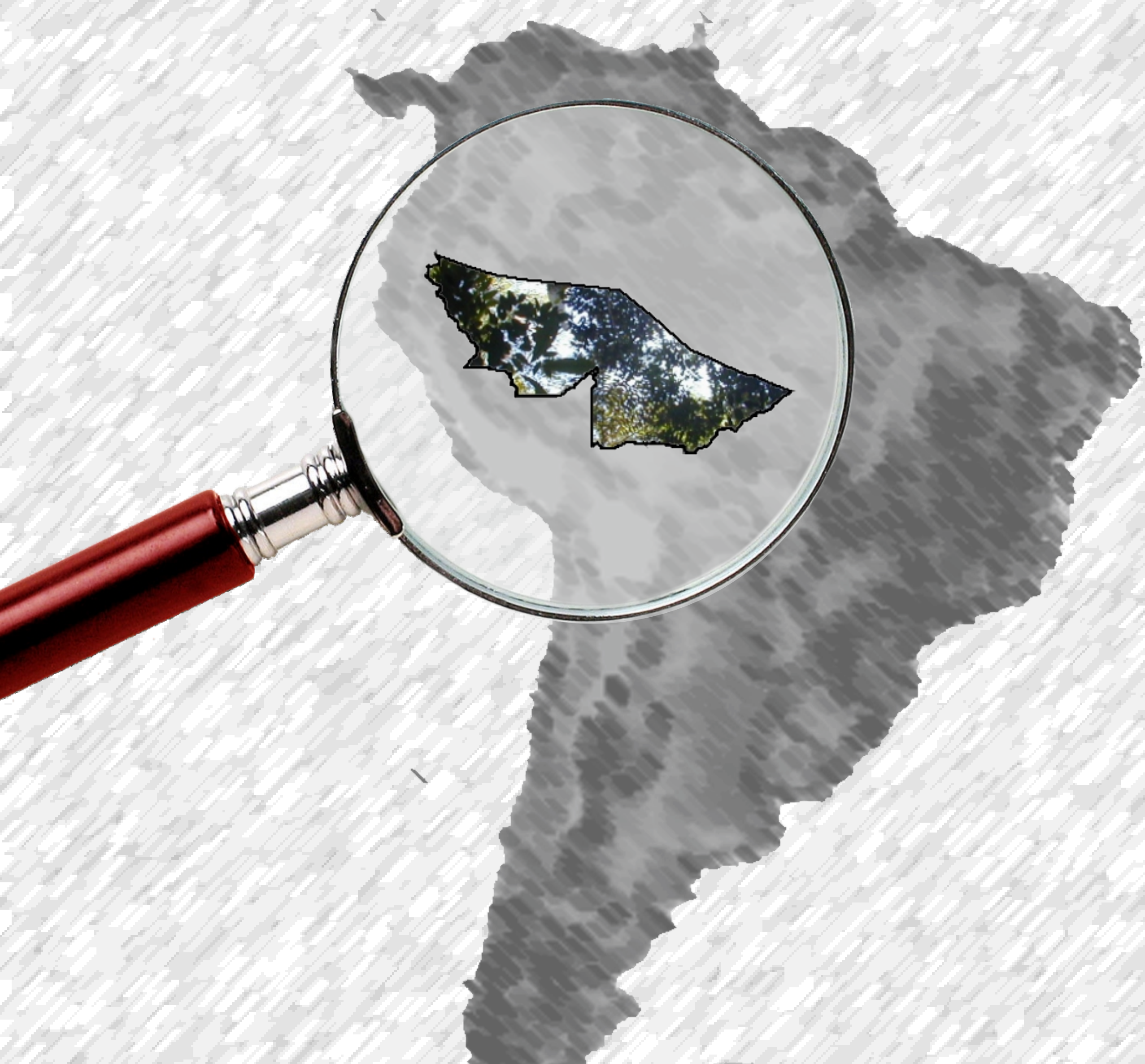

Acre State's Progress Towards Jurisdictional REDD+

Research, Analysis, and Recommendations for the state Carbon Incentive Program (ISA-Carbono)

IPAM Amazon Environmental Research Institute

Universidade Federal de Minas Gerais
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EXECUTIVE SUMMARY

In 2009, the State of Acre, Brazil, approved a law creating an ambitious Environmental Service Incentive System known as "SISA"[1] . The first program under development within SISA (called ISA-C[2]) will provide incentives for reducing emissions of carbon to the atmosphere from deforestation and forest degradation and is on trajectory to become one of the most advanced jurisdiction-wide REDD+ programs in the world. ISA-C is being designed to deliver robust GHG emissions reductions into a diversity of "pay-for-performance" compensation systems, ranging from regulated cap-and-trade governmental programs to large-scale private sector initiatives. These emissions reductions will flow from a new model of rural development that is already lowering emissions from deforestation and forest degradation as it improves the livelihoods of forest-dependent communities, maintains and restores biodiversity, soils, and water resources, and seeks greater productivity and market opportunities for its farm and livestock sectors. This report summarizes recent research done to provide information and recommendations for strengthening the ISA-C.

How Will ISA-C Work? General Recommendations: In general, ISA-C has avoided the most common problems that are limiting progress in many other jurisdictional REDD+ programs. To further strengthen ISA-C, we recommend that Acre (a) strive to keep ISA-C as simple as possible, taking advantage of the flexibility that is permitted by measuring performance across the entire state; (b) deepen policy alignment across sectors and their respective governmental departments; (c) design and launch a fast-track program, outside of ISA-C, to support the transition to a "zero deforestation" beef sector in Acre; (d) use the emissions reductions of "C" to further reduce deforestation and provide revenues for ISA-C as programs for indigenous, traditional peoples and smallholders are designed and implemented.

The transition to low emissions rural development: Low-emission rural development (LED) is defined here as a model that minimizes greenhouse gas emissions as it alleviates poverty, secures food production systems, recognizes indigenous peoples' rights/claims to land and resources, increases agricultural and forest-based production, and conserves biodiversity, water, and soil resources. The transition to LED could be facilitated by access to international markets that is improved by the recently-completed Inter-oceanic highway across the Andes. Acre is strategically positioned to deliver products into new markets that could carry premiums for the high social and environmental performance of the Acrean economy. Its state-wide transition to LED should be informed by the extreme variation in profitability of forest-maintaining and forest-replacing activities to minimize the "opportunity cost" of the transition.

Reference Level: Acre plans to use the Brazilian federal government's deforestation monitoring program (called "PRODES") data and reference level approach, which would provide 182 Mt of CO_2 emissions reductions from 2006 to 2020. This commitment to inter-operability with the federal system is very positive, with one important caveat: the severe downward adjustment of the reference level every five years could leave the state with insufficient revenues to implement ISA-C at a long run. Acre's own deforestation monitoring program detects ~20%

1 SISA stands for "Sistema de Incentivos para Serviços Ambientais", portuguese for "Environmental Service Incentive System".

2 ISA-C is the "Incentivos para Serviços Ambientais-Carbono" program, portuguese for "Environmental Service Incentives—Carbon".

more deforestation than the federal system and, if used as the basis for the reference level, would indicate a larger pool of emissions reductions and potentially more revenues for ISA-C. We recommend that Acre employ the PRODES data as the basis for the reference level, as planned, but use its own deforestation monitoring to demonstrate that PRODES underestimates emissions reductions achieved by ISA-C. In addition, we see as very positive the state's commitment to include fluxes from forest degradation by logging and fire and carbon enhancement by plantation and forest regeneration into its reference level and emissions reduction estimates.

REDD+ benefit allocation: We present three potential approaches to the determination of REDD+ benefit allocation across sectors: (a) a “stock and flow” approach that allocates among geographically-explicit land tenure categories, ex ante; (b) a “program planning” approach that focuses on a fast-track transition to a “zero deforestation” beef industry that “buys” time and perhaps funding for the development of programs for other sectors; and (c) a “hybrid” approach, the integrates elements of both. We recommend that Acre adopt an approach to REDD+ benefit allocation that is most compatible with current policies, cross-sector integration processes, and stakeholder consultation.

ISA-C Sector-Specific Subprograms: Finally, we present analyses in support of three subprograms. We identify several possible priorities for supporting the transition of smallholder settlements to sustainable, low-emission production systems. We describe preliminary economic analyses of the state-wide profits that could be achieved through a transition of the beef industry to “zero deforestation” production systems. Finally, we describe an approach for a program in support of agro-extractivist populations (rubber tappers and Brazil nut harvestors).

1 The Global Context of SISA in the Post-Copenhagen World

We live in the "post-Copenhagen" world. In the years and months leading up to the December 2009 climate summit in Copenhagen, there was still hope and optimism of a unified global regime that would establish the framework and funding for lowering greenhouse gas emissions to the atmosphere. That hope has now diminished, but in its place is a growing realization that solutions to climate change are bubbling up around the world as communities, cities, states, and nations choose to do their part to tackle the climate change threat. A global solution to climate change could still emerge in time to prevent severe damages to economies, ecosystems and societies if we harness the ambition and innovation that is being directed towards the mitigation of climate change. Of central importance are the policy frameworks under design that could deliver long-term, performance-based finance as REDD+ moves from its current status as a rather complicated source of funding (and perhaps some reputational benefits) to become the first step towards a new model of rural development that maintains and restores forests, reduces greenhouse gas emissions, increases the security of food production systems, protects water supplies, and secures the legitimate rights to land and resources of indigenous people and other rural communities.

One of the central components of the post-Copenhagen world is the regulated carbon market. Instead of the globally unified market that seemed to be a near-term possibility going into Copenhagen, numerous markets are now under development. Their long-term impact on the climate will depend upon the degree to which they are compatible and inter-connected. Such linkages are under development in a variety of circumstances. Most prominently, the California climate policy, called "Ab32", contains a provision for allowing regulated entities (e.g. coal-powered electricity companies) to achieve a small percentage of their emissions reductions through international offsets, such as those that could eventually be provided by Acre's SISA Carbon Program. The states of São Paulo and Rio de Janeiro also have climate policies that could lead to a demand for offsets from state-level REDD+ programs, and discussions are underway to establish such a system nationally within Brazil. Climate policies in Australia, New Zealand, or other nations could also create demand for international forest carbon offsets offered by jurisdictional REDD+ programs.

The demand for emissions reductions from REDD+ programs could also emerge from outside of regulated markets. "Pay-for-performance" finance agreements, led by Norway, have already been established with Brazil ($1B), Indonesia ($1B), and Guyana ($0.25B). Another agreement is under development with Ethiopia. Within these agreements, the money flows as deforestation declines. Companies that depend upon agricultural commodities and that have taken on voluntary commitments to reduce their firm-wide emissions of greenhouse gases (e.g. Unilever, Coca Cola, Mars and many others) are beginning to look at their supply chains as a way of offsetting their greenhouse gas emissions. Carbon emission reductions that are “bundled” into agricultural commodities could be greatly facilitated by jurisdictional REDD+ programs that define, register, and issue offsets to an expanding array of buyers.

Acre State has the potential to have the first jurisdiction-wide program in line to deliver REDD+ offsets into these emerging regulated, pay-for-performance, and voluntary carbon markets. If Acre accomplishes its goals it will have the potential to generate credits equivalents to 182 million tons of CO_2 by 2020 (see below), and many of the institutional innovations and legal structures that will be needed to create a jurisdiction-wide REDD+ program have already been created. Acre is part of a MOU with the State of California (as is the state of Chiapas, Mexico) that establishes a linkage agreement for early participation in California's cap-and-trade system, it is in dialogue with São Paulo and Rio de Janeiro government leaders to do the same, and it has placed its historical emissions reductions in BOVESPA, the Sao Paulo stock exchange. Acre was the first government to win a grant from the Amazon Fund which is where Norway's $1B commitment is administered, within the National Development Bank of Brazil—BNDES. This ~US$35 million grant to Acre is being used to reduce deforestation as well as to develop the ISA-Carbon Program strategy.

2 Florestania, SISA, and REDD+ in Acre: Building a Rural Economy on the Basis of Sustainable Use of Natural Capital and Ecosystem Services

In 1998, Acre Government started to develop a platform of forest-maintaining development called "Florestania". This novel new approach to socio-economic development has continued to be the foundation of the Acre Government ever since. The 13 years of Florestania brought several advances and innovations in natural resource management, rural governance, and the development of forest-based economies. Such innovations include:

a. *Ecological/Economic zoning:* The entire territory of the State of Acre is divided into geographical zones that place restrictions on land use activities (Figure 1). This Zoning plan has been approved by the State's legislation assembly and by the National Environment Council (CONAMA), and therefore carries the full weight of the law. This Zoning plan was developed through consultation with numerous stakeholders. The zones include areas of agriculture consolidation, of forest preservation, of indigenous and traditional peoples' territories, and of forest production for timber and other products. All states of the Brazilian Amazon region are developing or have developed Zoning plans, but Acre was the first to achieve full implementation.

b. *Economic incentives:* The Acre Government has promoted forest-dependent livelihoods by establishing a subsidy for native rubber. It has created green industrial sectors to increase the value of Acre's forest products. For example, this program has led to the first condom factory that buys its natural rubber from organized rubber tappers. It has led to a furniture and flooring company supplied by sustainably harvested timbers, and to a Brazil nut processing cooperative.

c. *Logging sector reform:* Acre has one of the highest levels of tropical forest certification (Forest Stewardship Council), with 60% of its annual timber yields supply by certified systems. More than half of all production has a state-approved management plan.

d. *Rural property licensing and certification system:* Acre is one of the first states in Brazil to resolve most of its land titling disputes. It has mapped most of its private property and about 5,000 families are in the process of certifying their land holdings.

