOR study on REDD+ saw that settlers in Pará often would prefer robust technical assistance rather than direct payments, in order to improve long term livelihood security.

We suggest that REDD+ or PES could be reconceived in the mode of landscape scale planning, with a focus on integrating and investing in coordinated instruments for AFS systems, forest restoration and infrastructure for producing and marketing alternative AFS and NTFP commodities. The LAU is already on hand as an instrument to certify sustainable land use activities in Mato Grosso. However, as previously noted, it took 6 years to finalize the LAU for PA Vale do Amanhecer. As SEMA-MT cannot manage its internal transaction costs for environmental licensing, financing for REDD+ might be directed at strengthening SEMA-MT institutional arrangements and coordination at the state and municipal level.

Borner et al (2009), Corbera et al (2010) and Duchelle et al (2013), among others, point toward the security of institutional arrangements as a condition necessary for effective, efficient and equitable REDD+. But matching REDD+ or PES with settlement sustainability involves more than the issue of regularizing land tenure – it involves multiple transaction costs both for state agencies as well as for individual settlers. SEMA-MT’s weak administrative capacity (Cf. Azevedo 2009) and the relative autonomy of the municipalities does not guarantee institutional coordination between the state and the locality.

Meanwhile, without institutional arrangements that account for transaction costs, settlers lack the resources to participate in the CAR system, raising issues of equity and fairness. And it is even more difficult if not impossible for settlers to manage transaction costs for the LAU without ICDP intervention. Compensating farmers for foregone opportunity costs may tend to favor large ranchers who can capitalize transaction costs on an individual basis (Gonçalves Simões et al 2011).

In addition, workshop participant responses indicated that there were different perceived levels of social legitimacy for the different interventions. For example, settlers perceived that they had no say in the organization of PRONAF sponsored activities. PRONAF was predetermined by outsiders; it involved limited information sharing and no participation whatsoever in decision-making. Settlers’ only choice with PRONAF was to “take it or leave it.”

In contrast, in terms of their specific interventions, settlers perceived that the UNDP, Aderjur/INCRA and Juruena Carbon Sink projects all involved consistent communication and processes or feedback about the specific activities. Specific interventions within these projects

were valued high in terms of the community's participation in decision-making and the perceived legitimacy of the cooperative arrangements.

Finally, ICDPs created additional social organizations and entities to which the community could appeal. From having only 3 entities in 1998 and in 2005 to which the settlement could appeal, in 2011 the settlement was infused with local associations, cooperatives and rural development assistance (ADERJUR) – all of whom sharing an interest in the health and well being of the settlement and the sustainability of its environment and ecology. Cooperatives (COOPAVAM, AMCA) were also viewed as factors in themselves having an influence on the conservation/deforestation land use history of the settlement.

10 CONCLUSIONS AND RECOMMENDATIONS

In the three settlements under consideration in this case study, the 80% legal forest reserve rule in the Brazilian Forest Code was perceived to be illegitimate and unfair. It was perceived to impinge on livelihood security, to contradict earlier land use rules, or to go against an INCRA-incurred ethic that land use conversion was a means of demonstrating active use of the land. Settlers experience tenuous and fragmented communication with federal state and municipal governing agencies. With exceptions, the social interface between settlements and the state has produced more insecurity than trust, more liabilities than opportunities.

ICDPs were seen to help bridge this lack of trust in Juína and Juruena, where the results indicated ICDP institutional impacts additional to and enabling of the environmental regulatory and governance framework in Mato Grosso.

New Brazilian Forest Code rules were made official in October of 2012, which grant amnesty for deforestation in settlements that has occurred before July 22, 2008. This means that between 80 and 100% of deforestation has the potential to be legalized in PA NC and PA I (Stickler et al. 2013). In May of 2013, the municipality of Cotriguaçu was reaching out to settlers to process the CAR, with some success. While environmental legalization does not imply that these settlements will restore forests or develop more sustainable land use, the new forest code should also make environmental governance more feasible and socially legitimate in settlements in NW MT.

However, while the new forest code rules recognize the acquired rights of settlers, the forest code does not necessarily encourage social organization around cooperative resources. In the context of the new Brazilian Forest Code, PA VAM has become something of an institutional anomaly in terms of environmental regulation and planning. After 6 years of concentrated institutional and infrastructural interventions, PA VAM is fully legalized. The settlement has managed to develop its own internal industries, supported by a collectively maintained natural resource. However, this industry does not involve agricultural production

on the individual lots themselves, and the LAU contains a demanding land use restoration plans to be implemented over a 35-year period. Developing alternative land use on the individual lots is an entirely different question than maintaining a collective forest for NTFPs, but forest restoration plans may eventually have legitimacy in PA VAM if those restoration plans can be integrated with attention to livelihood security.

In the case of PA VAM, ICDP interventions circumvented the question of land tenure irregularity and individual farmer transaction costs. They did this by integrating the legalization of the settlement's collective forest reserve with a plan for cooperative livelihood security through infrastructure and the marketing of Brazil nut products. Interviews revealed a common awareness of and legitimacy for the settlement's collective forest reserve. But this social legitimacy likely could not have been achieved except through linking the environmental license with the economic feasibility of the COOPAVAM and AMCA cooperatives. Thus, rather than to impose the environmental legal and regulatory system in isolation, the GEF-UNDP-SEMA project, Aderjur/INCRA and Juruen Carbon Sink projects built regulatory compliance in the context of other interventions and instruments, i.e. material infrastructure, market development and credit financing.

However, this particular collective approach was made possible by the fact that PA VAM had a collective forest reserve. There are 480 INCRA settlements Mato Grosso; few have collective forest reserves. Thus the potential to collectively circumvent individual transaction costs for NTFP certification in settlements is limited. On the other hand, cooperative licensing and certification would be possible for AFS, as AFS systems can be installed on individual farms. Well organized and sustained ICDP interventions could invest in coordination with INCRA, SEMA-MT on integrating long term land use planning with cooperative livelihoods through the aggregation of individual farm resources.

Alternatively, as demonstrated in Juína, the municipality can play a role in lowering transaction costs for farmers. The municipality supported individual settler land use registration in the CAR. Meanwhile, a local cooperative that was brought into being through an earlier ICDP project (PACA), managed after a similar several year period to obtain an environmental license for processing pupunha or heart of palm. Thus, land use planning was managed on an individual basis by the municipality, whereas the issue of certification and markets was managed by the local cooperative AJOPAM.

But while municipal government coordination can certainly coordinate environmental regulatory compliance in settlements, a concern for institutional development is that there is no guarantee for political and administrative continuity at the level of the municipality. Brazil's political system is very decentralized, in which county mayors have almost full authority and discretion over the municipal fiscal and budgetary affairs. In municipal political transitions, programs that attend to the institutional needs of settlers or smallholders risk being cut from one administration to the next.

As such, we suggest that ICDPs may have a vital role to play in terms of their independence of local electoral cycles. At the same time, settlers do not have sufficient collective resources to circumvent larger scale or cooperative certification or marketing challenges without assistance. Finally, social organization is difficult without the mobilization of cooperative resources, which can only come from ICDPs.

Households and farms within PA Vale have welcomed collaboration with ICDPs and at the same time that the settlement has developed its own cooperative engagement around new livelihoods – imagined by members of the community itself, such as the production of textile garments and the production of Brazil nut derived pasta and cookies, today distributed to tens of thousands of schoolchildren via the CONAB program.

As shown by the case of PA VAM, a truly integrated conservation and development project is more than support for business as usual. These livelihood arrangements in PA VAM are in fact a set of truly transformative institutional partnerships and arrangements, involving multiple transaction costs and multiple rules systems – legal, economic and cultural.

Finally, these institutional partnerships and arrangements are impossible to achieve based on the economic model of individual farmers acting in isolation, each of whom would rationally determine his or her land use based on a calculation of optimal rent / opportunity costs. On the basis of compensation alone, it would be difficult if not impossible for small settler farmers to opt out of the cattle economy while remaining on the land. Initial on farm investments, such as irrigation, would be difficult if not impossible to secure without documents necessary for securing loan or credit financing. At the same time, bringing alternative commodity markets to scale can only be accomplished through cooperatives in financial partnerships with ICDP state and private sector entities. While some farmers have been able to surmount the odds through their personal passions, a public or at least publicly oriented policy should consider the policy mix toward alternative commodity markets and feasibility of the institutional path to participation in that market.

Finally, not only multiple instruments, but synergies between multiple government agencies have been key to the social legitimacy and institutional viability of ICDP interventions. INCRA, lacking adequate resources, should be engaged as a partner in longer term interventions that help secure forest conservation through livelihoods.

