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A framework for ex-ante analysis of public investment in forest-based development: An application to the Brazilian Amazon

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ABSTRACT

This paper develops a framework for evaluating the ex-ante economic impacts of public investments in forest-based development. Computable General Equilibrium (CGE) models provide a powerful approach for evaluating public investments in sectors with strong inter-sectoral linkages and for capturing dynamic economy-wide effects. Results of CGE analysis may be analyzed in a social cost-benefit framework typically used by the public sector and multilateral development banks to assess investment viability and trade-offs between alternatives. In this paper, a dynamic CGE is developed to evaluate the impact of a development loan to promote natural forests, forest plantations and agroforestry development in the Amazonian state of Acre, Brazil. Results of the analysis demonstrate the positive impact the expansion forest-based development activities generates and the potential the approach has for comprehensive analysis of the direct, indirect and induced benefits of public forest sector investment.

1. Introduction

Ex-ante economic analysis of loans is a standard practice among multilateral development banks and typically involves a cost benefit analysis (CBA) and a financial sustainability analysis. Increasingly, Computable General Equilibrium (CGE) models are being used to assess the economic and employment benefits of public investments in sectors with strong intersectoral linkages. The use of CGE models in assessing public investments in tourism at the Inter-American Development Bank (IADB), for example, is often the recommended approach (Banerjee et al., 2016c; Banerjee et al., 2015; Banerjee et al., 2016b; Taylor, 2010; Taylor and Filipski, 2014). Public investment in water and irrigation related infrastructure is another area where CGE models are increasingly applied (Banerjee, 2015; Wittwer and Banerjee, 2015).

Some forest sector investments also impact multiple sectors and have dynamic effects on economies and local communities (Banerjee and Alavalapati, 2010). This paper develops a framework for ex-ante economic analysis of public forest-sector investments and applies it to the analysis of the second phase of the Acre Sustainable Development Program (PDSA II), an investment in forest-based development in the state of Acre, Brazil. Prior to the 1990s, Acre was in a state of chronic poverty with poor governance and infrastructure, and unsustainable land use with de facto open access to public forestland. This seemingly untenable situation began to improve in 1999 with the launch of a bold economic development strategy fundamentally rooted in forest-based development. One component of this strategy was the first phase of PDSA which invested in strengthening environmental governance, land regulation and critical infrastructure. Between 2002 and 2009, improvements in governance contributed to reducing the deforestation rate from 111,000 ha/year to 22,000 ha/year (Lima et al., 2012).[1]

PDSA II is a US$187.4 million investment with some support from the IADB to build on the successes and lessons learned of PDSA I with the goal of increasing the contribution of the forest sector to economic growth and poverty reduction, while controlling levels of deforestation. In the design and preparation of PDSA II, an ex-ante economic assessment was undertaken. This paper presents the public forest investment analytical framework developed for this analysis which combines the strengths of CGE modeling with CBA, and reports some of the key results of the analysis.

The section that follows provides background on forestry in the state of Acre, its key development challenges, and how PDSA II was designed to address these challenges. Section 3 describes the methodological approach and data used in the investment which includes a static one-period CGE model and a dynamic multi-period model. Section 4 presents results and Section 5 evaluates the results in a benefit cost

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[1] A review of some of the factors that led to Brazil's success in reducing deforestation may be found in Banerjee, O., Macpherson, A. J., & Alavalapati, J. R. R. (2009). Toward a Policy of Sustainable Forest Management in Brazil: a Historical Analysis. *Journal of Environment & Development*, 18(2), 130–153.

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framework. Section 6 concludes with a summary of the key findings and considerations for the use of this framework in subsequent analyses.

2. Background

2.1. The state of acre

The Brazilian state of Acre is located in the north west of Brazil and in the south west of the Brazilian Amazon. The state's surface area is 164,221 km^2 which is equivalent to 1.9% of Brazil's land base. Acre has over 790 thousand inhabitants, over 72% of which are urban dwellers largely concentrated in the state capital of Rio Branco. A large proportion of Acre's inhabitants were migrants from the drought-stricken north east of Brazil, many of which were lured by the region's rubber boom between 1850 and 1920. Most Acreanos, as the local inhabitants are called, live in traditional settlements and extractivist settlement projects. Many traditional and indigenous communities reside in protected areas and settlements.

Deforestation in Acre has largely been driven by agriculture and ranching during the 1970s and 1980s. Fig. 1 depicts deforestation in the state since 1988. Between 1988 and 2012, approximately 12,723 km^2 were deforested. Agriculture and cattle ranching occurred in parallel to unregulated land use and land grabbing, primarily along the BR-364 and BR-317 highways that were also established during this period. The last decade has seen a decline in deforestation as Acre and Brazil overall have shifted to a paradigm of sustainable forest management (Banerjee et al., 2009). Deforestation in Acre fell from 547 km^2 in 2000 to 199 km^2 in 2013; over the same period, deforestation in the Amazon fell from 18,226 km^2 to 5843 km^2.