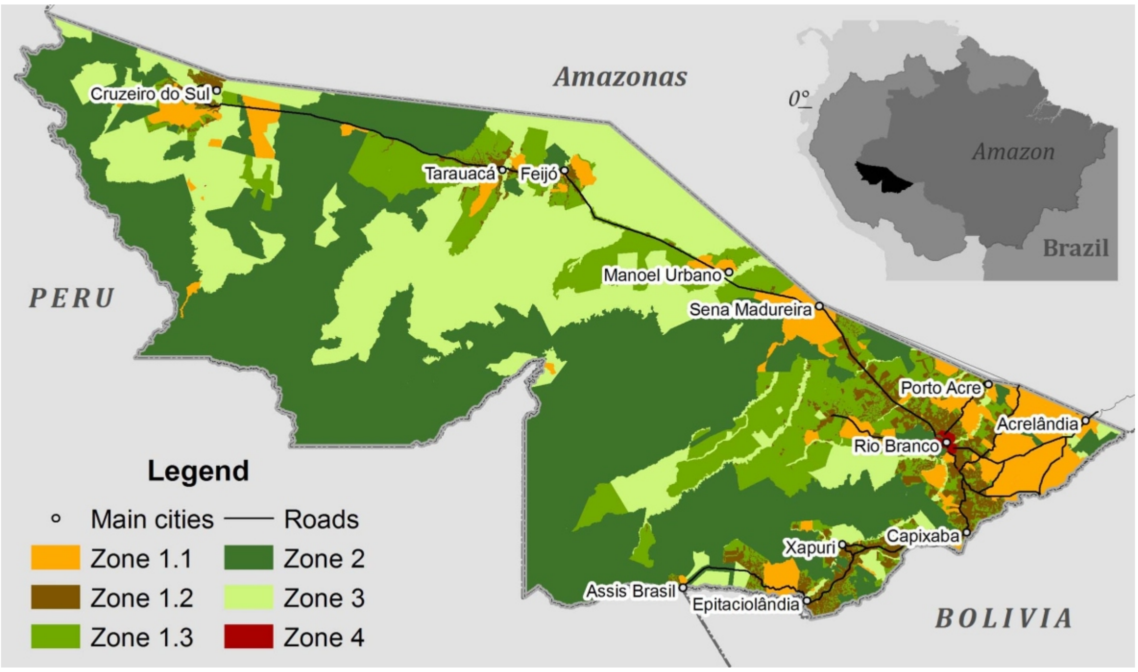

Figure 1. *Zones of permitted land uses as defined in Acre's Ecologic and Economic Zoning where Zone 1.1 represents the area of smallholders production area; Zone 1.2 represents agro-ranching production; Zone 1.3 represents management and protection areas; Zone 2 represents sustainable use and environmental protection; Zone 3 represents the priority areas for land tenure regularization; and Zone 4 the Urban areas.*

2.1 SISA & REDD+

In 2010, Acre consolidated its Forest-based public policies through a progressive new law that establishes the foundation for creating incentives for the maintenance and restoration of environmental services (Law 2,308/2010). This law, called the "SISA", the "Sistema de Incentivos para Servicos Ambientais" (Environmental Service Incentive System) includes principles and an institutional framework to allow the state to establish linkages with emerging markets for environmental ecosystem services. The first program to be developed within SISA is the "Carbon Incentive System" (ISA-C).

2.2 Institutional Structure

SISA operates through an innovative institutional structure that clearly separates regulatory functions and responsibilities, law enforcement responsibilities, and the attraction and brokering of carbon investments (Figure 2). This structure also provides an excellent example of the institutionalization of social and environmental safeguards at a jurisdictional level.

a. *The Institute of Climate Change (IMC)* is responsible for regulating, monitoring and controlling the activities of ISA-C. It is charged with creating a carbon registry for tracking carbon transactions and the sojourn of emissions reduction units as they are created, purchased, sold, and eventually retired. It establishes protocols for creating forest carbon projects and programs, and is responsible for establishing the technical and scientific standards for defining and transacting carbon. In addition, IMC has support from Acre's Geoprocessing Center (UCEGEO), linked to the Acre Foundation of Technology (FUNTAC), to monitor the losses and gains of carbon as well as other environmental services, subprograms and projects within SISA. SISA is linked directly with two main government secretaries, the Secretary of Science and Technology (SCT) (old Environmental Secretary - SEMA) and the Secretary of Finances (SEF).

b. *The Company for Development of Enviromental Services (CDSA)* is responsible for attracting investments (public and private sector) into SISA and brokering investments and project development in a way that is consistent with SISA regulations. This private-public partnership is a semi-autonomous entity that operates outside of the state bureaucracy, but its ability to transact carbon is regulated by the IMC.

c. *The State Commission of Monitoring and Validation (SVA)* is permanent, multiple-stakeholder body that reviews the social and environmental dimensions of SISA programs and projects. It is linked to the IMC and other state commissions (e.g. State Council of Environment, Science and Technology, State Council of Forests, and State Council of Rural Development and Sustainable Forest). The SVA is formed by eight members divided equally between civil society and government representatives.

d. *The Scientific Committee (SC)* is an advisory group of scientists from diverse background (social, natural, economic) assembled by the state government to support and evaluate technical issues related to SISA. This committee reports directly to IMC and responds to requests regarding performance baselines, forest monitoring, and other technical topics of relevance to SISA.

e. *The SISA's Ombudsman* is an office established to provide a channel of social control, monitoring and participation of the civil society related to the system.

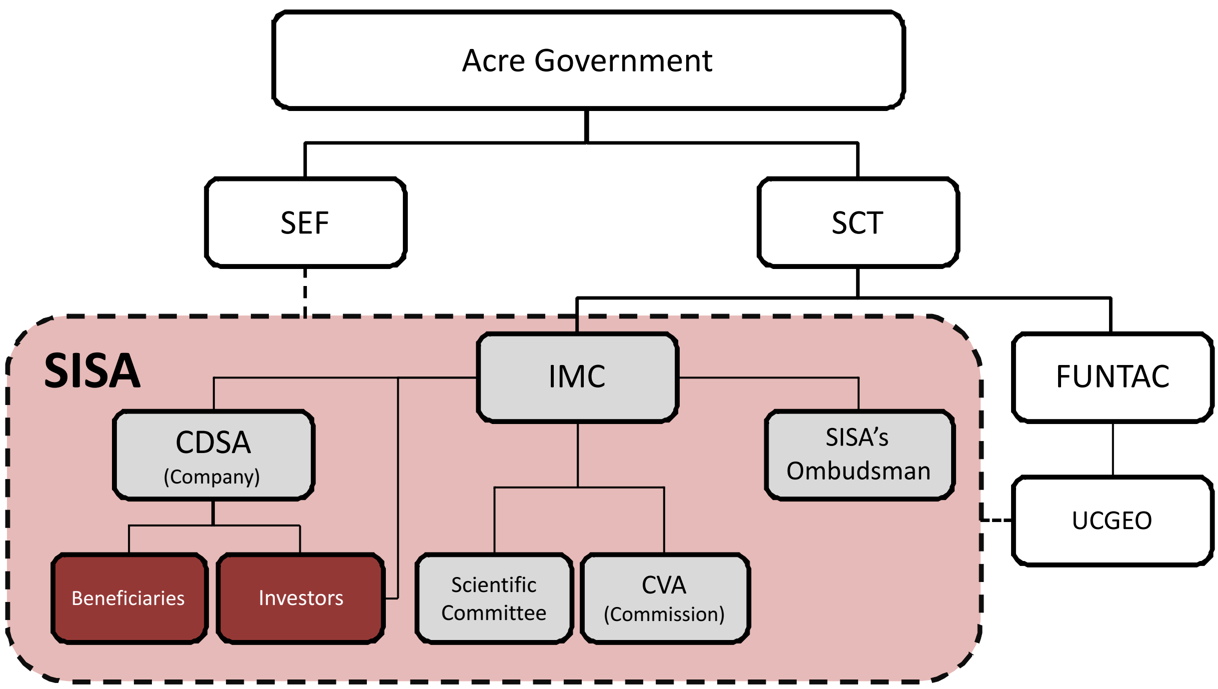

Figure 2. *Institutional structure of SISA within Acre's Government.*

2.3 SISA Programs

The main programs of SISA were created to stimulate the maintenance of the main ecosystem services provided by the state. They include the following programs: Enviromental Service Incentives Carbon (ISA-C), Sociobiodiversity, Water Resources, Climate Regulation, Soil Conservation and Valuing Cultural and Traditional Knowledge. ISA-C is the first program to be designed.

2.4 Carbon Incentive Program (ISA-C)

ISA-C incorporates the incentives and the projects related to reducing emissions from deforestation and forest degradation – REDD+. It seeks to create value for forests' role in storing carbon. The main incentives under development by this program include: promoting the transition of agricultural and livestock production systems to increase yields while reducing "horizontal" expansion into forests, increasing the economic value of standing forests, improving the livelihoods of forest-defending communities, and improving forest protection. ISA-C will provide incentives for environmental services based on the commercialization of carbon credits from avoided CO_2 emissions and through enhancement of carbon sequestration by regenerating and restored forests and through tree planting.

2.5 Progress Towards Implementation and Funding

IMC has developed a business model based on revenues from governmental donors, private sector investors, and multilateral and/or voluntary funds. SISA's largest source of funding to date is the project entitled "Valuing Forests in Acre", approved by the Amazon Fund in November 2010. This fast-track funding brought to Acre approximately $35 million (from which 10% were the counterpart from Acre State) to be used in infra-structure for environmental management and monitoring, to support the improvement and development of forest and agro-forest production chains, and to provide technical and financial support for environmental services. The activities of this project will be implemented in three years and are designed to benefit smallholders and traditional forest people such as extractivists (e.g. rubber tappers, Brazil nut harvesters) and indigenous peoples from Acre State.

Other opportunities of funds and support to SISA's ISA-C are expected to come from the private sector engagement on forest sustainable practices and reduced emissions from agricultural and livestock activities. Potential new sources to support SISA's ISA-C Program include the Governors' Global Climate and Forest Task Force (GCF) Fund recently created to support State initiatives to reduce their CO_2 emissions, the German Government, and the UK/DfiD. There is also an opportunity to establish an internal national Carbon market among Brazilian States. The most advanced states in this area are São Paulo and Rio de Janeiro. São Paulo approved a State Climate Law that allows the implementation of a state level carbon market and recently (2012) signed an MOU with the Acre Government for implementing a Cap and Trade system that uses emissions reductions created by Acre's ISA-C as offsets for São Paulo industries. Such an agreement is also underway between Rio de Janeiro and Acre. Besides contributing to consolidate the states' climate Policies, these initiatives can be an incentive to the implementation of the national carbon market as proposed in the National Climate Change Plan (Plano Nacional de Mudança Climatica).

2.6 Relationship Between SISA's ISA-C and the National Climate Change Policies

The National Climate Change Plan (NCCP) of Brazil is a law established in 2008. This plan was followed by a National Policy on Climate Change (NPCC) establishing, in 2009, official deforestation reduction targets for the Amazon (80% by 2020) and Cerrado (40% by 2020). In the context of emissions accounting, ISA-C should be designed to be inter-operable with the federal regime under development within the context of the NCCP and the NPCC. This means that Acre system should have a compatible reference level, registry, and should be part of a consistent system of allocation of revenues between the state and federal programs. A linkage structure between the state and federal accounting is proposed by Moutinho et al.(2011) in which emissions reductions from deforestation for the period of 2006 to 2020 can be allocated among the Amazon States using a ''stock and flow'' approach, that incorporates current forest carbon stocks and historical emissions from deforestation.

However, there are important aspects of this linkage architecture that need to be better developed and adopted by the government to achieve, fair, transparent, consistent crediting of states for their progress in reducing emissions from deforestation. One important gap is the lack of clarity of Brazilian's position on emissions offsets and the role of markets in compensating emissions reductions from deforestation. Acre's ISA-C program would be greatly strengthened if the Brazilian government formalized a policy and system for issuing reductions in emissions from deforestation into offsets markets that includs a national registry of emissions reductions and a system for allocating offset revenues among participating states. Federal clarity on REDD+ is also needed to determine the status of current REDD+ pilots and initiatives. One important step in this direction was taken by the Amazon Fund in 2010, which established an informal agreement on the allocation of emissions reduction revenues between federal and state governments and that included market mechanisms (such as offset markets) for supplying these revenues. In the same year, Amazon States established an informal agreement for allocation of projected emissions reductions among themselves and between states and the federal government, and for opening the system to market mechanisms. This agreement was supported by the Federal Government.

Another important issue is the lack of clarity internationally on the eligibility of emissions reductions achieved through Nationally Appropriate Mitigation Actions (NAMA's), as offsets--such as Brazil's NCCP. However, this would not necessarily apply to linkages between Acre and states outside of Brazil that take place outside of the framework of the United Nations Framework Convention on Climate Change (UNFCCC), such as the linkage under development with California’s cap-and-trade system.

3 How Will ISA-C Work? General Recommendations

The Acre Government is at a critical crossroads in its definition of the overall architecture of the ISA-C. Given Acre's leadership in developing a legal structure and institutional framework for lowering carbon emissions to the atmosphere from deforestation and forest degradation, decisions made over the coming months could have a strong influence on the design of similar jurisdiction-wide programs in Brazil and beyond. We provide general recommendations for this architecture based upon our recent analyses of 13 states and provinces that are members of the Governors' Climate and Forests task force (GCF) that is forging linkages between jurisdictional REDD+ programs under development in these states/provinces and California's AB32 climate policy. The results of this analysis are in press (EPRI 2012).

3.1 The Triple Goals of REDD

To succeed, Acre must continue to reduce its annual deforestation rate across the entire state while achieving real social and environmental co-benefits. This means developing an effective program for diminishing the dependence of the expansion of the beef industry on deforestation. Cattle ranching for beef and milk production occupies 83% of the deforested lands in the State of Acre , and continues to be the primary driver of deforestation.

But the success of the ISA-C also depends upon the delivery of tangible benefits to Acre's numerous rural communities, including indigenous groups, extractivist communities, and small-scale producers in farm settlements as they make the transition to low-deforestation, low-emission production systems. Responsible medium- and large-scale farmers and ranchers must also receive positive incentives for this transition.

Finally, ISA-C must achieve emissions reductions while improving the conservation of biodiversity, water resources, and soils. In the Amazon, declines in deforestation and forest degradation contribute directly to these environmental goals. In addition, ISA-C can provide the framework within which farming and livestock systems are improved to use soil and water resources more responsibly while promoting on-farm habitat integrity and connectivity.

3.2 Lessons from Other REDD+ Programs

Our analysis of the jurisdictional REDD+ programs under development within the GCF has identified several lessons summarized here.

a. *Politically courageous actions have been taken by state and province leaders with little positive return*: Many states and provinces in the GCF have taken bold measures to reduce deforestation and forest degradation, including moratoria on logging and deforestation, and confrontations with powerful forest-clearing constituencies. In the absence of tangible benefits for these governments in the form of funding, improved access to markets outside of the states, increased agricultural and livestock yields, improved livelihoods, or more and better jobs, it will be hard for these leaders to continue their efforts to slow deforestation and forest degradation. Acre has made important advances in building a forest-based rural economy. Investments in the state and its pro-forest development pathway are urgently needed to demonstrate the benefits and political viability of the low-emission rural development model.

b. *A lack of focus on the state-wide reference level:* The hallmark of jurisdictional REDD+ programs is the measurement of performance in reducing emissions across the entire jurisdiction. Few states and provinces describe their programs in terms of state- or province-wide performance, and fewer still have developed programs to achieve emissions reductions at this scale. Acre is an important exception to this trend, with a clear focus on state-wide performance.

c. *A lack of progress in taking advantage of the flexbility that is conferred to states by adopting the jurisdictional approach REDD+:* States embarking on jurisdiction-wide REDD+, in which performance in reducing emissions is defined against the jurisdiction-wide reference level, have flexibility to design the programs and policies that are the most effective in achieving the triple goals of REDD+, but few governments are exploiting this freedom. Acre is an exception to this pattern. Policy alignment, institutional innovation, the regulation of land use through the Zoning plan, the certification of rural properties, progress in moving the timber sector towards sustainable reduced impact systems, and sector-specific programs are under development or already implemented in Acre and provide an excellent foundation for ISA-C.

d. *Excessive focus on projects:* Most REDD+ programs are still a collection of REDD+ projects that are isolated from the policies and institutions of the state and federal governments. Projects are an important source of innovation and benefit delivery on the ground, and can operate more efficiently sometimes since they do not depend upon government bureaucracies to function. However, emissions reduction across entire jurisdictions is very difficult to achieve with projects alone. Acre is to be commended for developing the framework of its state-wide program before encouraging forest carbon projects. All Acre projects are under development in the context of the state-wide ISA-C.

e. *Lack of policy and ministerial alignment:* In most states, REDD+ is confined to a single Ministry/Department, with little penetration into those Departments (Agriculture, Transportation, Livestock, Mining) whose participation will be necessary for REDD+ to evolve into a new model of “low-emission” rural development. In Acre, there is a cross-sector dialogue (albeit a fragile one) on ISA-C that could provide the basis for it to become systemically imbedded in policies and planning across sectors. This dialogue must be strengthened and the goals of ISA-C formalized within the policies and institutions that focused on those sectors that contribute to rural development.

f. *Lack of engagement of the drivers of deforestation:* GCF states and provinces have had little success engaging the drivers of deforestation (e.g. cattle and agricultural sectors) in the development of their REDD programs, threatening the ability of these programs to perform. Acre has made substantial but, as of yet, insufficient progress in engaging the major driver of deforestation—cattle ranching—in a low-deforestation agenda.