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Pilot projects and agroenvironmental measures in northwest Mato Grosso, Brazil: impacts and lessons for REDD+ policy "mixes"

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Abstract. This case study, located within the Brazilian Amazon “Arc of Deforestation” examines the effectiveness of a sequence of Integrated Development and Conservation projects (ICDPs) and respective Agro-Environmental Measures (AEMs) promoted for deforestation mitigation, in Northwest Mato Grosso (NW MT). The study evaluates ecological, economic and institutional variables as vectors for land use decisions on deforestation on family farms in agrarian reform settlements, on lots of between 50-100 hectares. The region is a forest frontier comparable in size to Panama, and exhibits the highest deforestation rates in the Amazon, despite having experienced a broad range of initiatives aimed at halting deforestation and biodiversity loss over the past 15 years. The study is based on a sample of farmers in three municipalities (Juína, Juruena, Cotriguaçu) with varying exposure to ICDPs between 1995 and 2010. We performed an ex post analysis of ICDP impacts by assessing: (a) biophysical indicators of land use, carbon stocks, and tree biodiversity in forest and agroforestry plots; (b) the distribution and magnitude of economic gains leading to permanence of the ecological impacts; and (c) the institutional design and social-political context behind the cases, assessed through farmer interviews considering perceptions on institutions and governance. We identify opportunities for introducing sustainable land use practices and the need for a more systemic approach to project evaluation arising from ICDP experience. Environmental licensing and alternative, sustainable forest products marketing outcomes supportive to local livelihoods were achieved by integrating social organization with material and institutional infrastructure. As results indicate, even in a landscape subject to adverse political economic conditions, the support for an integrated set of instruments over longer temporal scales and at finer spatial scales can be effective routes for forest and biodiversity conservation as well as economic and institutional improvements. These achievements may also lead the way toward effective application of other conservation-oriented economic instruments.

12 INTRODUCTION

For decades, public administrators have been attempting to encourage conservation through combining command and control policies with economic incentives (Perlin, 1992). In Brazil this approach was spearheaded with international support stemming from concerns over deforestation in the aftermath of the 1992 Rio Conference. One of its most substantial ventures was the launching of the “Pilot Program for the Protection of Brazilian Rainforests” (PPG-7). This joint initiative of the Government of Brazil and Amazon states with support and technical assistance from the seven most wealthy countries of that era (the G-7), as well as the European Commission, the Netherlands and the World Bank, was an attempt to "reconcile economic development with sustainable conservation of the rainforest" (De Antoni, 2010). Similar initiatives were funded by the Global Environmental Facility (GEF) throughout the tropics. International donors also funded projects with non-profit organizations devoted to rural sustainable development and biodiversity conservation.

As one of the most active forest frontiers in the world, Northwest Mato Grosso (NW MT) was a focal point for various Pilot Projects, including the PPG-7 and a major GEF funded “sustainable biodiversity use” project from 2001-2009. These projects were comprised of a group of instruments that included: i), support for decentralization of environmental administration; ii), increase in area and number and consolidation of public Protected Areas (PAs), consisting of Indigenous Lands (ILs) and Conservation Units; iii), social consultation to prepare information in support of national and state Social, Economic and Ecological Zoning plans (ZSEE); iv), agroenvironmental measures, focused on the mosaic of agroecosystems, private forests and populations living in buffer zones or inside PAs and ILs.

The latter, agroenvironmental measures, moreover consisted of a full package: technical assistance for soil and water conservation; restoration of degraded areas; tree planting and agroforestry systems (AFS); appropriate technology; non-timber forest products (NTFP); and low impact forest management. Subsidized credit, certification and incentives for processing NTFP and other agricultural products would often also be included. Such a set of instruments fits the mould of Integrated Conservation and Development Projects, or ICDPs (Blom *et al.*, 2010), an approach that has seen a wave of criticism in the last decade.

Ferraro and Kiss (2002) pointed out that “direct payments for biodiversity conservation would be more effective and efficient than integrated conservation and development projects (ICDP) and should be adopted as policy tools to conserve biodiversity”. Also, according to Miteva *et al.*, (2012) “the number of rigorous impact studies on ICDPs is very small, with the evidence suggesting no impact from the interventions.” Ferraro and Kiss (2002) criticism is based on assumptions that “people are more likely to incorporate new sources of income as complements to existing activities rather than substitutes for them”, and that “the technical, economic, social and political conditions needed for an indirect approach to succeed are difficult to find in the real world”. For Miteva *et al.* (2012), the lack of evidence is linked to the lack of adequate data regarding impacts.

These articles identify a clear need for better empirical analysis and robust interdisciplinary quantitative-qualitative data about the outcomes of ICDP initiatives, to verify these statements in the “real world”. Our central assumption follows Minang and van Noordwijk (2013) who argue that “ICDP’s can be used as a strategy for implementation of REDD+¹ at multiple levels (...) The challenges are about choices or optimal mixes between multiple policies and instruments for addressing drivers of deforestation.” We consider also that ICDPs are an opportunity to promote the progressive selection of ideas from the place and time of their production until the time of their institutionalization as instruments of public policy (Foilleux, 2011).

ICDPs were designed to counter the narrow focus of conservation and development policies which were tailored towards specific outcomes, e.g. protected area creation. A narrow policy focus neglected how deforestation vectors operated in complex social-ecological systems (SES). SES “form a multilevel hierarchical structure, but where the different levels are of distinct kinds, i.e., the structure is not scale-free or across scales” (Holling et al, 2002). Mainstream economic policies are thus relevant to ICDP project design and evaluation, because ICDPs are nested within a larger policy context and regional economic growth trajectories. Direct and indirect drivers of land use change in the Brazilian Amazon are closely associated with developmental public policies such as large-scale infrastructure projects; persistence of rural credit programmes that prioritize extensive cattle ranching; land tenure regularization policies (or their absence); commodity markets; divergence between ministries; and lack of enforcement (May et al., 2011). Additionally, with respect to public decision making around land use, it is also relevant to consider the political power and influence of the protagonists of mainstream economic policies. Therefore, governance aspects cannot be neglected in an evaluation of ICDPs, as “ecological and social-ecological systems form nested sets of adaptive cycles, the larger, slower cycles generally constrain the smaller, faster ones and maintain system integrity” (Gotts, 2007). For the mainstream, the maintenance of systemic “integrity” implies that low commodity prices and subsequent crisis in cattle ranching will stimulate governmental response to shore up the industry with cheap credit and infrastructure support. However, no such support is generated for the smallholder segment, due to asymmetry of political power. Under such biased conditions, success would be serendipitous.

To evaluate such projects we utilized databases on participants in ICDPs in agrarian reform settlements in NW MT. We identified parameters to describe the effectiveness of ICDP instruments. We also consider and describe public policies *vis-à-vis* perverse incentives that incite deforestation, and we characterize local institutional conditions and perceptions. In the process we identify potential impacts and lessons about instrument selection contexts, including processes that help smallholders and agrarian reform settlers “overcome their shame and sense of exclusion ... to move from being recipients of welfare programmes to taking a proactive role in public affairs” (Rival, 2012).

In synthesis, amongst the identified instruments and institutions, we focus on adopted strategies, synergies, redundancies, inherent risks, successes and failures. We intend this to contribute towards a discussion about the role of ICDPs as a conservation strategy (Blom et

al, 2010), and also toward designing better projects in the current REDD+ “readiness”² context. The particular structure and configuration of multiple instruments, i.e., the policy mix, should be of key concern in REDD+ strategies (Enright *et al.*, 2012). The point is to inform on how best to integrate synergic policies and their related instruments in a more cost-effective, systemic impact oriented “policymix” (Ring *et al.*, 2011) at all stages of project development.

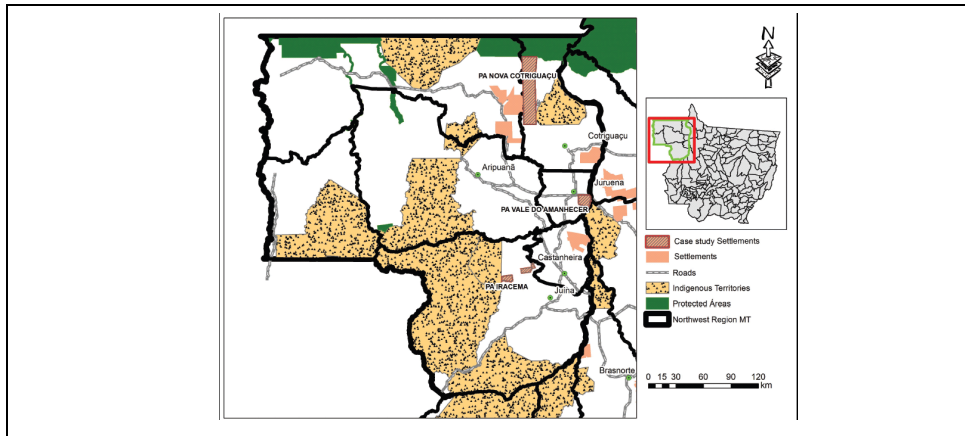
In the introduction we describe the context and the prevailing negative incentives. We describe the political scenario and its interface with ICDPs, and introduce conflicts associated with the expansion of cattle ranching. We identify ICDP-demonstrated opportunities for sustainable land use and the need for a more systemic approach to project evaluation. In the next section we focus on the research methodology, in which we describe the case study region and scope, and the multidisciplinary framework adopted to evaluate biophysical, economic and institutional variables using ICDP databases. Subsequently in the results and discussion sections, we introduce the quantitative and qualitative data describing specific gains made possible by these projects, and the spatial scale of these gains. We consider the particular set of instruments adopted and the contexts and arrangements that made them viable. In our conclusions we discuss the observed gains, information gaps and “grey areas” deserving further research. We advance the case for a “Policymix/policyscape” designed to reinforce land use mosaics that integrate de facto biodiversity conservation and sustainable agroecosystems.