One of the Government of Acre's goals is to maintain at least 80% of the state in forest cover with 25% under sustainable forest management systems with 1.5 million hectares of forests dedicated to the production of timber and non-timber forest products. In 2011, the state produced 1,064,195 m^3 of roundwood valued at 75.4 million reais.

Forest management in Brazil is guided by Forestry Code, Law 12.651 of May 2012. In the case of the Legal Amazon, the Forestry Code establishes that 80% of private land holdings must be kept in forest. Permanent Preservation areas serve to protect vulnerable areas on stream and river banks and areas susceptible to erosion. Brazil's Public Forest Management Law (Law 11284 of 2006) authorizes the establishment of forest concessions on public forestland which may be offered to private enterprises of various sizes. Management of State forests is regulated under Acre's Forest Law of 2001 (Law 1.426). This law sets out a framework for conservation and sustainable forest resource use with three mechanisms. Forests may be used as public productive forests or offered as concessions for communities or private enterprises. State forests may be managed by state public entities or private enterprises.

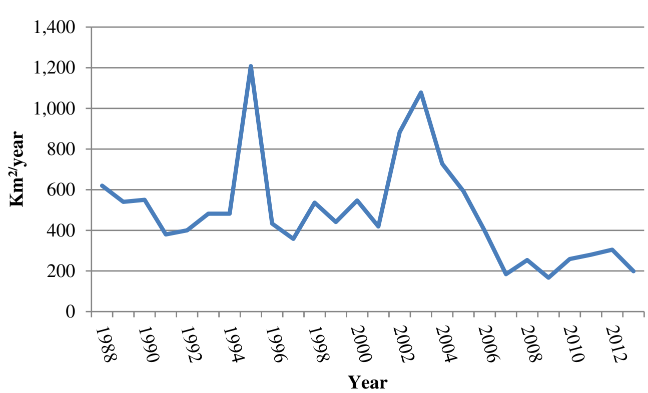

Fig. 1. Acre deforestation. Source: data from INPE, 2013; authors' own elaboration.

2.2. The acre sustainable development program—PDSA I

In the 1990s, Acre suffered from chronic poverty, poor infrastructure, low productivity, a lack of governance and nearly open access to forest resources. In 1999 with Jorge Viana, a forest engineer, assuming the governorship, Acre embarked an economic development program based on the sustainable management of forest resources. The government identified three critical challenges to enhancing forest-based development and livelihood opportunities. These challenges were: (i) open access nature of forest resources; (ii) low economic returns to traditional agricultural activities, and; (iii) a lack of adequate transport and energy infrastructure which has a direct bearing on economic competitiveness.

In a partnership forged between the IADB and the Government of Acre, a program to help to address some of these challenges was developed and PDSA I was designed. The goal of PDSA I was to improve the quality of life of the local population and ensure the sustainability of the region's natural resources. Specifically, PDSA I sought to: (i) modernize environmental governance and efficient use of natural resources; (ii) increase agricultural-sector growth and employment, and; (iii) reduce transport costs and increase access to electrification in rural areas.

Lines of action were developed along each of the three strategic directions. Aligned to the first, efforts included land administration, establishing protected area management, strengthening the state system for environmental management and promoting the preservation of local cultures and traditions. To increase agricultural-sector growth and employment, actions were directed to transfer appropriate technologies, support small producers, improve phytosanitary measures, support sustainable forest management and promote business development. Along the final strategic direction, investment was concentrated on improving land and river-based transportation networks and promoting alternative energy. The implementation of PDSA, valued at $108 million USD began in 2002 and concluded in 2010.

PDSA has a number of successes to report. While initially lacking in institutional capacity for environmental management, Acre's Environmental Information System (SEAIM) was developed, management was decentralized and Acre's Environmental-Economic Zoning was improved. To reduce the open access nature of forest resources, PDSA supported best practices in land use planning, tenure policy, administration and regularization. The state's core infrastructure has improved markedly, reducing transport costs and increasing competitiveness. The forest and agricultural sector have increased their importance to the state economy; forestry alone accounts for 18.6% of state gross domestic product (GDP), 60% of exports and supports 36% of rural livelihoods.

PDSA provided insight for future environmentally sustainable economic development of the state. While the construction of roads has historically been associated with increased deforestation, PDSA has demonstrated that if protected areas are strategically located and aligned with road construction, deforestation may be reduced. Second, the establishment of protected areas can gain local support if displaced livelihood activities are substituted with other attractive opportunities, which may be forest-based (Lima et al., 2012).

While PDSA concluded in 2010, a number of challenges remained. Some areas of public forests remain illegally occupied while there is a significant stock of degraded area, both of which could be used for forest-based and restoration activities. To encourage the development of forest-based economies the emergence of rural supply chains requires further support. Finally, continued institutional capacity building was required. To address these challenges the IADB and the state government of Acre formulated a phase II of PDSA; PDSA II is comprised of 3 main components: (i) expanding and consolidating protected areas, including areas eligible for forest management; (ii) developing competitive value chains, and; (iii) capacity building and enhanced governance.

The first component is comprised of 2 subcomponents; the first is designed to expand and consolidate state forests for production which