3.3 Recommendations for the General Architecture of ISA-C

a. *Keep it simple*: Whenever possible, reduce the level of complexity of the ISA-C. Foster innovation within civil society, agricultural sectors, and private investors without "over-engineering" the ISA-C program and subprograms. Keep the focus on state-wide performance towards the triple goals of REDD+ and the policies that will lead to systemic, long-term transitions of rural land sectors to low-emission pathways.

b. *Maintain flexibility*: Build in periodic reviews and adjustments to ISA-C programs

c. *Deepen policy alignment and engagement across Departments/Sectors*: Low-emission rural development must permeate all rural economic sectors if it is to exceed. Agricultural credit, rural extension services, agrarian reform, rural electrification, and transportation must incorporate the goals and objectives of low-emission rural development

d. *"Zero deforestation" beef strategy outside of ISA-C:* Foster the design and implementation of a transition to a "zero deforestation" beef sector for medium- and large-scale cattle ranches that resides outside of the ISA-C. This program could harness the potential for a largely self-financing transition (through increases in profits) to zero-deforestation beef that secures and deepens progress in lowering deforestation, as described in section 8. Use the reductions in emissions from deforestation to "buy time" to fully develop the ISA-C sub-programs in support of more forest stakeholders with lower incomes and higher vulnerability (including indigenous groups, agro-extractivist populations such as rubber tappers and Brazil nut collectors, and small-scale farmers).

e. *Avoid letting carbon accounting drive ISA-C program design*: With a focus on state-wide performance, Acre should continue to exploit its freedom to design programs for supporting the transition of the rural economy to "low-emission rural development" in the way that is most equitable, practical and efficient in the context of Acre's current policies, institutions, economy, culture, and natural resource base. Acre should exploit the freedom it has to design the most effective program for achieving the triple goals of REDD+ defined for the entire jurisdiction.

f. *Promote research, technical innovation, and ongoing policy analysis to foster innovation and adaptive management in support of the transition to low-emission rural development*: ISA-C is one of the world's most advanced laboratories in designing systemic programs for fostering the transition of rural development towards low-emission economies. Success will depend upon the inculcation of a culture of innovation and adaptive management that will be greatly facilitated by maximizing transparency and by encouraging research and analysis on program performance.

4 Acre's Transition to Low Emission Rural Development: General Considerations

ISA-C is under development to provide a system of incentives for fostering the transition to a new type of rural development. In this section, we provide some concepts and information to help frame this transition.

4.1 Defining Low-Emission Rural Development

We define "low-emission rural development" as a model that minimizes greenhouse gas emissions as it alleviates poverty, secures food production systems, recognizes indigenous peoples' rights/claims to land and resources, increases agricultural and forest-based production, and conserves biodiversity, water, and soil resources.

4.2 The Historical Logic of Rural Development in Acre

The approach to rural development builds upon a long history of rural economic activities devoted to extensive (low-productivity) cattle ranching and the extraction of non-timber forest products such as rubber and Brazil nut. More intensive forms of agricultural and forest production are now becoming feasible as access is facilitated by all-weather roads, and as rural electrification, sanitation, health care, education, law enforcement and courts of justice are successfully established across rural Acre.

4.3 The Dominant Role of Transportation Costs

Rural activities in Acre—as in most forest frontier regions—are strongly influenced by transportation costs. Acre's rural economy was born fully dependent upon river transportation. With the rising value of rubber and, to a lesser extent, Brazil nuts at the turn of the last century, immigrants from Brazil's northeastern region moved to Acre to work as laborers harvesting forest products; a precarious network of overland trails and roads evolved, linking river transportation systems. Nearly a century later, in the 1970s, the Interstate highways BR-364, running east-west, and the BR-317, connecting the capital city of Rio Branco to Peru, created important new economic corridors that greatly facilitated access to forests. Large-scale forest conversion to cattle pastures ensued, driven by both the desire of settlers to lay claim to large land holdings and for beef and milk production. With the paving of the BR-317 in 2000, conclusion of paving of the "Interoceânica" highway across the Andes to the Pacific coast (through Peru) in 2011, and the nearly-completed paving of the BR-364 to the west, transportation costs across the northern and eastern margins of the state have declined radically (Figure 3).

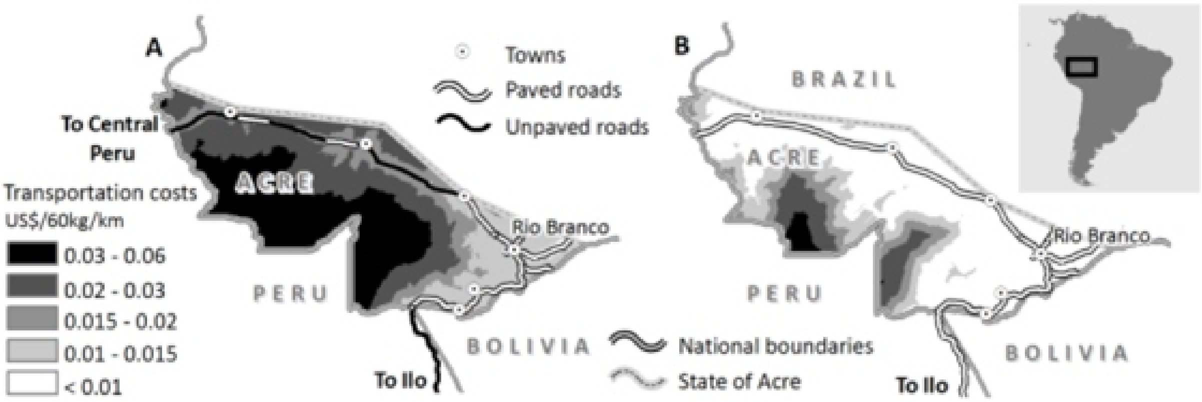

Figure 3. *The costs of transporting 60 kg of product to the nearest international port in Ilo, Peru, before and after the paving of the BR-364 (running east-west) and the BR-317 (running from Rio Branco southward). In most of the state, transportation costs to the port are reduced by more than half (Unpublished data from the transportation model described in Vera Diaz et al. 2007. Source: B. Soares-Filho, UFMG).*

4.4 Acre at the crossroads: economic integration with Peru and the Pacific

With the completion of the Interoceanic Highway and the BR-364, the Acre economy is now poised to become far more integrated with that of Peru, Pacific rim markets (including China), and the entire world, although the transportation of low value-per-weight products will continue to be prohibitive. The Madeira River transportation complex under development will also provide cheaper access of Acre products to global markets through the Amazon fluvial network. The Acre Government is well-positioned to use its social and environmental record of success to develop a differentiated export economy with the potential for high market access and, perhaps, performance premiums. In the near term, the industry that is best poised to take advantage of this new market access is the cattle industry. It currently comprises 92% of the state's export revenues and is poised to grow through intensification of existing pasturelands, as described in Section 8.

4.5 Modeling Economic Rents from Land-use

Acre's transition to a new rural economy will depend upon policies and incentives that successfully alter the behavior of thousands of land users. A convenient proxy for the logic of these land users is the profitability of competing land uses and the ways in which this profitability varies spatially as a function of transportation costs, other production costs, and expected yields. We developed spatially-explicit models of potential rents (profits) for Acre's principle competing land uses; to provide a first approximation of the value of land under competing uses, including those uses that keep the forest standing (timber production, rubber harvest, Brazil-nut gathering) and the main use that substitutes the forest (cattle pasture). Details on these models can be found on Soares-Filho et al. (2012)(Research Note 1).

4.6 The Opportunity Costs of Deforestation

Opportunity costs are the foregone profits from an economic activity that are not realized because of a decision to undertake an alternative activity. The opportunity cost of forest conservation can be calculated as the foregone profits from crop and livestock production that could have been realized if the forest had been converted to these production systems minus the profits that can be realized through economic activities that keep the forest standing. Similarly, the opportunity cost of deforestation can be calculated as the foregone profits from sustainable timber production, rubber harvest, Brazil-nut harvest and other economic activities that depend upon the forest minus the profits from those activities that depend upon deforestation. We estimated and mapped the opportunity costs of both forest conservation (through its impact on beef production) and deforestation (through its impact on timber, rubber, and Brazil-nut production) for the state of Acre.

a. <u>Timber</u>

Timber is the most important forest based economic activity in Acre. It represents 80% of the state's forest-based revenues. If the Acre timber stock were managed under selective harvest using "reduced impact logging" techniques and 30-year rotations, its net present value would be US$ 540 million (assuming a 5% discount rate). This potential rent is divided spatially between private lands (NPV = US$100 million), extractive reserves (US$146 million), indigenous lands (US$144 million), production forest and other conservation units (National and State forests – US$126 million) and small farm settlements (US$23 million). The areas of highest NPV are along the BR-364, between Sena Madureira and Feijó where a hectare of standing forest can reach a NPV of U$560 (Figure 4).

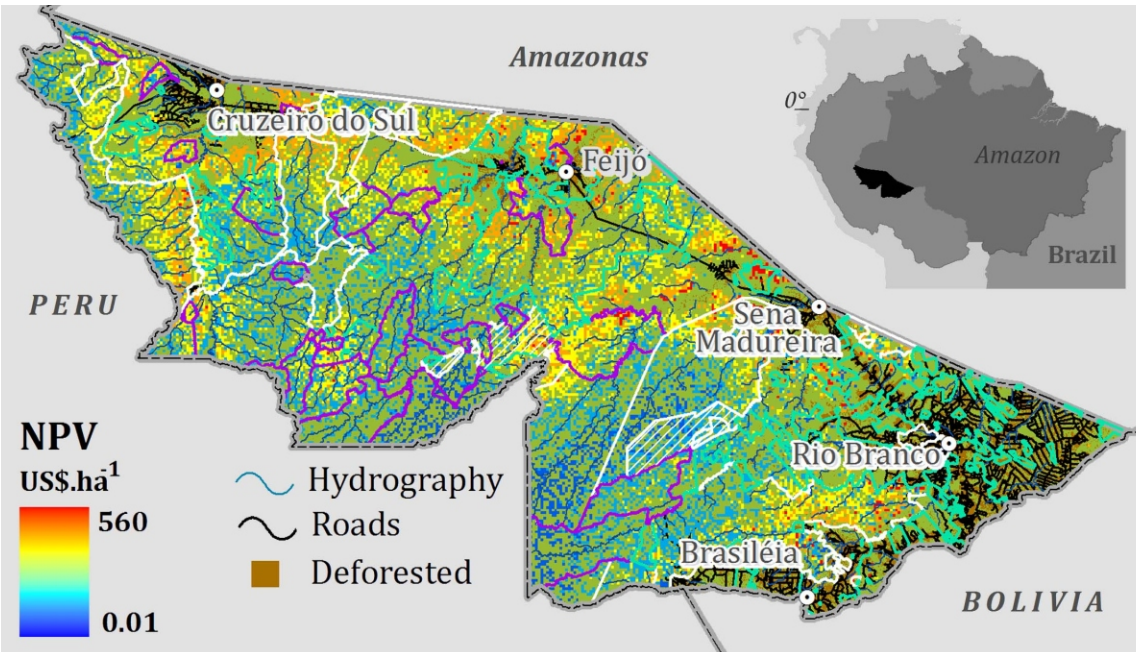

Figure 4. *Map of potential net present value (NPV) of the Acre forest estate if managed under 30-year sustainable rotations. This map was developed using a rent model that reflects predicted changes in transportation costs and investments in better timber management practices following Merry at al. (2009).*

b. _Brazil-nut_

Brazil-nut has always been the most important non-timber forest product in Acre and together with rubber production has helped to support rubber tappers and other forest based smallholder economies in the state. Acre alone is the second highest producer of Brazil-nut in the country, accounting for 28% of the national production. We estimated the potential NPV of forest stands for Brazil-nut production in the eastern end of the state. The potential productivity of Brazil-nut is 29.3±8.4 thousand tones (in their shells), with a potential rent varying from US$0.35 to US$8 million annually depending on the level of processing and supply chain structure (Nunes et al. 2011). These estimates generate an average NPV per hectare of US$0.16 to US$4.3 depending on tree density and transportation costs.

c. _Rubber_

Rubber is another non-timber forest product that is very important to the income of forest-dependent families in Acre. Rubber extraction from native forests is inefficient when compared to rubber tree plantations, but the importance of native rubber goes beyond its economic importance. It is a symbol of the autonomous rubber tapper movement that advanced a new form of land tenure called “extractive reserves”, in which rubber tapper families retain usufruct rights and can live within the reserve. The government of Acre created a rubber floor price to increase the viability of the rubber tapper population's traditional lifestyle. Our rent model for rubber was developed for eastern Acre where there is an average of 3 trees per ha with 1.7 liters extracted per tree each year. The rent for rubber in this region of Acre is calculated to be US$1.74 per hectare per year for the most processed product and with government price guarantees. In the absence of these guarantees, rubber extraction is not profitable.

4.7. The Opportunity Cost of Forest Maintenance

a. _Cattle pasture_

Cattle pasture is the most important economic activity of rural Acre occupying 83% of the deforested areas in the state (UCGEO 2011). The opportunity cost of forest maintenance in Acre is expressed primarily through foregone profits from cattle production (We did not estimate the opportunity costs of several other important agricultural activities undertaken by smallholders, including semi-subsistence production of manioc, rice, beans, and other crops). Our estimate of the rent of cattle pasture is based on the current characteristics of cattle production in the state, which is dominated by low productivity and efficiency, and accounted for transport costs and other costs of maintenance based on Bowman et al. (2012) . These estimates show that regions of higher NPV, reaching US$600 per hectare are concentrated in the eastern Acre where transportation infrastructure is improved (Figure 5), and pose a high threat to non-timber forest based activities presented above with much lower NPV.