13 CONTEXT AND MOTIVATION

13.1 The soya/cattle/logging policyscape

We present here a brief overview of the *ex ante* “policyscape” (a landscape mosaic shaped by a spatially explicit mix of policies) in NW MT, where different stages, from pre-colonial forest formations to stable mosaics (Barton *et al.*, 2013) are present, revealing the kind of incentives - basically stimuli to cattle ranching – that were applied. In this setting, ICDPs were introduced in an effort to inspire a shift in public policies. The Brazilian Amazon is one of the more active land-use frontiers in the world, accounting for nearly half of all tropical forest loss worldwide during 2000-2005 (Hansen *et al.*, 2008). However, in the 7 years since that period, deforestation in the Amazon declined by an impressive 75%, more than reaching the nation’s voluntary target for CO₂ emissions reductions announced at COP15 (May *et al.*, 2011). Even so, deforestation persists along a wide swath of municipalities in the so-called “Arc of Deforestation”, which includes all of NW MT. In 2009, nearly 80% of its original 104 thousand km² of forest cover were inside 11 indigenous areas (37%) and in 9 Conservation Units (5.5%), while 6 isolated indigenous peoples³ have been identified in the region. The remaining 57.5% of forests were constituents of rural land uses on private properties and agrarian reform settlements (Fig. 1) in a region consisting of seven municipalities: Aripuanã, Castanheira, Colniza, Cotriguaçu, Juína, Juruena, and Rondolândia (Vivan, 2011).

(a)



(b)

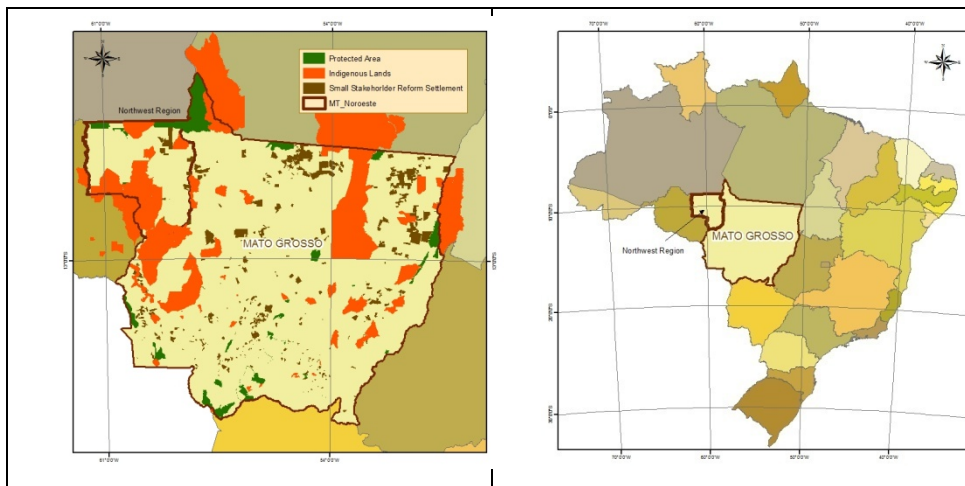


Fig 1. Northwest Mato Grosso and case study municipalities (a) and (b), agrarian reform settlements, Conservation Units (protected areas) and Indigenous Lands.

Deforestation in NW MT between 1990 and 2010 followed a pattern common to frontier areas throughout the Arc of Deforestation, involving infrastructure investments (opening roadbeds or paving of highways) and a surge in commodity prices (May, 2011). MT has the largest cattle herd population in Brazil (28.6 million), and Juína (over 543 thousand) has the sixth largest herd among Brazilian municipalities, harbouring a major slaughterhouse installed with BNDES (Brazilian National Development Bank) funding. Commodity prices played a major role as vector for deforestation between 2001-2005, when soy production increased by 81% in the state of MT. In 2005-2009 productivity increases contributed for 22% of the growth of soy production, while a total of 91% of the expansion occurred on previously cleared land, mostly old pastures in the Cerrado region, pushing cattle ranching from there into the Amazonian biome, where it became the principal vector for new forest clearing.

13.2 A “non-amenable” political scene

On the political scene, MT has had a contradictory history in its policies regarding conservation, making it a rather antagonistic setting for ICDPs. State level Social, Ecological and Economic Zoning (ZSEE-MT) has been ongoing since being required by Brazil’s Constitution of 1988⁴. The state government of MT allocated from 1998 to 2008 the sum of US\$ 6.05 million via PPG-7 for an Integrated Environmental Management Programme (PGAI) including a pilot zoning exercise in NW MT. The UNDP/GEF project in 2001 also allocated \$ 2.14 million for plans and zoning incentives to encourage the creation of an array of sustainable land uses (Vivan, 2009).

However, in 2009-2010, a very active and aggressive agribusiness lobby participated in public audiences about the ZSEE, flagging against economic risks implied by zoning restrictions for cattle and soy, and criticized the demarcation of new Indigenous Lands as a threat to rural development. In 2010 the agribusiness lobby substituted the original ZSEE proposal with its own version, providing for expansion into areas previously designated for protection. This version was then vetoed by the National Environmental Council (CONAMA), which established a political deadlock that remains unresolved⁵. These events are the public face of a hidden, harsher conflict over the future of land use in the region.

13.3 Crisis and opportunities for instruments and aligned policies

A state partner fundamental to the success of the GEF project strategy for implementing AFS, the state rural extension and research service (EMPAER-MT) was effectively dismantled through budget cuts from 2003 to 2013⁶, demolishing hopes that ICDP strategies might be mainstreamed. The state environmental agency (SEMA-MT), responsible for implementing command and control policies, had 36,000 applications for forest management waiting to be reviewed as of 2012⁷. Even with GEF support, it took 3 years to administer a request for a single forest management plot involving an FSC-certified company operating in NW MT and 4 years for the legal license to be issued to a local cooperative to establish a heart of palm and juice pulp processing facility in Juína.

Confronted with declining or inconsistent local political support for conservation agendas and state and federal policies and investment priorities that encourage deforestation, ICDPs nevertheless sought to adopt a set of instruments and aligned policies, where possible overcoming budgetary restrictions (Vivan, 2009). In NW MT the policy framework appears to have militated against any success, yet progress was notable. Our analysis of this case offers lessons for the road ahead on forest governance at the agricultural frontier.

14 METHODOLOGY

14.1 Location and project characteristics

We concentrated on primary and secondary data collected in the municipalities of Juína, Juruena and Cotriguaçu, considering the impacts of different instruments adopted through ICDPs implemented in NW MT beginning in 1995. Their results were assessed from different perspectives through: i) biophysical evidence at the farm and at the landscape level; ii) economic impacts, considering the contribution of AFS to net income of farmers in comparison with prevailing beef and dairy cattle practices; and iii) institutional impacts, in terms of lessons for the selection of instruments that can potentially compose a workable policymix in this setting.

Databases generated in the course of four ICDP projects carried out in NW MT between 1995 and 2012 and fieldwork in 2012-2013 contributed to this evaluation:

Pilot Program for the Protection of Tropical Forests in Brazil (PPG7), especially Type A Demonstration Projects (PD/A), with expected impacts in Juína. This project was implemented between 1995 and 2006 (Pinzón Rueda et al., 2006), mostly through the PACA Project (Tree Density Enhancement Consortium Project, 1996-1998), run by AJOPAM (Juinense Rural Association Organized for Mutual Assistance).

"Conservation and Sustainable Use of Biodiversity in the Frontier Forests of Northwestern Mato Grosso", with expected impacts concentrated in Juruena, Juína and Cotriguaçu. The project was funded by the Global Environmental Facility (GEF) and the Secretariat of Environment of Mato Grosso (SEMA-MT), and implemented by the United Nations Development Programme (UNDP-Brazil) between 2001 and 2010 (Vivan et al., 2008).

Juruena Carbon Sink Project/ADERJUR, with impacts concentrated in PA Vale do Amanhecer agrarian reform settlement, Juruena (PA_VAM). The project is funded by the state oil company Petrobras, through its environmental grant program "Petrobras Environmental" (2010-2011, renewed for 2013-2014).

14.2 Biophysical variables

14.2.1 Biomass, Carbon and AFS Tree Diversity

Part of the justification for pilot project investments in NW MT was to test ecosystem services markets, to protect biodiversity and to promote its sustainable use. A biomass inventory in forests and AFS is a basic tool to register carbon stocks which underpin PES. However, these same systems can be checked for habitat quality, using a set of indicators⁸ (Laurance and Vasconcelos, 2004) that act as surrogates for biodiversity status.

In 2010, the GEF project invested in a dual assessment in AFS of above ground carbon (Gonçalves, 2010) and plant diversity (Vivan, 2010). The same type of assessment was performed by the Juruena Carbon Sink Project (Nunes and Rugnitz, 2011). We used both

databases to contrast C stocks with plant diversity indexes in AFS, assuming that the latter attribute constitutes an important surrogate for habitat quality (DeClerck and Salinas, 2011). The baseline for carbon stocks for pastures in the region is 5 MgC/ha, whereas the tree diversity baseline is zero for the same pastures (Nunes and Rognitz, 2011).

Original data were assessed for distinct AFS systems, identifying and measuring vascular plants (trees) over 15 cm of diameter at breast height (dbh) in a group of 35 farms selected in different rural communities in the municipalities of Cotriguaçu and Juína. Each farm received rectangular sampling units of 700 m² (20 x 35 m), according to criteria of age and structure/composition of the AFS, resulting in 83 sampling units totalling 106 ha. Meanwhile, the Poço de Carbono project in Juruena assessed 31 farms using the same methodology, resulting in 74 sample units. A set of allometric equations were used to estimate tree biomass for all the samples. These equations were selected according to the study region's ecological conditions and the type of species measured.

The studies identified shrub or tree species, whether planted or regenerated; dbh measured at 1.3 meters; and the total estimated height for individuals. With these data we focused on the following phytosociological indices, using the Mata Nativa 2:10 software application (Copyright 2001-2007 Cientec):

- I= Age of the AFS in years;
- Carbon=Estimated Carbon stocks in MgC (tones of Carbon);
- Coverage Value Index (CVI) of each species. Obtained by summing values for density and dominance, which gave 72,4% for the same eight species;
- Importance Value Index (IV). Combines phytosociological values for each species;
- Diversity Index of Shannon-Weaver (H). Is sensitive to rare species (higher % of rare spp., lesser value); generally, values are between 1.5 and 3.5 (rarely above 5.0), and is sensitive to variations in abundances;

A species/area curve showed a stabilization trend with a strong determination coefficient ($R^2 = 0.9470$) given 83 sample units, involving 146 observed species (and other woody species in the case of agricultural crops, i.e. coffee, cupuaçu, cocoa). Considering similarities in species composition, the 74 sample units in Juruena resulted in the same trend. By integrating these phytosociological parameters with the Carbon stock measurements, these land use data provided us with a surrogate for habitat quality and related biodiversity.

The role of AFS as a surrogate for biodiversity gains and as habitat improvement for fauna was based on an empirical assessment in Juína and Cotriguaçu in 2008. This involved a case study of 5 farms adopting AFS (Gonçalves et al, 2009) in Juína and Cotriguaçu. These farms were the object of participatory analysis of landscape connectivity and of its implications in sighting wildlife. Using Google Earth images, a technician measured distance attributes and valued the area and form of forest fragments and AFS patches.

14.2.2 Land use dynamics

Having based our biophysical assessment on secondary data, we opted for in-depth case studies of land use dynamics, in order to carry out multi-scale and comparative analysis of social-ecological system variables (Ostrom 2007). A case study approach is also useful for identifying information gaps, methodological challenges and opportunities for further research.

14.2.2.1 Farm level

Relying on Vivan (2010), we evaluated data on 62 farms in Juína and Cotriguaçu compiled in data sheets and farm-level maps constructed through visual interpretation of land use (Amaral et al., 2011), complemented with on-farm interviews and field notation of GPS coordinates. All samples with areas under 30 ha were taken out of the evaluation, to retain matching between participants (AFS adopters) and controls (non-adopters of AFS). We identified 22 participants and 24 controls according to their relative exposure to ICDP activities during 1995-2012, as defined through participation records in project reports and by having AFS as a reported land use in the maps and data sheets. The land use maps were based on low resolution (30 m x 30 m pixel) Landsat images from 2007-2008, processed in a CAD environment, allowing digitization of polygons including the following categories: forest, grassland, Permanent Protection Areas (APPs), deforested APPs, Legal Reserves (RL), area of RL to be restored, drainage system, and roads.

14.2.2.2 Landscape level

A landscape scale analysis of deforestation dynamics was conducted for 3 agrarian reform settlements (PAs) in which ICDP projects could potentially show impacts, owing to distinct levels of engagement by settlers (INCRA, 2011): (1) Settlement Project Nova Cotriguaçu (PA_NC), Cotriguaçu, 99,988.5ha, 1,234 households, settled in 1995; (2) Settlement Project Iracema (PA_I), Juína, 18,120 ha, 343 households, settled in 1996; (3) Settlement Project Vale do Amanhecer (PA_VAM), Juruena, 14,400 ha, 243 families settled in 1998.

We used a time-series approach, comparing data and maps derived from Landsat imagery between 1995 and 2011. The study area was defined as the area within the above described agrarian reform settlements. The resulting product is a series of land cover maps revealing the temporal and spatial evolution of land use change, and enables comparison amongst the different settlements (Figure 1). We calculated the total area of forest remnants at the outset of the settlement, and then evaluated the progression (in percent of baseline forest cover) of the deforestation that took place. Following the case study approach, this procedure allowed us to compare avoided deforestation between PAs in terms of habitat losses and implicit costs of restoration in accordance with the requirements of the Forest Code for maintenance of a minimum 80% forest cover in the Amazon region.

14.3 Economic variables ⁹

Economic performance indicators included data on the following production systems: a baseline for cattle ranching and mixed cattle (beef and dairy); 'participant' land uses adopted by ICDP project participants; and NTFP, focused on Brazil nut collection. Data relies on a set of 55 farms ranging from 4-250 ha in size that were evaluated for land use in Juína and Cotriguaçu by Vivan (2010). Nunes and Rugnitz (2011) also produced a set of economic indicators for PA_VAM in the context of the Juruena Carbon Sink Project.

Data provide parameters over particular subsystem parameters including: Cattle ranching (dairy, beef, calves); Perennial monoculture crops (e.g., coffee); AFS plus silvopastoral systems; Forest cover. The original data source was cross-checked using field based interviews and reports. Sampling targets included smallholders within agrarian reform settlements or in similar contexts with regard to social, economic and property size variables in Juína and Cotriguaçu. The indicators for each subsystem included: (1) gross revenues obtained per unit of area managed (in US\$/ha); (2) gross revenues obtained per 8 hours of labour in an activity (in US\$/day); (3) Area in hectares that could be managed per unit of human labour in a year, i.e., based on 260 days of 8 person-hours per year (in ha/person). Along with restoration costs available in Vivan (2010), these data were used for a comparative analysis of cattle ranching and alternative land uses promoted by ICDPs.

14.4 Institutional variables and impacts

Finally, we carried out an institutional analysis during 2012 and 2013, in a joint effort with the Center for Tropical Agricultural Research and Higher Education (CATIE) graduate program in Tropical Forests and Biodiversity Conservation and Management, in Costa Rica.

Household questionnaires and semi-structured interviews were conducted with 29 farmers on lots of between 50 and 100 ha in settlements administered by the National Institute for Colonization and Land Reform (INCRA) in the municipalities of Cotriguaçu, Juruena and Juína. This sample included consistent year-to-year participants in ICDPs, occasional participants, and non-participants.

The questionnaires documented the current land tenure status and legal environmental status as regards registry in the "Cadastro Rural Ambiental" (CAR). The CAR is the national system for registering land owners' compliance with rules established by the new Brazilian forest code.

Semi-structured interviews with individual farmers were designed to record the historical experience of farmer interaction with various government and project entities. This took three approaches: i) interviews elicited values on a scale (1=low influence to 10=high influence) that each farmer associated with the perceived influence of four broad criteria (legal, economic, community/cultural, ecological) when making land use decisions; ii), interviews were used to draw out farmers' experiences of their communication with six actors, each with distinct if interrelated mandates in terms of land use conservation and management: INCRA, the Brazilian Institute for Environment and Renewable Natural Resources (IBAMA), SEMA-

MT, the local municipal government, local associations, and ICDPs (Cf. Long 2001); iii), interviews prompted responses in terms of perceived legitimacy or fairness of distinct components or instruments making up the Brazilian Forest Code (Cf. Corbera et al 2007).

These individual interview responses were collated and compared with group workshop data, in order to further understand the historical evolution of land use decision-making processes and institutional arrangements. Researchers then held a group workshop with farmers from the Vale do Amanhecer settlement in the municipality of Juruena. This group workshop entailed: First, the participative construction of a socio-ecological timeline of vectors and factors affecting land use decision-making and deforestation in PA_VAM over the 15-year time period since the first ICDP activities in the region; Second, a group evaluation of the perceived practicality and land use influence of specific project instruments in PA_VAM during the same period; Third, a group evaluation of governance in terms of participation and perceived institutional legitimacy for the same specific project instruments, over the same 15-year period.

15 RESULTS

15.1 Biophysical Impacts

15.1.1 Biomass and Carbon at farm level

Distinct AFS compositions in the municipality of Juruena demonstrated similar carbon sequestration values; although the range of values indicated in Table 1 suggest that management, species selection and spatial structuring influence C sequestration and storage:

Table 1. Agroforestry Systems categories and average C stocks (Mg C/ha) after 8-14 years, Juruena, Mato Grosso, Brazil, 2011. Adapted from Nunes and Rugnitz (2011).