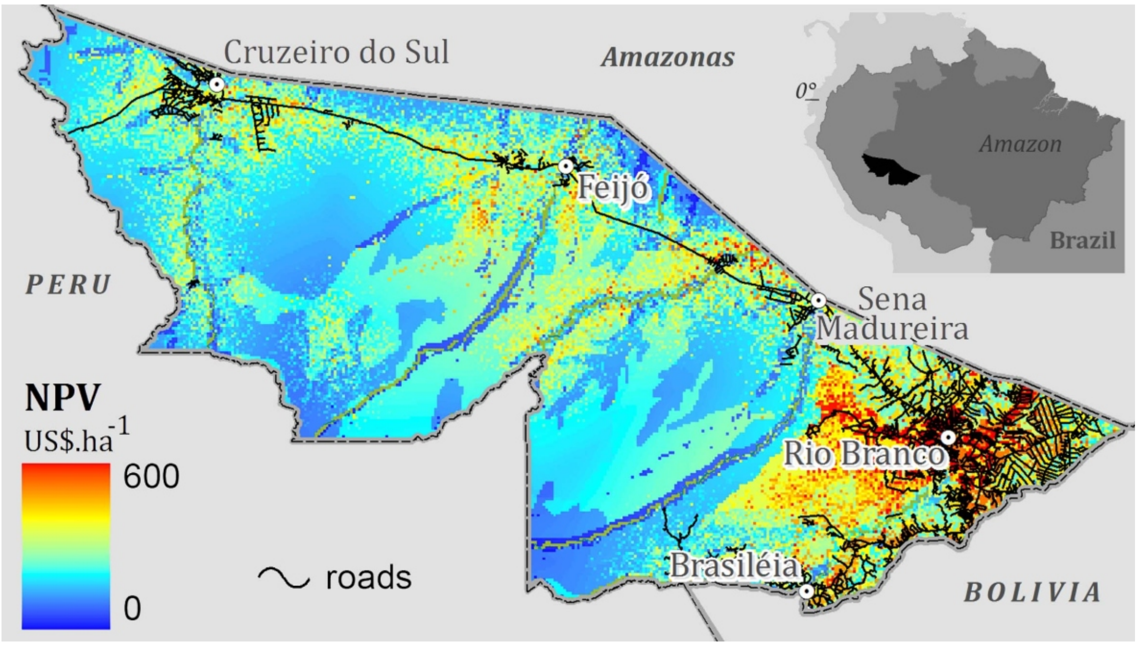

Figure 5. *Estimated NPV of cattle ranching in Acre state.*

4.8. Using Rent Models to Estimate the Minimum Value of Carbon

One measure of the cost incurred by the Acre economy to achieve the state's carbon emission reduction targets is the state-wide difference in NPV between cattle pasture and forest-based economic activities (the sum of timber, Brazil-nut, and rubber production) with and without the state's planned reductions in deforestation (Figure 6). This difference in NPV can be expressed in terms of cost per ton of CO_2 by simply dividing it by the amount of carbon in the forest. This approach does not take into account the secondary and tertiary industries associated with these economic activities. Using this conservative approach, we estimate average values of US$1.64 per ton of CO_2.

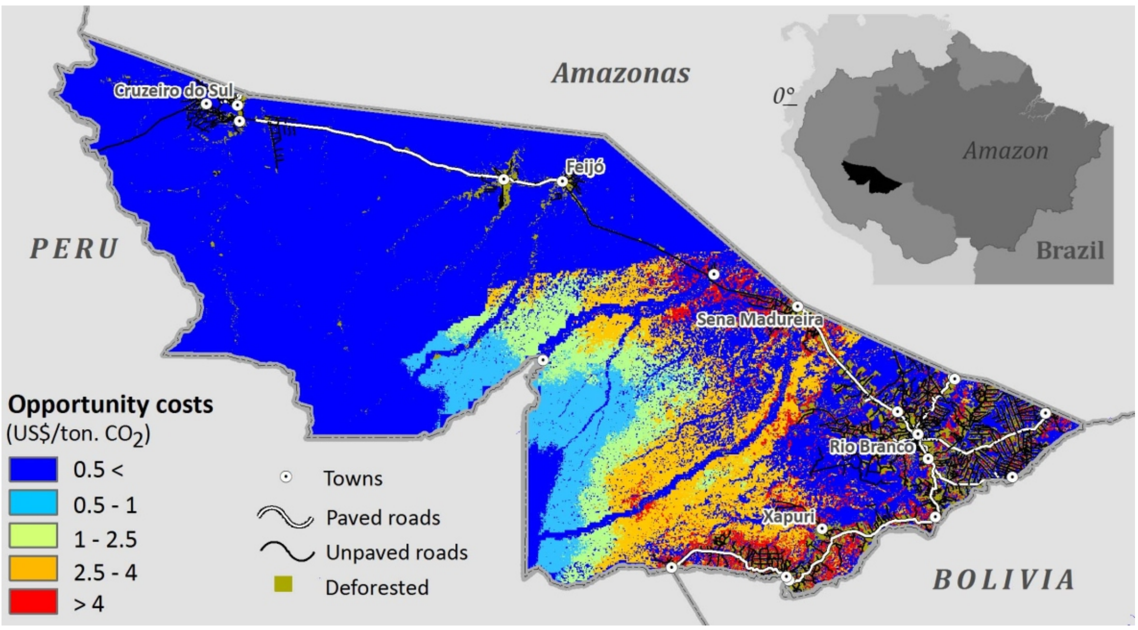

Figure 6. *Opportunity cost per ton of avoided CO_2 emission in Acre state.*

This approach to the estimation of the opportunity cost of reducing emissions from deforestation does not consider many other values of forests. Forests are the best way to buffer against the climate shocks that are affecting the Southwestern Amazon, by maintaining year-round transpiration to the atmosphere that can reduce the severity of droughts (Nepstad et al. 2008). Forests act as giant firebreaks across the landscape, preventing the spread of fires escaped from pastures and croplands (Nepstad et al. 2001). In addition to the timber, Brazil-nut, and rubber production that they provide to the formal Acre economy, they are also the source of medicines, resins, wild game, and natural beauty.

4.9. The Opportunity Costs of Achieving Acre's Deforestation Reduction Target

We estimated the state-wide cost associated with the decline in deforestation that would be needed to achieve Acre's deforestation reduction targets. For each year between 2008 and 2020, we “allowed” (through the model) deforestation to take place up to the maximum area defined by the target (Section 5) assuming that those areas with the highest probability of deforestation would be cleared first. After simulating deforestation through 2020 allowed by Acre's target, we tallied the difference in NPV for those forest areas that were not deforested. The total area of avoided deforestation was assumed to be the difference between the historical reference level (see Section 5) and the deforestation target (1,150 km^2, Table 1). The opportunity cost of this avoided deforestation and avoided emissions of 366 $MtCO_2eq$ was $623 million (Table 1).

Table 1. *The area of avoided deforestation, avoided emissions of CO_2, and associated opportunity costs of Acre's 2020 deforestation reduction targets. These spatially-explicit results are summarized by land category: Indigenous Lands (IL), Conservation Units (CU), Settlement Area (SA), Private Property (PP), and Public Undesignated Lands (PL).*

Land Category	Avoided Deforestation (‘000 ha)	Avoided Emissions (Mt CO_2)	Opportunity Cost (Million US$)
Indigenous Lands	9.8	3.9	0.4
Conservation Units	63.4	21.2	45.8
Settlement Area	364.6	105.6	234.2
Private Properties	390.9	126.3	209.4
Public Lands	322.0	109.3	133.8
Total	1,150.7	366.4	623.6

5 Carbon Emission Reference Levels

The state of Acre covers an area of 16.4 million hectare. It has already lost 12% of its forests to other land uses such as cattle ranching and slash and burn agriculture at a rate of 60 thousand hectares per year from 1996 to 2005 (Research Note 2; Alencar et al. 2012). The remaining 88% of its forest cover represent a carbon stock of 1.97 Pg C in above ground biomass and 2.4 Pg C including the carbon stored in the roots (Figure 7). Carbon stocks average 131 $tCha^{-1}$ (153 if we include roots and assume that root biomass is 20% of aboveground biomass). Carbon stocks are lowest (85 to 110 tC ha^{-1}) in bamboo forests, and are generally higher in the eastern end of the state.

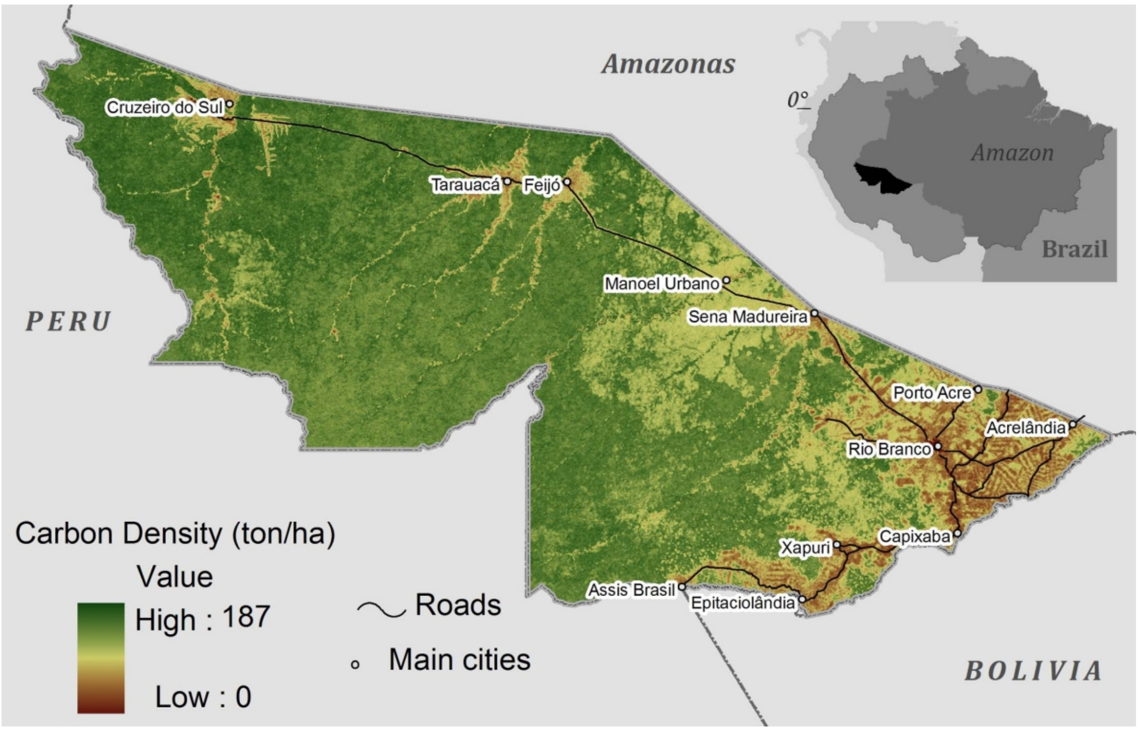

Figure 7. *Spatial distribution of forest carbon stocks in Acre State (Source:Baccini et al. 2012).*

5.1. State-wide Reference Level: Deforestation

The state-wide deforestation reference level is, by definition, the best available estimate of future deforestation that would occur in the absence of the state's efforts to reduce deforestation. The reference level is extremely important because it provides the basis of comparison for determining the state's future compensation for its reductions in deforestation and associated reductions in carbon emissions[3]. The Brazil National Space Research Institute (INPE) has mapped deforestation in the Amazon Region most years since 1988 (INPE 2011). This dataset provides an excellent opportunity for the Acre Government to estimate its

3 More precisely, it is the "crediting" reference level that is the level of emissions below which crediting can began. The crediting reference can be equal to or lower than the reference level.

deforestation reference level using a consistent dataset that is available to other states of the Brazilian Amazon. In Acre, the PRODES estimate of deforestation is conservative (Alencar et al. 2012; Research Note 2). The State's own forest monitoring program has determined that deforestation is, in most years, approximately 20% higher than the PRODES estimate, with the average for the period from 1996 – 2005 being 30% higher than the average deforestation rate by PRODES in the same period[4] (UCGEO 2011, Alencar et al. 2012).

Deforestation simulation is a powerful tool for examining the potential impacts of policy and market scenarios, but it is not appropriate as a tool for establishing reference levels because of its complexity and vulnerability to political manipulation. Instead, we believe that the default approach to the definition of reference levels should be the use of the historical average rate of deforestation over a period of ten years, except in those cases where there are very clear reasons to apply an adjustment to this rate, either upward or downward. This perspective is based upon extensive research conducted by IPAM and UFMG in the development of models that simulate the future of Amazon deforestation and its economic drivers and the influence of policies and market processes on deforestation (Soares-Filho et al. 2004, Nepstad et al. 2006a, Nepstad et al. 2006b, Soares-Filho et al. 2006, Vera Diaz et al. 2007, Nepstad et al. 2008, Merry et al. 2009, Stickler et al. 2009, Soares-Filho et al. 2010, Bowman et al. 2012).

The Brazilian Government has estimated the reference level of the Amazon region as the average deforestation for the period 1996-2005 assuming an average carbon density of 132 tC ha^{-1} (Serviço Florestal Brasileiro 2008). It has also assumed that the reference level should be adjusted downward by every five years based upon the more recent 10-year interval of deforestation. Hence, the reference level for 2011-2015 should be the average deforestation for 2000-2010.

We estimated Acre's reference level in two ways. First, we estimated it to be fully consistent with the Brazilian Federal Government approach (Scenario 1), using INPE/PRODES data and estimating average annual deforestation for the 1996-2005 period, adjusting the reference downward every five years (Figure 8)[5]. Second, we estimated the reference level without the downward adjustment of the reference level every five years.

Under the Scenario 1 Reference Level, Acre state would avoid 182 Mt of CO_2 emissions by 2020; 46% of that from 2006 to 2010 (Figure 8). Acre reduced emissions beyond its target by 23 $MtCO_2$ (12%) for the 2006-2010 period. These avoided emissions represent about 6% of the Brazilian Amazon's agregate emission reduction. If we consider a fixed reference level of 60 thousand hectares until 2020 (Scenario 2 of reference level), and the same target with a 42% reduction every commitment period, the amount of deforestation reduction jumps to 297 Mt CO_2 until 2020 (Figure 8).

These emissions reduction estimates are conservative. If we adopt the UCEGEO estimate of historical deforestation during the 1996-2005 instead of PRODES data, the amount of avoided emissions for the 2006-2020 period climbs to 221 $MtCO_2$, with approximately half of these emissions reductions (109 $MtCO_2$) occurring from 2011-2020 (Alencar et al. 2012; Research Note 3).

4 More details can be accessed in the Research Note 2 in Annex.

5 This Scenario 1 reference level was adjusted downward every 5 years starting on 2006 and ending in 2020, based on the average deforestation of the previous 10 years (Figure 8). Once the reference level or baseline was established, we used a reduction target of 42% from the average deforestation from 1996 to 2005 to draw a target line that when subtracted from the reference level indicated the amount of deforestation that is likely to be avoided if the targets are reached (Figure 8).