AFS composition	Carbon stocks (MgC/ha)
<i>Shaded coffee</i>	65.6 (27.5 - 107.0)
<i>Shaded cupuaçu (Theobroma grandiflorum)</i>	55.6 (30.1 - 75.9)
<i>Palm trees</i>	54.1 (20.5 - 102.7)
<i>Forest home garden</i>	75.1 (44.9 - 122.7)
<i>Silvopastoral</i>	48.7 (16.2 - 119.2)
<i>Teak (Tectona grandis)</i>	46.1 (11.3 - 97.6)
<i>Mixed native tree consortium</i>	67.0 (12.4 - 151.3)

Considering Carbon stocks values as a part of a composite proxy for habitat, the average (timber exploited) degraded forests around Cotriguaçu had values similar to those estimated for private smallholders' forest fragments, and close to AFS more than 10 years of age in Juína and Cotriguaçu (Table 2). The variation of stocks in AFS (75-192 MgC/ha) is related to management, as some AFS are installed after selective logging, leaving Brazil nut or other useful trees. Mature and more complex AFS then show, from the habitat perspective, a potential functional role complementary to that of forests (Wiersum, 2004; Clement et al., 2007; DeClerck and Salinas, 2011), by providing connectivity in highly fragmented landscapes.

Table 2. Land uses and Carbon stocks in Forest fragments and Agroforestry Systems (AFS) in northwest Mato Grosso.

Land use	C stocks (MgC/ha)	Source
<i>Degraded forests managed for timber</i>	173	<i>Scaranello (2011)</i>
<i>Private small holders' forest fragments</i>	142	<i>Gonçalves et al. (2009)</i>
<i>AFS more than 10 years of age</i>	192	<i>Vivan (2010)</i>
<i>AFS (31 farms) assessed by the Poço de Carbono Project</i>	75	<i>Nunes and Rugnitz (2011)</i>

15.1.2 AFS Tree Diversity at farm level

In the Juruena assessment, of the 10 most frequent species in AFS, eight are native (Table 3). These 8 account for 35.1 % of the total Importance Value Index (VI), which combines phytosociological values for each species, according to the plant community to which they pertain (Matteucci & Colma, 1982). The Relative Coverage Value Index –VC (%), obtained by summing relative values for density and dominance, gave 36.2% for the same eight species. As such, one third of the total biological value is due to native species, and represents around 35% of the horizontal structure of the AFS.

In a complementary study, Gonçalves et al. (2009) evaluated wildlife sightings in the context of AFS-forest connectivity. Results showed that sightings were reduced (≤ 20 spp) in cases where AFS and forest were over 1 km apart. Larger areas of forest inside the farm did not affect these values, reinforcing the general assumption that lack of connectivity has a critical effect on wildlife mobility between habitat patches (Gascon et al., 2004). Greater wildlife diversity (46 spp) and greater observed feeding, reproduction and movement, were registered for cases which had more forest cover and higher landscape connectivity between AFS and forest. Even for small farms within 3 km from the municipal urban center, better AFS/forest connectivity was associated with increased wildlife sightings (≥ 28 spp).

Table 3. Phytosociological parameters of the 10 most utilized tree species in AFS >15cm of dbh in 75 samples of AFS in Juína and Cotriguaçu, NW MT, Brazil, 2010.

Species	Local name	n	VC	VC (%)	VI	VI (%)
<i>T. grandis</i> (*)	Teca	907	45.3	22.7	49.9	16.6
<i>B. guianensis</i>	Garrote	394	20.0	10.0	28.7	9.6
<i>S. amazonicum</i>	Paricá	199	21.5	10.7	25.9	8.6
<i>B. gasipaes</i> (*)	Pupunha	446	19.8	9.9	22.4	7.5
<i>I. ingoides</i>	Inga	150	7.5	3.8	11.4	3.8
<i>S. macrophylla</i>	Mogno	117	5.9	3.0	9.0	3.0
<i>T. serratifolia</i>	Ipe Amarelo	118	4.7	2.4	8.8	2.9
<i>C. sciadophylla</i>	Embauba	85	4.6	2.3	7.8	2.6
<i>Ficus sp.</i>	Figueira	55	4.3	2.1	7.0	2.3
<i>C. odorata</i>	CedroRosa	72	3.8	1.9	6.9	2.3
Accumulated values for native spp		2543	72.3	36.2	105.5	35.1

(*) = non-native species. n=number of trees evaluated.

For forest fragments evaluated in Juína and Cotriguaçu (Gonçalves, 2009), Shannon Index values varied between 2.6 and 3.8, suggesting a certain ecological integrity despite the common history of logging in these areas. This is consistent with evaluations of degraded, logged forests in Southeast Asia (Edwards et al., 2009). Further studies can confirm if, beside C stocks and diversity, other AFS attributes in the region as a whole (size, shape, border, connectivity, composition and structure) are providing for the functional role indicated by our results.

15.1.2.1 Landscape units levels: deforestation trends in PA's

Table 4 indicates percentage of original forest cover in the three settlements starting from the year of their initiation. PA_I and PA_NC were the most deforested settlements in percentage terms at the end of this period. PA_I was the first settlement in which "cleared area" surpassed "forest area" occurring between 2004 and 2005. PA_I also has the lowest value for remaining forest, or 18%. In PA_NC, "cleared area" surpassed "forest area" in 2008; in 2011 PA_NC has 35% of forest remaining.

Table 4. Forest cover dynamics (% remaining**) on four Agrarian Reform Settlements (PA) in NW MT, Brazil, 1996-2011.

Year	96	97	99	00	01	02	03	04	06	07	08	09	11
<i>PA_I</i>	100	87	*	*	73	57	62	44	*	27	29	28	18
<i>PA_NC</i>	100	99	*	*	*	*	78	71	57	*	56	42	35
<i>PA_VAM</i>			100	96	90	84	78	75	70	65	63	59	57

PA_I=PA Iracema, Juína; PA_NC=PA Nova Cotriguaçu, Cotriguaçu; PA_VAM=PA Vale do Amanhecer, Juruena; PA_J=PA Juruena, Cotriguaçu. *=Years with no satellite data. **= The baseline (100 %) is the area of Forest still remaining at the time of the beginning of the settlement.

In contrast, PA_VAM had 57% of original forest area in 2011, and we observe that total deforestation in PA_VAM has not proceeded at the same rate as in PA_I and PA_NC. At the end of roughly a decade, PA_VAM has 22% more remaining forest than has PA_NC, and 39% more remaining forest than has PA_I. The fact that PA_VAM had preserved 39% more forest cover than PA_I involves resource management, legal, institutional and economic considerations. First, in resource management terms, as a collective legal reserve, the forest area is being managed as a single area, in which 4,500 ha are managed through the mapping and georeferenced identification of Brazil nut trees (800 trees are identified within the collective legal reserve). Forest paths are maintained, implying periodic monitoring of forest invasions by poachers and loggers. Certification for NTFP products is tied to the maintenance of the collective reserve, which includes fire prevention.

In legal terms, PA_VAM restoration plan requires that less land on individual lots be restored to forest in order to reach the 80% benchmark. With the new Forest Code, in order to calculate the 80% required, Riparian Areas are now subtracted from the total area of the settlement, and then 80% of the remainder is required for conservation as a legal reserve (Brazil, 2012)¹⁰. Finally, in institutional terms, creating a collective reserve and resource management plan for the entire settlement was an institutional innovation. Other settlements in the region had forest reserves delimited at the individual lot level. While collective governance of the collective reserve in PA_VAM has been fraught with difficulties, it has proven institutionally feasible. In contrast, securing individual farmers' compliance with forest code restrictions has been next to impossible.

15.1.3 Deforestation at farm level

Overall, ICDP participants exhibited 13% greater forest cover than 'controls (see Table 5 below). Considering the benchmark of 80% forest cover (summing riparian areas and LR), our results indicated that 72% of the positive group had deforested over 10% in excess of

legally permitted levels, while for the control group 95% had deforested to the same extent. AFS represented 4.2% of the aggregate area for all positive farms.

If the legally required forest reserve (Legal Reserve - LR) amount was instead 50% – which was the reserve requirement prior to 2001 – only 33% of the positive farms would be out of compliance, in contrast to 62.5% for the control group. Under current regulations small farmers are permitted to include AFS area as part of the LR. However, as we focused on forest habitat, we did not include this area in LR calculations, as the focus of the analysis was on native forest conversion to other uses, not total tree cover. Also, Table 5 shows that bigger farms are more cattle ranching oriented and generate more negative economic externalities in the form of restoration costs, providing for an economic interface of deforestation mitigation impacts that is much greater than the percent of forest conserved indicates.

Table 5. Forest cover and estimated costs for restoration between 46 farmers from Juína and Cotriguaçu (<30ha<400ha) adopters and non-adopters of AFS as part of ICDPs. 2010.

Samples (n)	FA (ha)	AFS (ha)	FC (ha)	FC (%)	Costs (US\$)	RC vs. FA
24 (control, average area =95 ha)	2,298	0	774	34	2,912,277	1,267
22 (positives, average area =8 ha)	1,859	63	869	47	1,690,919	910
Difference for positive group	-439	+63	-95	+13	-1,221,359	1,4

FA=Total Farm Area; AFS=Total Agroforestry area; FC=Forest Cover in hectares; FC%= Percentage of forest cover in relation to total area of the farm; RC/FA=Relation between Restoration Costs vs. Farm Area.

15.2 Economic impacts

In this section we analyse direct economic gains from adopting ICDPs promoted land use, and indirect gains related to avoided costs pertinent to environmental legal liability and fire prevention. Economic gains inside PA_VAM can be viewed in the context of a baseline offered by Vargas (2006). In 2005, for 70% of settler households over half of their income came from working outside of the settlement. Only 12% had farm-based incomes equal to the Brazilian minimum wage (US\$ 150 in 2005)¹¹. The majority were below the poverty line.

Currently, in terms of employment, 30 tons of Brazil nuts are collected inside the PA_VAM reserve annually. This requires a 30 person labor force working full time. One day of labor collecting nuts is economically attractive: US\$ 1.5/kg x 30,000kg/100 days labor = US\$ 150/day. Furthermore, 70% of the production cost of Brazil nut byproducts is for the labor needed to process the nuts. This economic value accrues to the local community in the form of salaries.

In 2013, two organizations funded with support from the GEF project (AMCA¹² and COOPAVAM) will process Brazil nuts from the PA_VAM RL, as well as nuts provided from five Indigenous Lands, one Extractivist Reserve and by surrounding farmers. To finance the purchase of these raw nuts US\$ 1,160,000 in financial credit will be provided by the National School Food Program (PNAE) and the Anticipated Acquisition Program (PAA) – programs managed by the federal CONAB program within the Ministry of Agriculture. Such financial contracts with CONAB will allow COOPAVAM and AMCA produced Brazil nut products to reach 33,000 persons in seven local municipalities.

Table 6. Synthesis of economic indicators estimated for 55 farms 4-250ha range evaluated in the municipalities of Juína and Cotriguaçu, Mato Grosso, Brazil, 2010.

AFS (participants)	US\$/ha (gross revenue)	US\$/PD	ha/PYL	Costs (%)
Shaded extensive cocoa AFS	377	49	32	0
Shaded cocoa AFS intensive mgmt.	4000	110	5	7
Tree shaded coffee AFS	1552	33	7	7
Coffee and Pupunha AFS	1268	99	5	3
Intensive, irrigated AFS	7176	341	8	3
Cupuaçu extensive based AFS	1119	142	42	7
Silvipastoral Dairy cattle	504	71	42	16
NTFP (Brazil nut, raw)	13	150	880	0
NTFP (Brazil nut, subproduct Dry nut)	63	ni	ni	60
NTFP (Brazil nut, subproduct Oil)	43	ni	ni	10
NTFP (Brazil nut, subproduct Flour)	28	ni	ni	10
NTFP (Brazil nut, Flour+Oil)	71	ni	ni	10
Control group				
Cattle (beef)	114	43	97	35
Cattle (mixed beef and dairy)	212	209	39	45
Open sun Coffee monocrop	1117	35	6	35

GM = Gross Margin; PD = person/day; PYL / ALP= per year labour per person. Labour is not included in costs as farmers do not habitually hire external workforce.

For individual farmers we consider an average of 33 ha of pasture and US\$ 212/ha.yr⁻¹ as an economic baseline for a well managed mixed cattle (dairy, beef) ranching based smallholder. This represents US\$ 6,996/year/household. Taking an average of 2.3 ha for AFS, which represents approximately US\$ 4,000/ha.yr⁻¹ for shaded cacao (cocoa), total farm income increases to US\$ 9,200. This is a 56.5% gain, while it uses less than 7% of the land area that cattle require (see Table 6).

Moreover, over time AFS enhances soil fertility and can imply additional resource opportunities. In one case evaluated by Gonçalves et al. (2009), given a time cycle of 14 years, a stand of 140 teak trees (*Tectona grandis*) planted in the boundaries of a 12 ha property was valued at US\$ 70,000. In the same area and in a 14 year time period, a farmer would obtain US\$ 1,140/ha selling calves, considering an average of 36 ha of pasture and US\$ 95/ha.year⁻¹ for calf produced (Vivan, 2010).

Implementation costs for AFS versus establishing pasture for livestock are roughly identical (US\$ 2,800/ha). However, pasture based systems are larger in scale; hence establishing 33 ha of pasture requires US\$ 92,400 in investment, whereas 2.3 ha of AFS needs only US\$ 6,400. Drawbacks for AFS involve time delays to reach full operation (5 years) and the need to have commodity chain arrangements in place. One economic advantage for dairy farming is the cash flow obtained by selling milk, which equates to a small monthly wage. However, stagnant prices for milk, cattle price volatility and the temporary closing of slaughterhouses tend to weaken the economic viability of small scale beef and dairy operations.

For landscape units like PA_VAM, it is important to understand the territorial legal context. Firstly, COOPAVAM and AMCA's NTFP production depends on legally protected areas (Legal Reserves, Certified Timber operations, Indigenous Lands), as well as smallholder (10-400ha) private forests. Considering the small farms in which they are located, these small private forests are mostly under the 80% legal reserve benchmark, such that these forests are not open to legal deforestation, even if illegal activity in private and public protected areas continues (Martins et al, 2012)¹³.

Given a legal requirement that farms not complying with forest code rules be restored for environmental purposes, our assessment indicated US\$ 2,737/ha for restoration costs. Hypothetically, with legal enforcement the control group of farmers would need to invest US\$ 1,220,000 more in restoration costs than would participant. This is a difference of 140%. Such a difference suggests that the environmental externalities produced by cattle ranching are essential to their profitability; if they were effectively regulated they would go out of business.

At the landscape level, comparing deforestation between PA_VAM and PA_I represents US\$ 14,350,091 in avoided restoration costs. PA_VAM has also benefited from environmental services as a result of the forest reserve, and raw Brazil nut collected inside the LR generates US\$ 45,000/year, an activity that helps for monitoring against poachers and illegal logging.

Finally, fire prevention is another source of avoided costs, as firebreaks (3m strips of barren soil designed to interrupt fire spread) cost around US\$ 0.90/linear meter (Vivan, 2010). Unmanaged fires threaten new tree plantings within settlements (AFS producing cash crops), and can cause serious investment losses. AFS thus represent an economic incentive to avoid use of fire and to adopt collective measures to avoid fire spread and to limit pasture area expansion in critical areas.

15.3 Institutional impacts

15.3.1 Field based questionnaire and semi-structured interview results

All farmers in the sample had been living in their respective settlements for at least 10 years, some for as long as 18 years. None had been granted private tenure rights, or “Título Definitivo,” (TD), to be distinguished from the INCRA authorized Usufruct Rights contract, or a “Concessão de Uso” (CCU). The CCU is the current arrangement for documenting land tenure in NW MT. While twenty-three farmers in the sample were officially recognized as CCU holders, 15 possessed and 8 did not possess the CCU document. Six out of the 29 the settler farmers had been deemed invalid beneficiaries, due to strict INCRA rules about the beneficiary profile.

The CCU, issued under the authority of INCRA, is a prerequisite to a farm being registered in the CAR, under the authority of SEMA-MT. Unlike the PA_I and PA_NC settlements, and all other settlements in NW MT, the PA_VAM has a collective Legal Reserve and a collective environmental license or LAU, formally signed in May of 2012. This institutional process took nearly 6 years to complete, and involved significant investments and commitments by the UNDP-GEF project, SEMA-MT and INCRA. The LAU held by PA_VAM is a comprehensive environmental license encompassing long-term environmental planning for the settlement as a whole, at the same time as it permits the settlement to engage in the production of Brazil nut oil and other activities. This LAU supercedes current SEMA-MT rules for processing the CAR on individual settlement lots.

Table 7 below indicates simple averages of value responses from individual farmers interviews, organized by municipality and by participation vs. non-participation in ICDPs. Responses suggested that settlers within PA_VAM give more weight to legal and ecological considerations when making land use decisions than do settlers elsewhere. Reinforcing this result, responses indicated that ICDPs participants weigh legal factors more heavily than do controls.

Table 7. Simple average values (1-10) attributed to broad factors or criteria affecting farmers' land use decisions. 1 = minimum influence, 10=maximum influence. N=29 interviews.

	Legal	Economic	Community	Ecological
By municipality/settlement				
Cotriguaçu / PA Nova Cotriguaçu	4.3	7.9	7.2	8.3
Juruena / PA Vale do Amanhecer	6.6	7.1	7.7	9.0
Juína / PA Iracema	4.8	8.4	8.0	7.1
By participation/non-participation in ICDPs				
Strong/moderate participation (ICDPs)	5.9	7.0	7.5	8.4
Controls	4.4	9.0	7.8	7.8

Source: Workshop with PA_VAM settlers, Juruena, April 2013.