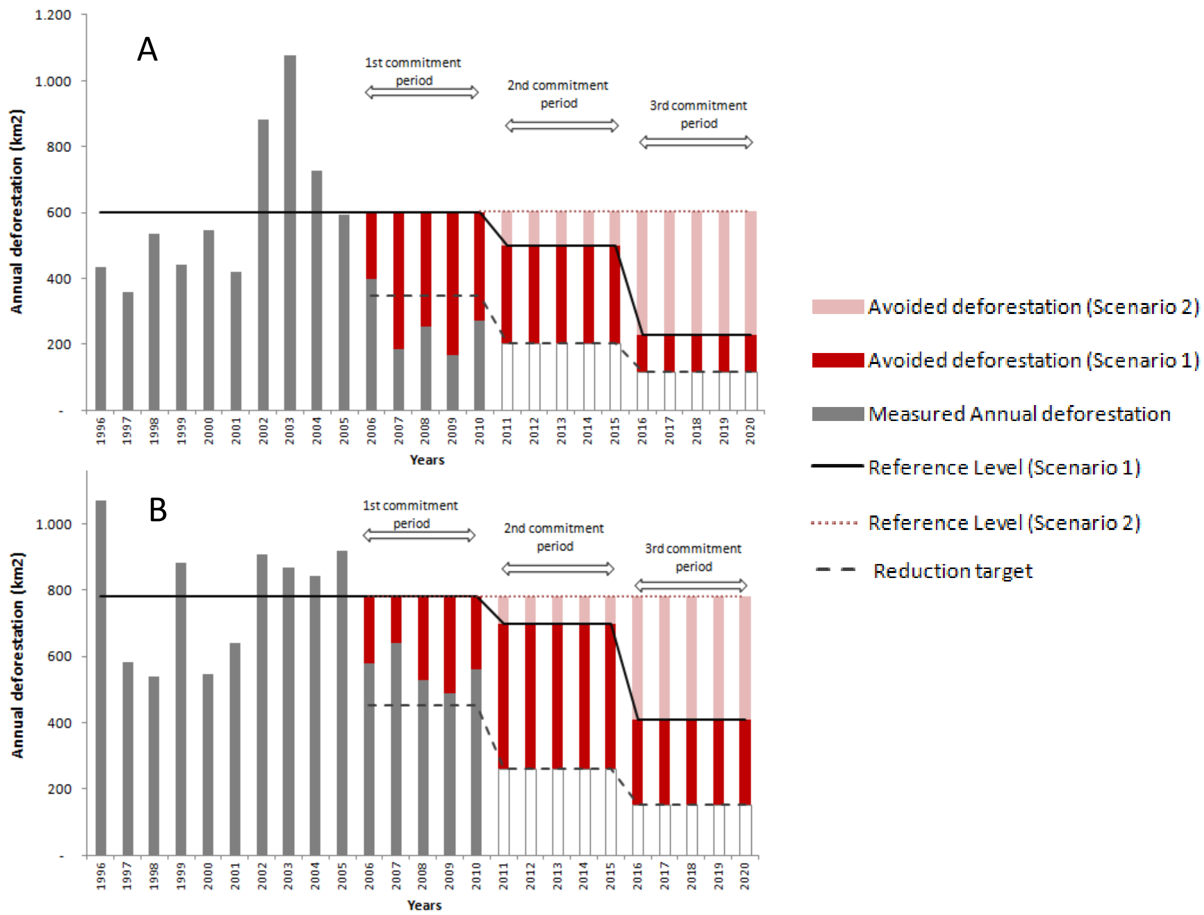

***Figure 8**. Reference levels and deforestation target used to calculate the avoided deforestation and emissions of Acre state following the methodology of the revised NPCC (Brasil 2010) using Prodes (A) and UCGEO (B) data; the scenario 1 reference level follows the approach of the federal government (Brasil 2008); the scenario 2 reference level is based upon a reference level that is not adjusted downward every 5 years. The target is estimated as a 42% below the scenario 1 reference level.*

5.2. State Reference Levels: Forest Degradation and Forest Carbon Enhancement

Acre plans to also develop reference levels for forest degradation and forest carbon enhancement. A possible integrated approach for reconciling Acre's carbon fluxes and calculation of reference levels must include the three main types of carbon fluxes including: 1) emissions from forest conversion to crop fields and cattle pastures (“deforestation”, or the first “D” of REDD+), 2) emissions from forest degradation by logging and fire (“degradation” or the second “D” of REDD+) and 3) carbon enhancement (i.e. carbon removals from the atmosphere) through tree planting, forest regeneration, and forest restoration, and through the recovery of degraded forest following fire and logging (Figure 9). To achieve reference levels for these fluxes, Acre will need to develop annual maps of the forest areas affected by logging and fire and the and the changes in carbon stocks following each type of disturbance. A system to map stages of forest regeneration or carbon accumulation must also be implemented. Once these fluxes are historically measured they can be used to establish reference levels for each type of emission (Figure 10). As it develops and implements its capacity to monitor all three categories of carbon fluxes and to succeed in lowering emissions for all three, Acre's amount of emissions reductions that qualify for compensation should increase.

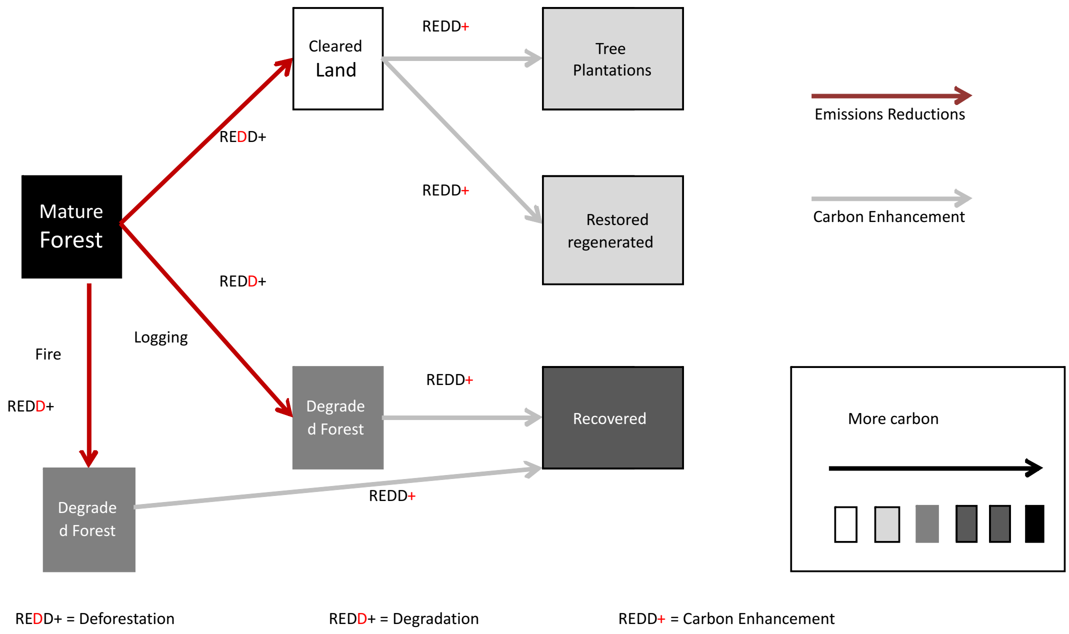

Figure 9. *Integrated approach for reconciling Acre's three types of carbon fluxes (Source: EPRI 2012).*

Acre has take important steps towards monitoring of these other fluxes. It has started to build the time series of forest areas affected by forest fires with rates representing 70% of the deforested area in the year of 2010, as well as mapping the cleared areas under regeneration (about 25% of the cleared land in Acre is under forest regrowth) (UCGEO 2011). The state has invested in research to estimate the impacts of selective logging on biomass reduction and is acquiring an airborne LIDAR system to increase its monitoring capacity (Asner et al. 2010).

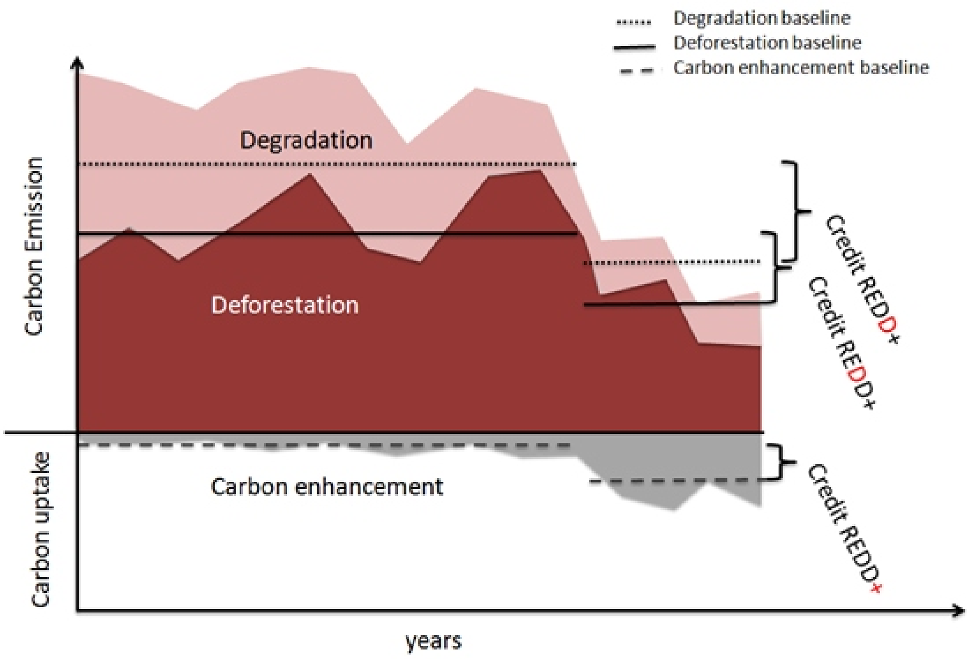

Figure 10. *Integrated approach for establishing and reference levels for the major carbon fluxes associated with REDD+ (Source: EPRI 2012)*

6 Allocation of REDD+ Benefits

The success of the SISA program will depend on the achievement of measurable reductions in greenhouse gas emissions from deforestation and forest degradation, and increases in carbon uptake in regrowing or planted forests. This net reduction in the flow of forest carbon to the atmosphere must be achieved in a way that is consistent with Florestania: it must improve the livelihoods of rural communities and producers, secure rural peoples' legitimate claims on land and natural resources, secure food production systems, maintain or restore the health of watersheds, and conserve biological diversity. It must allocate REDD+ incentives efficiently and fairly to achieve both reductions in emissions and improvements in social wellbeing and environmental conservation. Reductions in emissions will depend upon programs to engage and re-direct ranchers and farmers away from forests as they strengthen the “drivers” of conservation—those indigenous and traditional communities whose livelihoods depend upon forest maintenance.

We review three general approaches for determining the allocations of REDD+ benefits among sectors: one based on carbon accounting stock and flow second based on a “programmatic” approach, and the third representing a hybrid version of the stock and flow and programmatic approaches.

6.1. Allocating ex ante Through Stock and Flow Accounting

In the first approach, carbon accounting is used ex ante to determine the allocation of future revenues coming into the ISA-C system before it is implemented. This approach is consistent with the allocation among states of the Brazilian Amazon and the Brazilian Federal Government as proposed by Moutinho et al. (2011; Figure 11). It would divide the state territory into four large categories of land tenure that represent the main socioeconomic groups that are either responsible for conserving or deforesting forests. The socioeconomic groups considered as conservation drivers are indigenous peoples (Indigenous Territories – IT) and riverine, extractivists and/or traditional peoples (who reside in public Estractive Reserves, Agro-Extractive Settlements, and other types of Conservation Units –CU). The drivers of deforestation include small-scale farmers living in government official settlement project areas (SA) and medium to large farmers and cattle ranchers occupying portions of the remaining state area including undesignated public land and private property (PP). Acre could allocate its share of total emissions reductions achieved by Brazilian Amazon states (6%) across the land tenure categories following a stock and flow accounting scheme[6] that incorporates both the amount of forest carbon that is held within each land tenure category (“stock”) and the historical rates of deforestation-driven emissions associated with each category (“flow”)(Figure 11). The contribution of stock vs. flow to the allocation can be adjusted by assigning different weights to each in the formulation.

6 This approach was first suggested by Cattaneo (2008) and applied to the Amazon states by Moutinho et al. (2011).

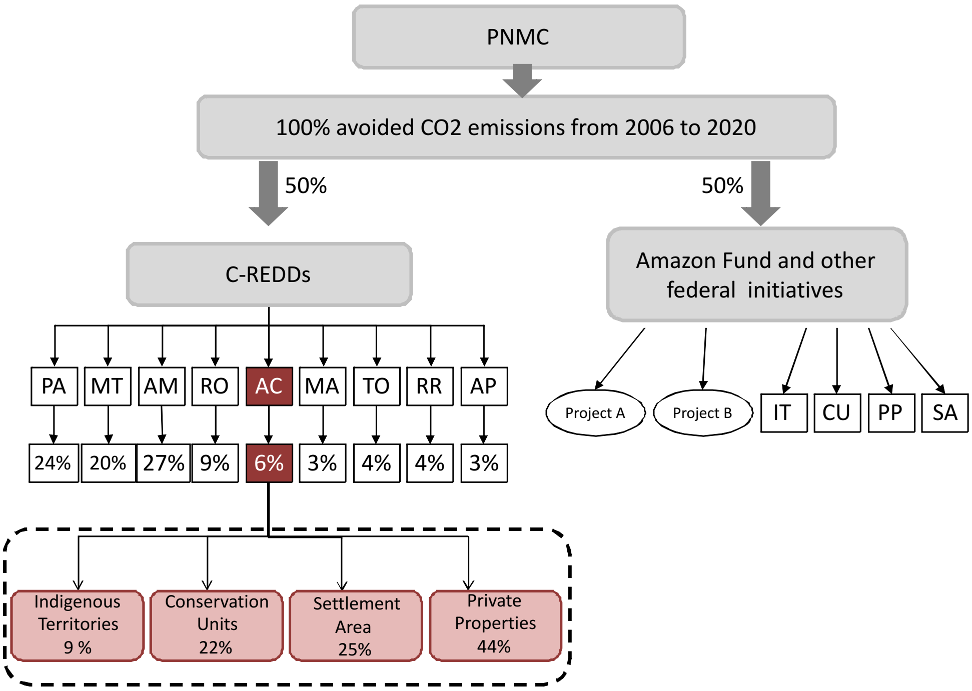

Figure 11. *Proposal of CO_2 emissions reductions allocation by National, State and tenure categories (or "sectors") based on a 50 : 50% stock and flow approach adapted from Moutinho et al. 2011. C-REDD represents the proportion of offset carbon credits from avoided national emissions distributed to the Amazon States (PA – Pará, MT – Mato Grosso, AM – Amazonas State, RO – Rondônia, AC – Acre, MA – Maranhão, TO – Tocantins, RR – Roraima, AP – Amapá)*

To illustrate the stock and flow approach and compare the results to alternative formulations, we calculated three scenarios of avoided emissions benefit allocation for IT, CU, SA, and PP land tenure categories in the state of Acre. The first scenario used only the historical CO_2 emissions from deforestation from each category, the second scenario considered only the carbon stocks of each category, and the third used a 50:50 weighting for stocks and fluxes for each category. The stock and flow allocation provided the most balanced allocation across land tenure categories (Figure 12). The allocation to indigenous territories (IT) climbs from 3 to 20.6 Mt CO_2 when comparing flow and stock and flow formulation, respectively, and increases from 16.5 to 49.5 Mt CO_2 in CUs when comparing the flow-based and stock-and-flow-based allocation (Table 2). The weighting between stock and flow could be adjusted to achieve the most politically acceptable solution.