Concerning the perceived legitimacy or fairness of the Brazilian forest code, our results suggested that settlers feel that the current 80% forest reserve rule in the Brazilian Forest Code is inappropriate, unreasonable, and unfair. In contrast, riparian buffer protection areas (APP) rules were considered to be appropriate, reasonable and fair. This did not mean that farmers were actually in compliance with APP rules or that farmers had georeferenced documents indicating compliance, but that results indicated, in general, perceived legitimacy of the APP rule as a stand-alone instrument.

Formal institutional communication between state and federal agencies, NGOs, municipalities, not to mention with local communities, is often less than flawless in the context of federal agrarian reform settlements in northwest Mato Grosso. Legal factors, considered broadly, were perceived to be of less importance for individual settlers' decision-making around land use. The findings suggest that the Brazilian forest code does not have a material presence in the lives of agrarian reform settlers in the same way that do local economic, community or ecological factors. Without local institutional commitment to their livelihoods, settlers perceive environmental regulations as arbitrary rules, designed by outsiders, with limited social or material relevance in these remote areas. With exceptions, in these settlements the authority of federal and state environmental regulations does not manifest itself in daily life. Many settlers lack land tenure documents and cannot afford transaction costs to process georeferenced environmental regulatory documents.

Settlers offered many various reasons for the illegitimacy of the current 80% forest reserve rule in the Brazilian forest code. One is that prior to 2000 land owners in the Amazon biome could legally deforest 50% of their land. A second reason is that INCRA originally directed

settlers to deforest their lots to establish and secure their rights and to prove that they were using the land productively. Another is that it would be difficult if not impossible, under current market conditions, to secure a livelihood if settlers are limited to cattle ranching as their main economic activity, to be undertaken on only 20% of their land (resulting in 10-20 ha of pasture).

We should note that PAs are socially fractured and they continue to experience internal conflicts. At the same time, settlers have sought to distinguish themselves from indigenous and older traditional communities in the Brazilian Amazon, and have emulated a pastoral culture based on individual homesteading. ICDPs like the UNDP-GEF and Juruena Carbon Sink Project made important institutional gains in providing opportunities for communities that were culturally divided to collaborate around economic activities.

15.3.2 Group workshop results

In the Vale do Amanhecer settlement, factors affecting land use and land use change involved a complicated patterning of political alliances, fire, road building, federal agricultural credit programs (PRONAF), a violent gold rush invasion, infrastructure development, the formation of local cooperatives, and the price of agricultural commodities, among other factors. The settlement's relationship with the municipality was not consistent in time but changed from one particular mayoral administration to the next.

From 2002-2004, PA_VAM was subject to a violent invasion by gold miners, which required a federal police intervention and the temporary cessation of the GEF-UNDP project's local activities in 2005¹⁴.

The use of fire and burning practices were perceived from the initiation of the settlement continuously year to year until the observed end to fires in 2012. The federal agricultural credit program PRONAF was perceived as one of the strongest influences or incentives to clear forest. PRONAF coincided with the peak of deforestation in PA_VAM in 2001. Deforestation in 2000 and 2001 was almost four times as high as it was in 2008.

The factors above were identified by settlers in the elaboration of a timeline. Settlers also identified and valued specific program and project interventions in the settlement in terms of their perceived practical influence. The settlers focused on 4 specific years (2001, 2005, 2008, 2011) in which distinct program or project influences were apparent, and conducted a participative assessment of specific activities and approaches. Table 8 below collates the settlers' responses and organizes the identified interventions by type.

There were different programs or projects operating in the settlement in each year. PRONAF in 2001, UNDP in 2005, Aderjur/INCRA in 2008, and Carbon Sink Project in 2011. Aderjur/INCRA was a ICDP partnership led by a rural development organization (Aderjur) founded through the initiative of the UNDP project leadership. Aderjur's partnership with INCRA organized the construction and outfitting of the Brazil nut processing factory discussed previously in the economic impacts section.

Top rated interventions identified and valued in Table 8 included training, credit, technical assistance, social organization, the elaboration of the LAU, portable saw mill services, the installation and outfitting of the Brazil nut factory, and market development. We note that many of the top-rated instruments are synergic, and would have limited viability in isolation. For example, investments in infrastructure and equipment would have little impact without social and cooperative organization (and vice versa), and social and cooperative organization would be of little interest without the ability to engage specific markets or develop new markets. Likewise, new market development is severely limited without legal documentation.

Table 8. Value of different interventions in terms of practical influence (1 = low practical influence to 10 = high practical influence) as perceived by agrarian reform settlers in Vale do Amanhecer settlement, Juruena, Mato Grosso, Brazil, 2013.

Timeline	2001	2006	2008	2011
Project	Pronaf	GEF-UNDP	Aderjur/Incra	C Sink Project
Perceived Value				
Capacity building				
<i>Courses/training</i>		10	8	8,5
<i>Visits and exchanges</i>		6	8	5,5
<i>Workshops</i>		7		7,5
Services				
<i>Deforestation 10h bulldozer</i>	4			
<i>Portable saw mill</i>		10		10
<i>Technical assistance</i>				9
Cooperative organization				
<i>Social organization (COOPAVAM)</i>			10	
<i>Social organization (AMCA)</i>				10
Institutional supporting services				
<i>Community management of NTFP</i>		8		
<i>CONAB: financial support</i>				8
<i>Brazil nut factory and purchase of machinery</i>			9	
<i>Credit application</i>	9			
<i>Elaboration of contracts with indigenous</i>				8
<i>Environmental license (LAU)</i>		9		
<i>Mapping NTFP trees and production study</i>		8		
<i>Market development</i>				10
<i>Soil analysis</i>	8			
Provision				
<i>Chick starter kit</i>	1			
<i>Chicken wire</i>	1			
<i>Coconut seedlings</i>	0			
<i>Fruit trees</i>	7			
<i>Horse drawn cart</i>	3			
<i>Manual seed planter</i>	1			
<i>Coffee seedlings</i>	6			
<i>Dairy cattle</i>	8			
<i>Fencing wire</i>	9			
<i>Fertilizer</i>	5			
<i>Line trimmers</i>				7
<i>Trees seedlings</i>		6	6	7
<i>Water reservoir</i>	2			

Source: Workshop with PA_VAM settlers, Juruena, April 2013.

In addition, workshop participant responses indicated that there were different perceived levels of social legitimacy for the different interventions. For example, settlers perceived that they had no say in the organization of PRONAF sponsored activities. PRONAF was predetermined by outsiders; it involved limited information sharing and no participation whatsoever in decision-making. Settlers' only choice with PRONAF was to "take it or leave it."

In contrast, in terms of their specific interventions, settlers perceived that the UNDP, Aderjur/INCRA and Carbon Sink projects all involved consistent communication and processes or feedback about the specific activities. Specific interventions within these projects were valued high in terms of the community's participation in decision-making and the perceived legitimacy of the cooperative arrangements.

15.4 Institutional discussion

ICDP projects in NW MT took place in an antagonistic political economic climate and in the context of fragile support from federal and state agencies. But ICDP impact could be observed, given the following indicators: collective resource management, cooperative organization, increased economic returns for NTFP and AFS commodities, technical rural assistance, infrastructure support, and the integration of environmental regulation and planning with the above. In addition, there was evidence of the increased viability of the environmental regulatory framework, in terms of settler registration in the CAR in Juína and the legitimacy of PA_VAM's collective forest reserve through the LAU.

Because PA_VAM had had longer contact with ICDPs, this particular settlement was in a position to integrate and learn from various interventions. The developments observed in PA_VAM and specifically with COOPAVAM and the Brazil nut production chain indicated that a combination of instruments could overcome an antagonistic political economic environment, if applied in an overlapping sequence: 1) Setting priorities by mapping the potential of the remaining forest; 2) training and technical assistance; 3) cooperative social organization; 4) Legal certification of sustainable production Involving the collective forest land and resource management plan; 5) Material investments in infrastructure (buildings, equipment); 6) Market development, credit financing and the elaboration of contracts with surrounding indigenous communities; 7) contracts with private companies and CONAB; 8) Public (and political exposition) by national recognition; 9) Scale improving efforts (and support) to expand Brazil nut products.

PA_VAM had retained 39% more forest than did the worst case settlement for forest loss, PA_I. And there was 13% more forest cover on a individual lot basis assessment, indicating the viability of ICDP impact on conservation. But this impact was linked to how alternative agricultural commodity markets were established and sustained. Considering ICDP impacts on development, the institutional analysis indicated that the combination of technical assistance, credit, social organization, certification, marketing, material infrastructure and

processing of the LAU were all critical for consolidating an alternative land use decision making process in PA_VAM. The economic importance of NTFP was enhanced as was the economic importance of nearby Protected Areas (Legal Reserve, Indigenous Lands).