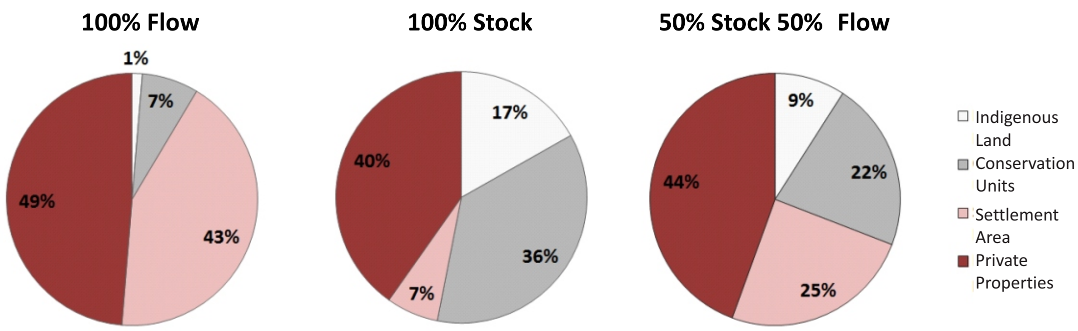

Figure 12. *Proportions of avoided emissions allocation for three scenarios of stock and flow for the four tenure categories.*

Table 2. *Avoided emissions by tenure category for the three scenarios of stock and flow (Millions of tons of CO_2 emissions reductions). The stock and flow scenario was calculated using baseline parameters of the Decree 7.390 from December 9 , 2010 (Brasil 2010).*

Tenure category Emissions Reductions ($MtCO_2$)	Sector-specific subprogram beneficiaries	Scenario 1 100% Flow	Scenario 2 100% Stock	Scenario 3 50%Stock and 50%flow
Indigenous territories (IT)	Indigenous peoples	3	38.2	20.6
Conservation units (CU)	Traditional and extractivists peoples	16.5	82.4	49.5
Settlement Areas (SA)	Smallholders and colonists	97	15.3	56.2
Private properties (PP)	Medium and large cattle ranchers and farmers	110.7	91.4	101

6.2. Allocation Based on Program Planning

This second approach begins with the question "how much finance, technical support, and basic rural services does each rural sector need to fulfill its potential in Acre's transition to low-emission rural development?" While this question is being answered through sector-specific, participatory program design processes, the state rapidly intervenes to slow forest clearing by the main deforesters—cattle producers—thereby increasing the likelihood of decreasing deforestation at scale and creating a large pool of emissions reductions to generate the revenues necessary to pay for the sector-specific programs. In short, this approach builds the sector-specific programs as it rapidly lowers emissions to generate the revenues to pay for the programs. Allocation is determined after the programs are designed according to the needs identified within each program.

This approach focuses on the major threats to REDD+ today: the lack of engagement of the farm/livestock sectors in REDD+ programs and the lack of tangible benefits for forest-defending sectors. It is based on the premise that an early stream of benefits flowing to the most needy rural stakeholders would buy the ISA-C precious time as it launches the sector-specific program design processes for indigenous peoples, traditional peoples (rubber tappers, Brazil-nut harvestors), smallholders, and the medium- to large-scale farmers and ranchers (Figure 13). These processes would require at least two years to be done properly.

One particularly important feature of this approach is the fast-track intervention in cattle production. Our preliminary analyses indicate that the transition to a zero-deforestation beef sector that is growing at the rate of 3.5% per year could take place with state-wide profits to producers of several billion dollars (Section 8). In other words, this transition could be largely self-financing, with forest carbon incentives reserved for those producers who are most in need (smaller-scale producers with less access to capital) and those producers who have demonstrated compliance with regulations and commitment to sustainable practices.

The fast-track intervention in the beef sector could help producers realize greater profits on their existing pasturelands through technical assistance to help them adopt improved beef production practices (Sá et al. 2010) and to access the "Brazil Low Carbon Agriculture" (Agricultura de Baixo Carbono) credit line, which provides sub-prime (5.5%) loans in support of the transition to low-deforestation ranching and farming (Stabile et al. 2012). This technical assistance could be complemented by stronger enforcement of regulations that restrict access to forests (e.g. the Zoning plan and the Forest Code, recently revised), subsidies for lime, improved forage grass, and improved cattle breeds, and work with meat packing plants to implement sustainability standards and traceability.

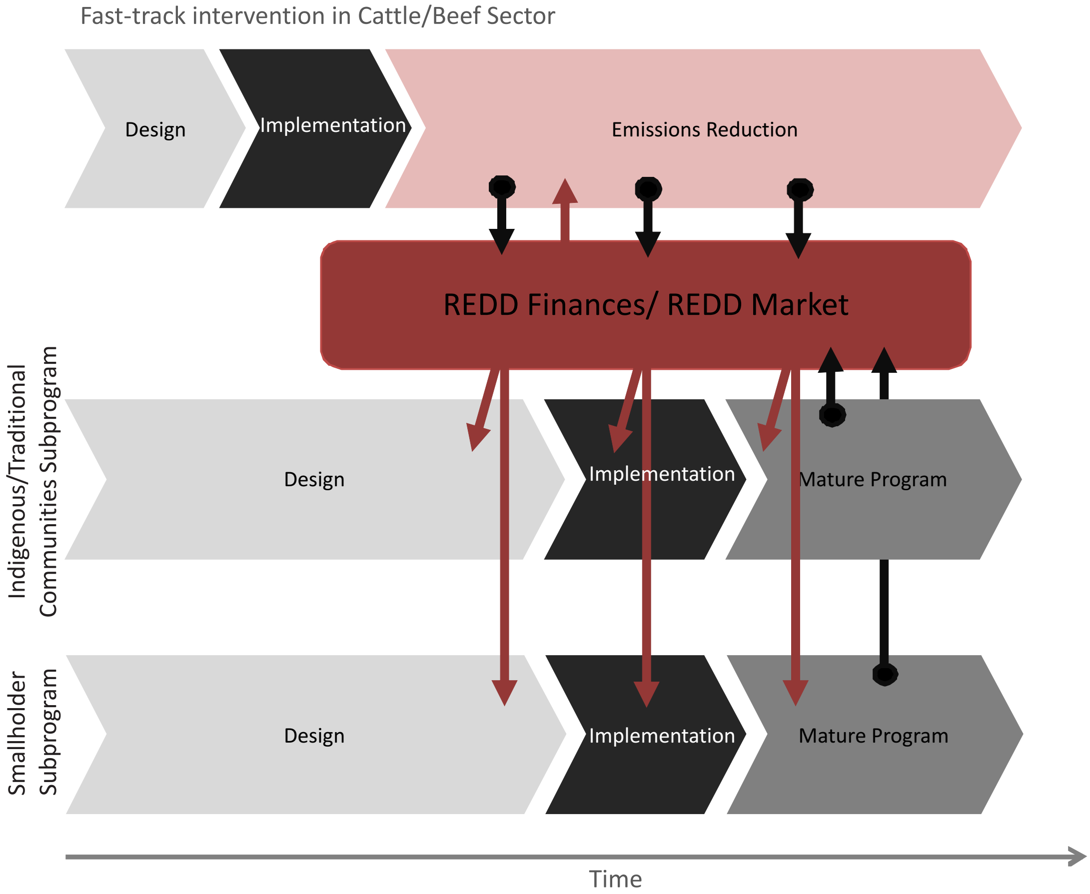

Figure 13. *Suggested chronology of subprogram creation inside SISA.*

6.3 Hybrid Approach

Both the stock-flow and the program planning approaches to the allocation of REDD+ benefits must implement and sustain programs of the ISA-C that are already under development and that would provide systemic support for the transition to low emission rural development. These programs are summarized in Table 3.

Table 3. *Suggestion o f REDD benefit allocation for ISA-C following an hybrid approach (stock and Flow and Programmatic).*

			Stock and Flux Approach			
Programmatic Approach	Governmental Programs Integrated with SISA		Tenure Category and Beneficiaries			
	Programs	Objective	Indigenous Lands (Indigenous peoples)	Conservation Units (Traditional peoples, extractivists and	Private Properties (colonists, medium and large farmers)	Settlements (smallholders)
	Valuing Forest Stocks Policy	Give incentive to sustainable production chains	X	X	X	X
	Policy for payment for Certification of Rural Properties	Support sustainable production through financial and technological resources			X	
	Smallholders Certification State Program	Give subsidies and support to sustainable production, management plans and provide payments for environmental services			X	X
	State Forest Plan	Provide concessions to enterprise and community forest management		X		
	Economic and Ecological Zoning	Provide the framework for environmental regularization of rural properties			X	X
	Community Development Plan - PDC	Integrate basic assistance policies, strength community organizations and consolidate sustainable production strategies		X		X
	Indigenous Land Management Program - PGTI	Strengthen the strategies of natural resource management inside and along the border of indigenous lands	X			
	State Network of Technical Assistance	Promote local and regional markets through the empowerment of communities on production and commercialization	X	X	X	X

Besides these governmental programs, SISA's ISA-C will also need specific subprograms for smallholders, for supporting intensification of beef production, and for agro-extractivist populations. Conceptual and analytical contributions to these program development processes are presented in sections 7, 8 and 9. These subprograms can be applied for more than one land tenure category (Figure 14).

In this hybrid approach, stock and flow allocation of REDD+ revenues could be associated with thematic Subprograms that apply to one or two of the land tenure classes described under the stock and flow section above (Figure 14).

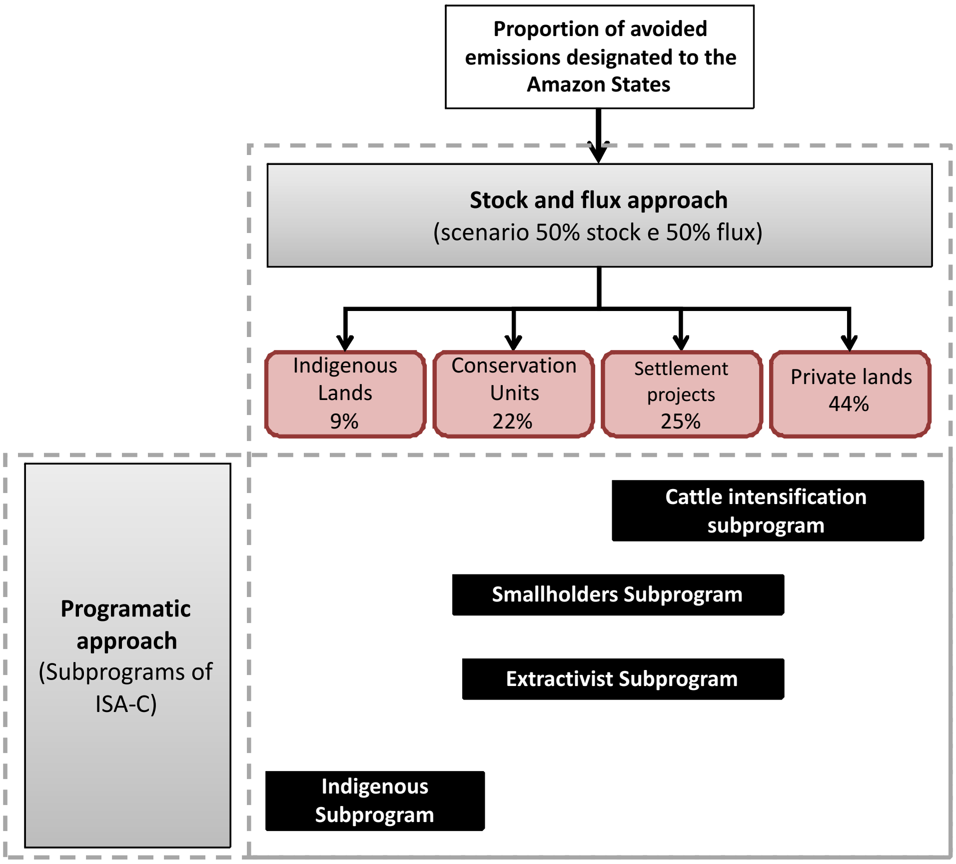

Figure 14. *A hybrid approach to allocation of REDD+ revenues across ISA-C subprograms in which stock and flow is used to define the allocation and thematic Subprograms are designed and implemented across one or two land tenure classes.*

7 Contributions to the Development of the Smallholders Subprogram

Smallholders in Acre are part of a large and amorphous group that includes recent colonists and grades imperceptibly into traditional and indigenous peoples. In Acre, smallholders, defined here as those with properties under 200ha, comprise 90% of rural land owners. Most of these properties are in settlement projects, a land tenure category that occupies 10% of the state area (Figure 15). While smallholders' share of forest area is small (6%) compared to their numbers, their contribution to state carbon emissions is much larger, accounting for 36% of accumulated deforestation. Land cover and use in family farms consists of annual (3% of landholding area) and perennial (6%) crops, pasture (26%) and forest (61%). This land use distribution is partially reflected in smallholder incomes, which are derived from annual crops (56%), livestock (20%), while perennials and forest extraction only account for 10% and 3%, respectively, of household incomes. Smallholders are responsible for a major share of the value of state agricultural production, accounting for 72% of the value of animal production, 83% of perennials and 78% of annual crop production, but only 51% of forest extraction.

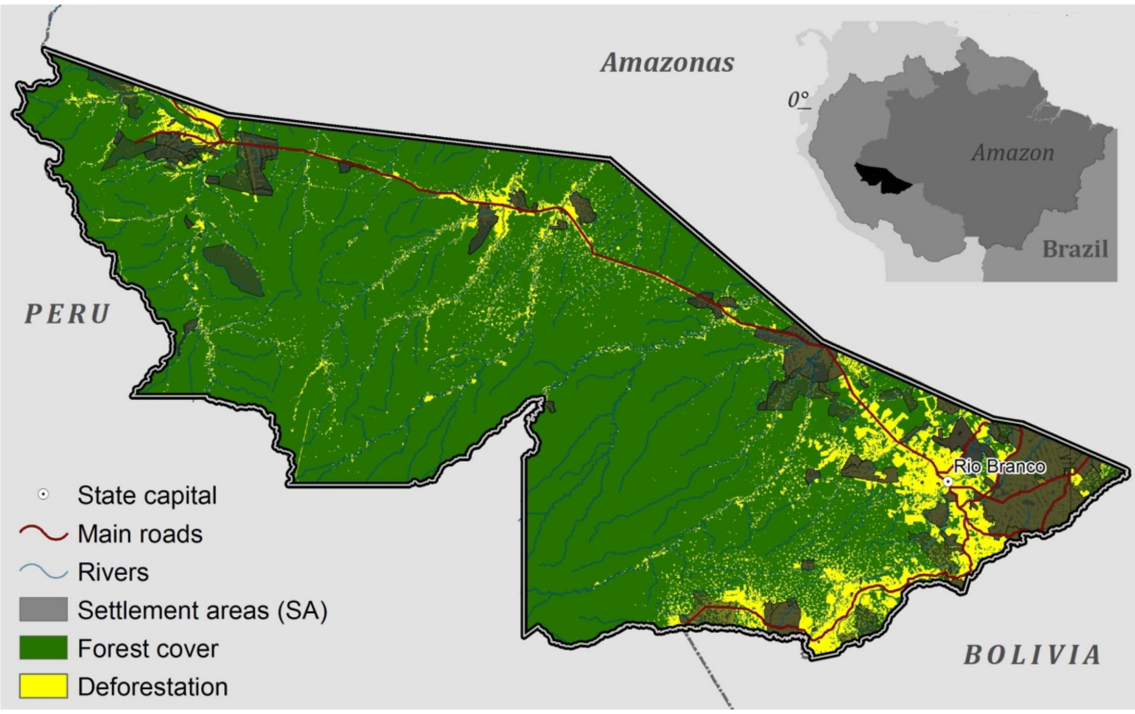

Figure 15. *Distribution of settlement areas (SA) in Acre.*

Due to their disproportionately large contribution to deforestation, smallholder emissions are a major priority for reducing emissions state-wide through a REDD+ regime. However, in most cases high emissions are a symptom of the precarious conditions prevailing in areas of smallholder settlement. While the state of Acre has made greater investments than most

Amazonian states, smallholder settlements are still plagued by structural difficulties such as: precarious infrastructure, limited and sporadic governmental presence, scarce rural extension services and a paralyzing regulatory bureaucracy. The combination of these problems guarantees the perpetuation of the conditions that have led smallholders to mine their forest resources.

A REDD+ regime can facilitate the resolution of these problems and the consolidation of a transition to low-emissions forest-based land use strategies. The main elements of a governance-based smallholder rural development strategy include:

a. *Complete land tenure legalization and environmental licensing*: These two requirements are preconditions for approval of forest management plans and many other kinds of productive investments including carbon markets. The major factor that has stalled settlement development in Amazonia is absent or incomplete documentation of land tenure status and environmental licensing.

b. *Invest in the infrastructure for functional settlements and reserves:* Very few settlements have adequate infrastructure to support the sustainable development of their territories. A major investment is needed in road networks, transportation systems, communication systems , sanitation, energy, health and education to provide existing settlements with the basic infrastructure they need to sustainably develop their territories.

c. *Strengthen rural governance*: Strengthen institutions and institutional arrangements at municipal and settlement scales, transfering more land management authority to municipal and settlement level governance institutions and increase government participation in local monitoring and enforcement.

d. *Shift to low emissions, forest-based production systems*: Shift household economies to low emissions land use systems that integrate productive and extractive activities to optimize sustainable global production.

e. *Access to and compliance with markets*: Prepare farmers and farm organizations to enter two major categories of markets, those for farm and settlement production and those for sale of carbon and other environmental services.

f. *Strengthen and expand rural extension services*: The critical factor in rural development is the quality and quantity of rural extension services, far more than access to credit, a double-edged sword at best. The shift of a majority of smallholders throughout the state to sustainable, low emissions, forest-based land use systems will require major investments in training of agents, expansion of a network of extension offices and sufficient funding for regular field visits and community projects.

g. *Acre Government Policies for Sustainable Forest-Based development*: The state of Acre's “Valuing Forest Stocks Policy”, with funding from the World Bank, is implementing a comprehensive program to reduce deforestation, increase incomes, strengthen governance and improve provision of social services to smallholders throughout the state, including traditional agro-extractive populations living in reserves, smallholders in

INCRA settlements and other private lands and communities in Indigenous territories. This program addresses most if not all the main elements described above and draws on Acre's long history of experience with sustainable forest-based rural development and PES programs, notably Proambiente.The development of SISA's ISA-C program provides an excellent opportunity to evaluate the performance of the various subprograms of the "Valuing Forest Stocks Policy" in addressing the six broad issues described above and creating the conditions needed for the implementation of a state wide REDD+ regime for smallholders funded through global carbon markets.

7.1 SISA's ISA-C Program and Smallholders

Most if not all of the programs and activities described above have been implemented or are contemplated in the State's program. Some additional points to consider in designing the SISA's ISA-C program include:

a. *Review existing programs and performance:* The development and implementation of a ISA-C subprogram for smallholders provides an excellent opportunity to undertake a comprehensive evaluation of the performance of individual subprograms to identify bottlenecks in the delivery of program services and benefits, redundancies, conflicts and gaps in program implementation, the transaction costs incurred by participating farmers, and the impacts each program has had on land use, forest health and the quality of life in rural settlements.

b. *Evaluate interaction between state and federal programs for smallholders:* A second major area for evaluation is the relationship between federal and state institutions and their respective programs for agro-extractive and smallholder populations in the state. A key role for SISA is to serve as a catalyst to organize the full range of programs and resources provided by state and federal government institutions into a coherent program with shared coordination and management of federal and state government programs implemented in the state of Acre, thereby seeking to optimize the use of the total volume of resources available.

c. *Train and Expand Network Extension Agents:* Promote training of extension agents in key areas related to shifting the productive base of smallholder farming from high to low emissions, forest-based, land use systems that can sell achieve additional value through carbon and PES markets.

d. *Conditionality and performance based benefits:* It is critical that program benefits and compensation for ecosystem services be rigorously tied to compliance with contractual obligations as proven through monitoring and evaluation of land use activities involving local institutions and overseen by SISA.

e. *REDD+ Demonstration Sites:* SISA's ISA-C program should start by investing in a small number of settlement level demonstration sites in which low emissions production and management models are implemented and monitored and serve as centers for dissemination of promising approaches to surrounding smallholder communities.

f. *<u>Monitoring and Adaptive Management</u>:* In many cases program execution rather than design is the critical factor in the performance of rural development programs. One problem is the absence of an effective system of monitoring and evaluation that informs the annual planning process, thereby contributing to progressive improvements in program performance and ability to adapt to change.

In the case of SISA a participatory monitoring system has two related objectives: 1) evaluate the performance and impacts of government programs in promoting the shift to sustainable low emissions land management systems, and 2) provide markets, local farmers, certifiers and environmental regulators with information on the status of forest carbon and other ecosystem services in smallholder properties, communities, settlements and reserves. SISA should play a strategic role in the development of an adaptive approach to program implementation by taking the lead in organizing the continuous monitoring and evaluation of program impacts and compliance with management plans and PES contracts.

In conclusion, the state of Acre is uniquely poised to implement a pioneering state wide program for facilitating the shift from an extensive, high emissions production strategy to a more intensive low emissions strategy that reduces deforestation and increases carbon stocks while improving the sustainability of land and resource use. The implementation of SISA provides the state with the opportunity to more closely integrate its existing rural development programs and focus them on the creation of the conditions necessary for the successful implementation of a state wide REDD+ regime for smallholders; one that satisfies global carbon markets and roundtables, while contributing to the development and consolidation of sustainable forest based smallholder economies.

8 Background information for cattle ranching sub-program: prospects for the transition to a “zero deforestation” beef sector

Cattle ranching is the main economic activity of Acre state. In 2010, cattle pastures covered 1,746,000 ha of the state representing 83% of the state's total deforested area (UCGEO, 2011) and 92% of the state's export revenue (U$249 million[7], SEFAZ 2011). The herd of 2,578,500 head of cattle (IBGE, 2011b) was distributed among 19,920 rural properties. The majority (95%) of these properties had fewer than 500 animals and totaled 50% of the State´s herd. These data show the importance of smallholder/ family production in Acre's cattle ranching industry.

If Acre is to secure and deepen its progress in lowering deforestation rates, a systemic program will be needed that supports the continued growth of the beef industry while simultaneously shifting the industry to a “zero deforestation” pathway. These duel goals can be achieved through intensification of beef production: through “vertical” increases in production through higher yields per hectare of pasture instead of “horizontal” increases in production through pasture expansion into forests. In this section, we examine the economic viability of a program that fosters a transition to a zero deforestation beef sector that is growing at 2.2% and 3.5% annually, following the projections of the state's growth in beef production through 2021 provided by the Brazilian Ministry of Agriculture and EMBRAPA, respectively. We assume that this intensification will be achieved through changes in cattle production systems that are already being implemented in Acre (Sá et al, 2010). At current levels of beef production, these projections of growth in the state's beef production would require 4,720 and 8,030 km^2 of new deforestation, respectively.

There are currently two major types of beef production systems—“improved” and “advanced”—that provide higher yields than the traditional system, as summarized in Table 4 . One of the most important features of these production systems is that the increases in yield associated with intensification is greater than the additional cost per kg of beef (See details os this section analysis in Nepstad et al. 2012). Intensification from the traditional to an advanced system increases the production cost per hectare by 139% but at the same time increases productivity by 202%. This means that the shift to intensification is potentially profitable.

These costs do not take into account the initial investments that are necessary to make the transition to intensification. We estimate this cost to be U$250 per hectare.

To provide a preliminary estimate of the economic viability of the beef intensification in Acre that would be necessary to achieve expanded production (2.2 and 3.5% annually) without deforestation, we calculated the statewide increase in profits to the beef sector in Acre by 2021 using three beef prices (U$2.17, U$2.83, U$3.50 per kg). We did this calculation for three different percentages of the current pasture area undergoing intensification: 25, 50, 75% and 100%. This is illustrated in figure 16.

7 Considering an exchange rate of R$2.00/U$ 1.00

Table 4. *Stocking rate (animal units = AU), productivity, production cost and cost per hectare of traditional, improved, and advanced beef production systems in Acre state. Data from Sa et al. 2010.*

System	Stocking rate (AU/ha)	Productivity (kg/ha/yr)	Production cost (U$/kg)	Cost per ha (U$/ha/yr)
Traditional	1	61	1.77	107.65
Improved	1.5	115	1.46	168.95
Advanced	2.5	184	1.40	257.46

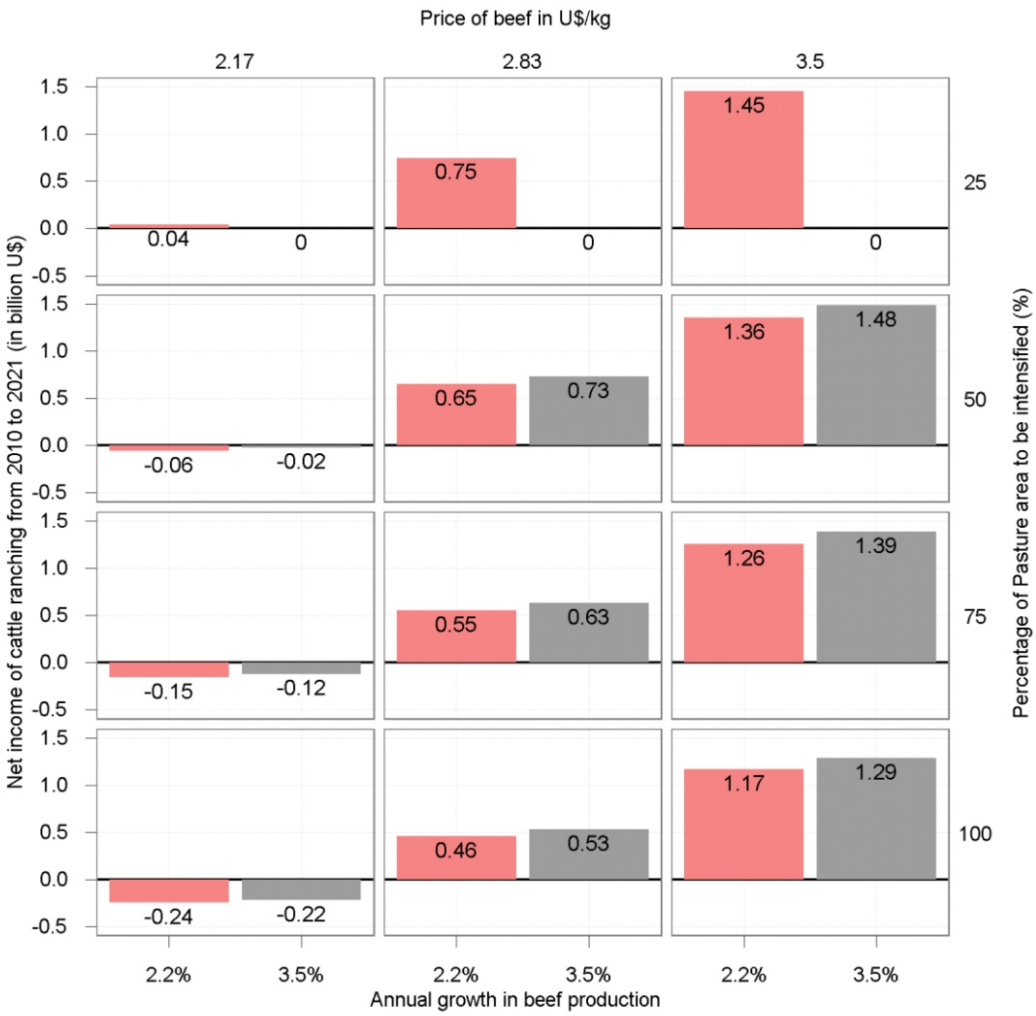

Figure 16. *Net income of cattle ranching for beef production in the State of Acre under a "zero deforestation" trajectory, effective immediately, from 2010 to 2021. The results consider two rates of annual growth of beef production, and applying intensification to technology to four percentages of the total pasture area. (Note that, for 3.5% growth, intensification in only 25% of the area surpasses the support capacity of the advanced system, thus the income is not shown.)*

These preliminary analyses of the economic viability of the transition to zero deforestation beef indicates "break-even" at the lowest beef price, and aggregate profits up to U$1.5B for the highest beef price (Figure 16). Further work will be needed to determine how these profits compare with the scenario of horizontal expansion of the beef industry into forests.

The most important conclusion of this analysis is that the transition to zero deforestation beef sector could be largely self-financing if beef prices are reasonably high. Carbon finance could be employed in conjunction with existing credit lines for pasture intensification, such as the "ABC" (Brazil Low-Carbon Agriculture) credit program of the Brazilian Government.

The design and implementation of a program to foster the transition to a zero deforestation beef sector will require the cooperation of several Government Departments, research institutions, rural extension, and the direct involvement of cattle producers themselves. The program must be differentiated for different types of beef producers, with special attention given to the small-scale producers of farm settlements, where cattle are also the basis for a milk industry (see Section 7). Small-scale farmers with herds of 500 head or less own 50% of the state's herd.

9 Subsidies for an Extractivist subprogram

The future of agro-extractivist cultures (e.g. rubber tapper and Brazil-nut gatherers) and low emission forest-maintaining economies in the Brazilian Amazon are threatened by deforestation and forest degradation. Cattle ranching and other non-forest based land uses adopted by rubber tappers themselves are gradually replacing the traditional economy based on extraction of forest product in Extractive Reserves and Sustainable Development Reserves (Peralta and Mather 2000), while these reserves also experience pressure from logging and mining activities carried out by larger-scale operators (Schwartzman and Zimmerman 2005). Several factors have contributed to this scenario including the low economic competitiveness and efficiency of extractivism, lack of resources and infra-structure and insufficient management and co-management capacity of responsible agencies (ICMBio, the Brazilian agencies responsible for protected areas) and local agro-extractivist organizations, and the lack of economic incentives to support sustainable forest production in these territories. The promotion of forest economies that value the standing forest and provide steady improvements in the livelihoods of forest-dependent communities represent a major institutional and financial challenge that must be addressed in order to maximize these vectors of conservation and minimize the vectors of deforestation (Borges et al. 2007) .