Settlers in PA_VAM interacted with ICDPs consistently over the course of at least 8 years, compared to only 2-3 years in PA_I and only sporadically in PA_NC. This seems to have resulted in substantial forest conservation relative to a baseline and in an observed end to fires in the PA_VAM in 2012. Organization of a collective forest legal reserve played a major role, but likely could not have been achieved without the organization of economic opportunities in relation to the reserve. The overall vision emerging from the institutional analysis suggests that reinforcing local organization and forest resources governance, including external sets of rules (certification, LAU) made possible for a local collective governance to evolve. In this context, if farmers were expected to rely only upon individual direct payments to access these services and markets, they would be cut off from those collective livelihood and conservation alternatives promoted by ICDPs and the process with which they are associated.

While conservation payments or PES might be able to contribute in a policy mix (Börner et al. 2010), their application will demand the presence of adequate institutional arrangements. As these arrangements are not present in this agrarian frontier context, the situation demands more systemic effort to integrate instrument mixes in order to compensate for environmental governance failure. Given the insecurity of institutional arrangements and the political economic hegemony of cattle ranching, we question whether it would be possible to defer deforestation strictly on the basis of foregone opportunity costs for individual settler farms.

16 CONCLUSIONS

Time and spatial scale sensitive impacts. Our hypothesis was that it would be possible to assess ICDP impact in NW MT using distinct spatial scales and long temporal scales, and by cross-referencing available ecological, land use, economic and institutional data. Findings reinforced this hypothesis: one hectare of AFS is invisible from a GIS analytical perspective, but from a socio-economic perspective this single hectare can employ almost 20 times the workforce and can return more than 93 times the agricultural revenues than can cattle ranching, and the implications were assessed i.e. through the percent of remaining forest considering farmers that did not adopt AFS versus adopters. Carbon stocks, faunal and tree diversity impacts are very important at farm level, but temporal scales of analysis can misjudge their potential impacts in the landscape level.

For both economic and biophysical analyses, along with attention to geographical scale, the temporal scale of ICDPs should be reconsidered. Land use changes like forest restoration and AFS require a reorientation of the production system, and even faster growing AFS required 3-5 years to reach full economic maturity. In social-institutional terms, potentially 3 or more years (reaching 6-8 years total) are required in order to redirect the way land use decisions are made. Since AFS implementation requires long maturation times, economic and

institutional arrangements involving AFS should be designed to reflect their positive externalities, as an added financial incentive toward the production of alternative commodities. We expect a time period of upwards of 12 years for AFS to be consolidated, accompanied by a greater area of pasture being set aside for AFS or forest regeneration. This process has been demonstrated by individual innovation in the adoption of AFS in already deforested areas (Gonçalves, 2008). And, considering that public policies were antipathetic to alternative, forest integrated commodities, up to 15 years would be required for land use impacts to register at the landscape scale.

Policyscape viability or weakness. The viability and impact of economic instruments is a function of how they interface with other instruments in a policyscape. Underfunding of state environmental regulatory agencies created multiyear delays in terms of processing legal documents for sustainable production, whether for sustainable forest management or for AFS/NTFP product licensing. ICDPs described in NW MT were able to surmount some of the institutional bottlenecks that restrict positive outcomes, indicating particular instrument synergies and sequences as relevant for that aim.

Agroenvironmental measures and impact assessment. ICDPs projects are not a single instrument but a mix of them, impacting on the organization of labour and the economic logic of land use, as well as in the institutional arrangements and perception of norms and rules concerning environmental protection. Biophysical evidence takes time and implied in committed attention to what are related and truly complex political, economic, ecological and social issues. From such a perspective, better GIS methods and high resolution imagery are necessary, along with sampling economic, institutional and biophysical details at the farm level in order to calibrate imagery with the interpretation of land use impacts from projects. High-resolution imagery can also reduce uncertainties regarding interaction of carbon stocks with land-use change, such as forest degradation, selective logging, AFS, and silviculture (Asner et al., 2010). Moreover, efforts of participatory mapping and forest and AFS composition, structure and connectivity must be performed, in order to improve qualitative data and to prove additionality for the avoided deforestation or restoration achieved.

Institutional, legal and economic overlaps. Alternative commodity markets are underdeveloped in the region, but long-term ICDP investments in certification and environmental licensing helped bring to scale these markets and also the material infrastructure needed to access these markets. Local social organization was made viable as it integrated with material and institutional infrastructure supporting local livelihoods. The regional context shows farmers and agrarian reform settlers perceiving the Forest Code as a problem. ICDP participants inside PA_VAM, on the other side, see external environmental norms and rules, like the LAU and riparian areas protection as valid and important instruments. Along with certification, they are perceived as linked to their commercial success and motivating the conservation of their remaining forests (Legal Reserve).

Transferability of lessons learned. We understand that other managed forests (sometimes termed rural forests) bordering protected areas can take advantage of the lessons learned in this case. We point to certain managed forests that have availed themselves of the lessons of integrated spatial planning: the Dehesas and Montado cork oak forests in Portugal (Antunes,

2012) and Spain; the mosaics landscapes of SE Poland (Baran-Zglobicka and Zglobicki, 2011); the chestnut forests of Corsica (Michon, 2011); the Faxinais from southern Brazil (Moro and Lima, 2012), and even the open pine forest with combined grazing in Nordic countries (Oksanen and Riseth, 2005). In ecological and political terms, this is a critical moment to consider a mix of instruments to cope with the challenges of the Forest Code, ZSEE and even the status of Indigenous Lands and protected areas by the agribusiness lobby. Also, it may offer opportunities to mainstream successful approaches for collective and individual incentives that have proved effective at the level of agrarian reform settlements and smallholders to constitute managed forests as a continuum between protected areas and agroecosystems (Wiersum, 1994; Wiersum, 2004), providing the desired mosaic of sustainable land uses in PA buffer zones, and avoiding the risk that all forest regions would need to go through the transition stages described by Barton and Adamowicz (2013).

Managed forests, like the RLs inside PAs and in private, small and medium sized farms can represent not just a very important acquisition to a REDD+ strategy, but also as important components in regional sustainable economies. As Menon et al. (2009) states: “rural forests are often not autonomous local forests, but the product of a complex relationship between the state and local actors mediated by public policies”. This is the case for NW MT, where a complex institutional design included non-profit, governmental, municipal, farmers and private institutions. Despite information gaps, our research offered a view of how a more systemic view of these projects can identify their role in a REDD+ strategy integrating private, public and protected forests, along with the agroecosystems with which these forests are linked, in ecological, economic and institutional terms.

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¹ REDD+: Reducing Emissions from Deforestation and forest Degradation in developing countries, considering the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.

² REDD+ readiness relates to the efforts a country is undertaking, with the support of multilateral or bilateral initiatives, to build its capacity to be ready for a REDD+ mechanism. Source: <<http://www.un-redd.org/FAQs/tabid/586/Default.aspx>>.

³ Isolated indigenous people are not contacted by FUNAI (Indigenous Peoples Federal Agency), which identify their territorial range in order to define protection measures for them and for their territory.

⁴ According to Article 23 of the Constitution of 1988, the federal government is responsible for preparing both national and regional Social, Economic and Ecological Zoning (ZSEE), whereas the states must develop their own ZSEE in accordance with the national and regional levels and with the development of municipal master plans, respecting the existing ZSEE's.

⁵Source: <http://www.jornalmeioambiente.com/materia/2308/liminar-suspende-zoneamento-de-mato-grosso>

⁶Source: <http://www.circuitomt.com.br/editorias/cidades/26335-empaer-vive-10-anos-de-sucateamento.html>

⁷ Source: <http://www.treslagoasflorestal.com.br/noticias/16180/o-licenciamento-ambiental-em-mato-grosso-esta-agonizando>

⁸ Plant diversity indices, connectivity between forest fragments and with riparian areas, total area of each fragments, shape (the more compact, more resilient to disturbance), management, protection against poaching and registered presence of resident wildlife.

⁹ The economic evaluation relied on data provided by Vivan (2010) and Gonçalves (2008), Proambiente and the federal family farm loan program PRONAF; internal project reports (GEF, Petrobrás, Proambiente); published studies (Vivan, 2008); reports of technical assistance and support organizations, particularly AJOPAM.

¹⁰ For PA_VAM: PA total area for legal reserve calculation = 14,400 ha (total area) – 2,279ha (identified as Riparian Protected Areas) = 12,121ha x 80% = 9,696 ha = (residual legal reserve).

¹¹ Source: http://www.debit.com.br/consulta30.php?indice=salario_minimo

¹² Associação de Mulheres Cantinho da Amazônia, formed by a group of 120 women from the PA_VAM.

¹³ For July 2012 in the Amazon, 47% of deforestation occurred inside PAs (16%), Indigenous Lands (1%) and Conservation Units (30%). Overall deforestation in the Amazon (139.5km²) represented an increase of 50% in relation to July 2011.

¹⁴ Paulo C. Nunes, pers. Communication.

¹⁵ POLICYMIX project (<http://policymix.nina.no>) funded by the European Commission, Directorate General for Research, within the 7th Framework Programme of RTD, Theme 2 – Biotechnology, Agriculture & Food (Grant no. 244065).