This considering the high level of threat in which the culture, rights and resources of these peoples are exposed to, and the role of their territories on conserving large stocks of forest carbon, a significant proportion of the potential financial resources derived from avoided deforestation emissions under the REDD+ mechanism should be channeled to benefit such peoples. This mechanism can represent an opportunity to support and promote forest economies that are adapted to the Amazon, consequently improving the quality of life of these families. We present examples of different strategies that could be used as a bases for distributing benefits from REDD+.

9.1 REDD+ and the Strategy to Reach Extractivists

The strategy of benefit distribution from the national reduction emissions from deforestation to forest people beneficiaries could be done using both Federal and State institutional frameworks (Figure 17). There are three main programs in which these resources could be divided: one is the economic incentives program, the second is a project based program, and the third is a government management program. These programs should reach these families on at least three levels: at the family level, at the organizational level and at the level of agencies responsible for agro-extractivists and their territories.

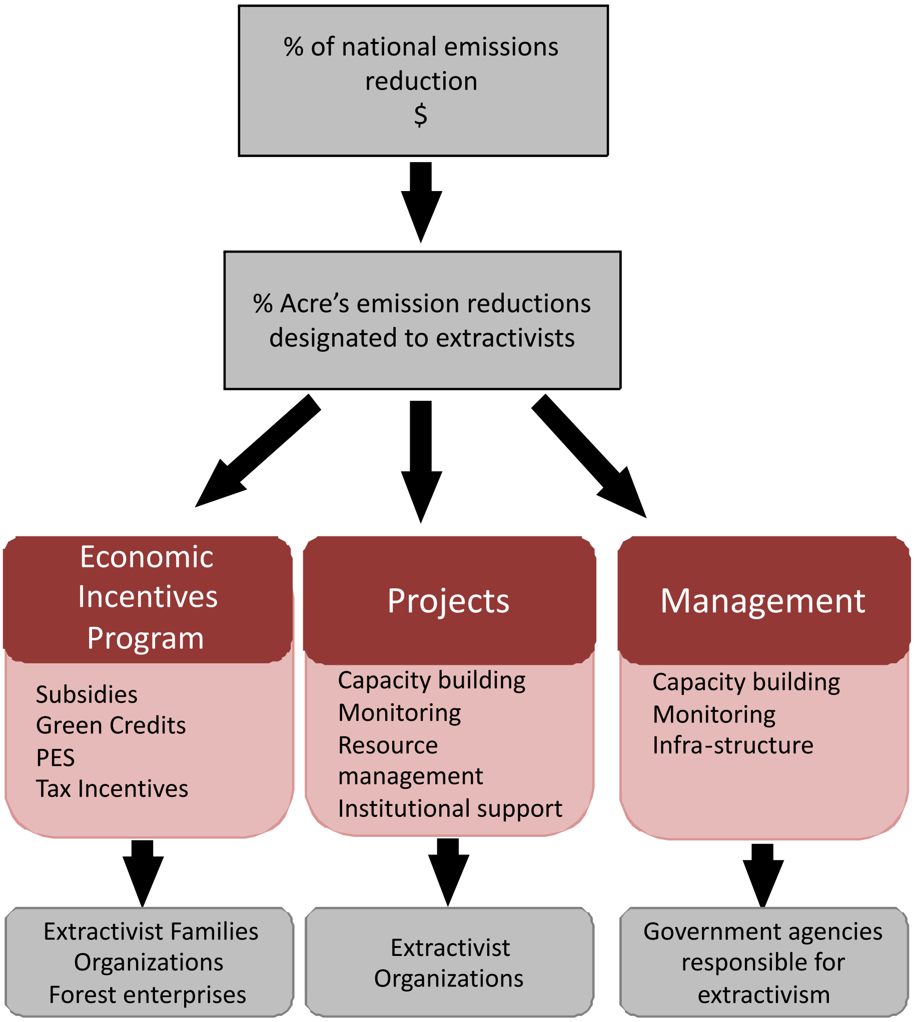

Figure 17. *Strategy of reduction emissions' benefit distribution to agro-extractivist families.*

At the level of the governmental agencies responsible for the agro-extractivists, the strategy should allow for significant, well-designed investments in their territories and resource management. This include support on implementation and enhancement of infra-structure to measure and monitor local and surrounding emissions from deforestation and degradation, help to support the resolution of land tenure problems, and strengthen the institutional capacity of agencies and local organizations in management and enforcement to control deforestation (Dutschke et al. 2008). The financial mechanism created by government programs to benefit the extractivists would be: subsidies to sustainable forest based economic activities, direct benefits to local communities, fiscal incentives to enterprises that help to strength forest product chains, special credits associated with the transformation of non-timber products into value-added goods when appropriate and if desired by extractivists, and capacity building of such communities in managing and monitoring their resources.

At the extractivists family and organization level, such investments could be used to enhance the quality of life of such peoples, through policies of compensation for environmental services such as direct payments or benefits ; and investments in policies that increase the value of forest products. These policies can support, promote and develop forest economies based in non-timber and timber forest products, create easier connections with special markets, support and strength the physical infra-structure and human resources for management and monitoring of these territories, and support internal capacity building of inhabitants for co-management and social organization (Mazer et al. 2012).

10 Conclusion

Acre State is well positioned to deliver and fully implement the first Jurisdictional REDD+ Programs through the state's Environmental Service Incentive System (SISA). This program called, ISA-C, has the potential to help foster the state’s transition to low emission rural development by attracting revenues for reductions in emissions from deforestation at the same time that it gives incentives to the maintenance of forest carbon stocks.

For the ISA-C to achieve its potential, it should be designed and implemented in a way that maximizes simplicity and compatibility with the State's current policies, cross-sector integration, and stakeholder consultation processes. It should be driven by the economic logic of the state, including the large spatial variation in profitability for both forest-maintaining and forest-replacing activities. Acre should maintain compatibility and inter-operability with the national deforestation monitoring system and reference level approach, but use its own monitoring system to demonstrate that the national deforestation data provide conservative estimates of Acre's real contributions to emissions reductions. Finally, it should choose the approach to benefit allocation that is both politically expedient but consistent with the State's public policy formulation, its institutional innovation that is underway, and the real costs of each of the major sectors that must be reached through ISA-C.

Finally, Acre must move quickly to “fast-track” programs that will accelerate the transition of the beef industry to “zero deforestation” as it provides alternatives to deforestation to swidden farmers. The emissions reductions of such fast track programs would help to guarantee state-wide performance, increasing its ability to attract investments that could be used to both design and implement the sub-programs for indigenous territories, extractive reserves, and smallholder settlements.

11 References

Alencar, A., I. Castro, S. Silva, and A. Baccini. 2012. Situação do Estoque Florestal e Dinâmica do Desmatamento no Estado do Acre. Caderno Técnico, 2. IPAM, Brasilia. 25p.

Alencar, A., D. Nepstad, I. Castro, P. Moutinho, and O. Stella. 2012. Subsídios para o Cálculo de Linha de Base e Emissão Evitada do Estado do Acre. Caderno Técnico, 3. IPAM, Brasilia.20p.

Asner, G. P., G. V. N. Powell, J. Mascaro, D. E. Knapp, J. K. Clarck, J. Jacobson, T. Kennedy-Bowdoin, A. Balaji, G. Paez-Acosta, E. Victoria, L. Secada, M. Valqui, and F. Hughes. 2010. High-resolution forest carbon stocks and emissions in the Amazon. PNAS 107:16738-16742.

Baccini, A., S. W. Goetz, W. S. Walker, N. T. Laporte, M. Sun, D. Sulla-Menashe, J. Hackler, P. S. A. Beck, R. Dubayah, M. A. Friedl, S. Samanta, and R. A. Houghton. 2012. Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps. Nature Climate Change 2.

Borges, S. H., S. Iwanaga, M. Moreira, and C. C. Durigan. 2007. Uma análise geopolítica do atual sistema de unidades de conservação na Amazônia Brasileira. Page 28 Política Ambiental. Conservação Internacional. Belém, PA.

Bowman, M. S., B. S. Soares Filho, F. D. Merry, D. C. Nepstad, H. Rodrigues, and O. T. Almeida. 2012. Persistence of cattle ranching in the Brazilian Amazon: A spatial analysis of the rationale for beef production. Land Use Policy:558-568.

Brasil. 2008. Plano Nacional de Mudanças Climáticas. Brasil. http://bit.ly/MMA169

Brasil. 2010. Decreto 7.390, de 9 de dezembro de 2010. p.6. Available at: http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Decreto/D7390.htm

Cattaneo, A. 2008. Regional Comparative Advantage, Location of Agriculture, and Deforestation in Brazil. Journal of Sustainable Forestry 27:25-42.

Dutschke, M., S. Werzt-Kanounnikoff, L. Peskett, C. Luttrell, C. Streck, and J. Brown. 2008. How do we match country needs with financing sources? Pages 77-86 in A. Angelsen, editor. Moving Ahead with REDD: Issues, Options and Implications. Center for International Forestry Research (CIFOR), Bogor, Indonesia.

EPRI. 2012. A comparative analysis of GCF REDD programs. EPRI, Washigton.

INPE. 2011. Monitoramento da Floresta Amazônica Brasileira por Satélite. Instituto Nacional de Pesquisas Espaciais, São José dos Campos, SP. http://www.obt.inpe.br/.

Mazer, S., A. Alencar, E. Mendoza, and D. McGrath. 2012. Subsídios para um Subprograma Extrativista. Caderno Técnico, 6. IPAM, Brasilia.10p.

McGrath, D., C. Pereira, E. Mendoza, A. Azevedo, and S. Rivero. 2012. Subsídios Para um Subprograma Voltado à Agricultura Familiar no Acre. Caderno Técnico, 4. IPAM, Brasilia.26p.

Merry, F., B. S. Soares Filho, D. Nepstad, G. Amacher, and H. Ridrigues. 2009. Balancing conservation and economic sustainability: The future of the Amazon timber industry. Environmental Management 44:395-407.

Moutinho, P., O. Stella, A. Lima, M. Christovam, A. Alencar, I. Castro, and D. Nepstad. 2011. REDD no Brasil: um enfoque amazônico: Fundamentos, critérios e estruturas institucionais para um regime nacional de Redução de Emissões por Desmatamento e Degradação Florestal - REDD. CGEE, Brasilia.

Nepstad, D., G. Carvalho, A. C. Barros, A. Alencar, J. P. Capobianco, J. Bishop, P. Moutinho, P. Lefebvre, U. L. Silva Jr, and E. Prins. 2001. Road paving, fire regime feedbacks, and the future of Amazon forests. Forest Ecology and Management 154:395-407.

Nepstad, D., S. Schwartzman, B. Bamberger, M. Santilli, D. Ray, P. Schlesinger, P. Lefebvre, A. Alencar, E. Prinz, G. Fiske, and A. Rolla. 2006a. Inhibition of Amazon deforestation and fire by parks and indigenous lands. Conservation Biology 20:65-73.

Nepstad, D., B. Soares Filho, F. Merry, A. Lima, P. Moutinho, J. Carter, M. Bowman, A. Cattaneo, H. Rodrigues, S. Schwartzman, D. McGrath, C. M. Stickler, R. Lubowski, P. Piris-Cabezas, S. Rivero, A. Alencar, O. Almeida, and O. Stella. 2009. The end of deforestation in the Brazilian Amazon. Science 326:1350-1351.

Nepstad, D., M. C. C. Stabile, A. Azevedo, J. Valentin, and E. Mendoza. 2012. Subsídios Para um Subprograma de Intensificação da Pecuária no Acre: Uma Análise Estadual. Caderno Técnico, 5. IPAM, Brasilia.18p.

Nepstad, D., C. Stickler, and O. Almeida. 2006b. Globalization of the Amazon beef and soy industries: opportunities for conservation. Conservation Biology 20.

Nepstad, D. C., C. Stickler, B. Soares Filho, and F. Merry. 2008. Interactions among Amazon land use, forests and climate: propects for a near-term forest tipping point. Phil. Trans. R. Soc. 363:1737- 1746.

Nunes, F. S., B. S. Soares-Filho, and H. O. Rodrigues. 2011. Valorando a floresta em pé: A rentabilidade da Castanha do Brasil no Acre. IX Encontro Nacional da Eco Eco, Brasilia, BR.

Peralta, P., and P. Mather. 2000. An Analysis of Deforestation Patterns in the Extractive Reserves of Acre, Amazonia from Satellite Imagery: A Landscape Ecological Approach. International Journal of Remote Sensing 21:2555-2570.

Sá, C. P. d., C. M. S. d. Andrade, and J. F. Valentim. 2010. Análise Econômica para a Pecuária de Corte em Pastagens Melhoradas no Acre. EMBRAPA, Rio Branco, AC.

Schwartzman, S., and B. Zimmerman. 2005. Conservation Alliances with Indigenous Peoples of the Amazon. Conservation Biology 19:721–727.

Serviço Florestal Brasileiro, 2008. Fundo Amazônia, Serviço Florestal Brasileiro. Available at: http://www.sfb.gov.br/publicacoes/institucionais/fundo-amazonia.

Soares-Filho, B., A. Alencar, D. Nepstad, G. Cerqueira, M. d. C. Diaz, S. Rivero, L. Solorzano, and E. Voll. 2004. Simulating the Response of Deforestation and Forest Regrowth to Road Paving and Governance Scenarios Along a Major Amazon Highway: The Case of the Santarém-Cuiabá Corridor. Global Change Biology 10:745-764.

Soares-Filho, B. S., E. Mendoza, R. Giude, L. B. V. Hissa, F. Nunes, C. Jaramillo, H. Rodrigues, W. Leles, and M. Bowman. 2012. Rentabilidade dos Usos da Terra e Custo de Oportunidade das Florestas do Acre. Caderno Técnico, 1. IPAM, Brasília.

Soares Filho, B., P. Moutinho, D. Nepstad, A. Anderson, H. Rodrigues, R. Garcia, L. Dietzsch, F. Merry, M. Bowman, L. Hissa, R. Silvestrini, and C. Maretti. 2010. Role of Brazilian Amazon protected areas in climate change mitigation. PNAS 107:10821-10826.

Soares Filho, B., D. C. Nepstad, L. M. Curran, G. C. Cerqueira, R. A. Garcia, C. Azevedo-Ramos, E. Voll, A. McDonald, P. Lefebvre, and P. Schlesinger. 2006. Modelling conservation in the Amazon basin. Nature 440:520-523.

Stabile, M.C.C., Azevedo, A.A. & Nepstad, D.C., 2012. O programa “Agricultura de baixo carbono” do Brasil: Barreiras para sua implementação, Brasília-DF, Brasil: Instituto de Pesquisa Ambiental da Amazônia (IPAM). Available at: http://bit.ly/IPAM_Barreiras

Stickler, C. M., D. C. Nepstad, M. T. Coe, D. G. McGrath, H. O. Rodrigues, W. S. Walker, B. Soares Filho, and E. Davidson. 2009. The potential ecological costs and cobenefits of REDD: a critical review and case study from the Amazon region. Global Change Biology 15:2803–2824.

UCGEO. 2011. Monitoramento do Desmatamento no Acre. SEMA, Rio Branco.

Vera-Diaz, M. d. C., R. K. Kauffman, D. C. Nepstad, and P. Schlesinger. 2007. An interdisciplinary model of soybean yield in the Amazon Basin: the climatic, edaphic, and economic determinants. Ecological Economics.

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