



Actor and frontier types in the Brazilian Amazon: Assessing interactions and outcomes associated with frontier expansion

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ABSTRACT

This paper analyzes frontier expansion in the Brazilian Amazon as a process that depends on multiple exogenous and endogenous factors operating at diverse scales, but whose trajectory depends on the dominant actor type (smallholders or medium- or large-scale landholders) occupying the frontier landscape. Despite the broad growing trend of pasture expansion for adoption of cattle ranching as the main land use associated with frontier expansion, some differences persist across actor types. In relative terms, medium- and large-scale landholders place most of their cleared forestland under pasture, and in absolute terms, largeholders have deforested more than smallholders because they hold larger tracts of land. Recently, however, deforestation activity has been increasing in frontiers occupied by smallholders who tend to convert a greater proportion of the forestland in their landholdings to agricultural land uses than larger-scale landholders, mainly to expand cattle ranching operations. Furthermore, smallholders tend to maintain higher cattle stocking rates than medium- and large-scale landholders, which tend to adopt extensive systems of cattle production. Both economic and human development indices in each frontier type vary according to actor type. While in absolute terms, higher per capita agricultural income levels are found in frontiers where largeholders predominate, the corresponding incomes are higher in smallholder frontiers when prorated by unit of land under crops and pasture. In addition, the Human Development Index is higher in frontiers with greater presence of large-scale landholdings.

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1. Introduction

In the Brazilian Amazon, the debate about economic growth, social development, and forest conservation is closely related to the discussion of the boom-and-bust cycles that characterize the evolution of logging and agricultural frontiers (see [Rodrigues et al., 2009](#); [Schneider et al., 2000](#)), the expansion of which occurs to the detriment of extractive and conservation landscapes ([Pacheco et al., 2011](#)). Frontier expansion is understood here as the result of a process of progressive occupation of forestland by different actors that often have competing claims over the land ([Schmink and Wood, 1992](#)). This process often leads to the appropriation of forestlands, followed by the removal of forest resources for conversion of land to agricultural uses ([Andersen et al., 2002](#)). Frontier evolution, in its initial stages, can be interpreted as a process of primitive accumulation; this process, largely motivated by an interest in extracting the existing natural resources (e.g. soil and forests), tends to evolve toward more productive ways of using the land along with frontier consolidation ([Kaimowitz, 2002](#)).

The contemporary concept of frontier development involves economic and political aims of integrating into the mainstream national economy territories that are considered unoccupied or idle lands ([Dreifuss, 2000](#)). In the Brazilian Amazon, economic goals revolve around establishing and consolidating claims over natural resources, with the aim of generating incomes from exploiting such resources and subsuming their use into broader circuits of capital, labor, and exchange of goods. Yet emerging conservation aims have put into question conventional economic goals, thus highlighting the value of forest ecological services ([Nepstad et al., 2011](#)). The political goal of frontier expansion is to include frontier areas within the political domain of the nation-state. Nevertheless, frontier evolution raises challenges in terms of the distribution of benefits derived from natural resources use, creates social conflicts, and tends to deplete such resources in the long term. In some cases, it threatens the livelihoods of the frontier's original inhabitants. Although tenure and land use policies designed to improve the protection of local tenure rights and improve forest conservation have recently been devised, little effort has been invested in enhancing the productivity of already occupied land ([Borner et al., 2010](#)).

In this paper, I assess the interplay between frontier and actor types, focusing on the Brazilian Amazon and exploring implications for deforestation, agricultural income, and human development at

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the municipal level. Various labels have been coined to describe frontier attributes, such as pioneer and consolidated (Schneider, 1995), productive and speculative (Margulis, 2004), contested (Schmink and Wood, 1992), and populist and corporatist (Browder and Godfrey, 1997). I argue that frontier development constitutes a multidimensional process influenced by factors taking place at different scales, and leads to different outcomes depending on both frontier and actor types. This view builds upon emerging explanatory perspectives looking for integrated approaches to understanding nature–society interactions (Batterbury et al., 1997; Roy Chowdhury and Turner, 2006).

At the macro-level, policy shifts and market structures largely define the pattern of capital accumulation taking place in the frontiers. However, a diverse set of decision parameters affects land occupation and use at the micro-level, defining the adopted production systems and resultant land uses (Kaimowitz and Angelsen, 1998). I argue that the interactions between these factors shape frontier configuration, in relation to both frontier and actor types, with impacts on deforestation and local development.

In this light, I adopt a perspective that, on the one side, observes different stages of frontier evolution (i.e., pre-frontier, frontier, post-frontier) and on the other side looks at different actor types (i.e., smallholders, medium- or large-scale landholders) along the different stages of frontier evolution. While smallholders in the initial stages of frontier expansion adopt more diversified production systems with a mix of crops, secondary forest succession, and primary forests, frontiers dominated by large-scale landholders tend to undergo massive forest conversion for extensive cattle ranching. However, whichever way the frontier evolves, landscapes suffer from greater homogenization of land uses due to the growing expansion of pastureland at the expense of forest cover.

In addition, smallholder frontier types tend to distribute income more equitably. Rural economic income measured by the agricultural gross domestic product (GDP) is higher in landscapes with a greater presence of medium- and large-scale landholders when estimated on a per capita basis, but it is higher in smallholder frontiers when prorated by unit of agricultural land. Furthermore, the Human Development Index (HDI) tends to be higher in landscapes dominated by largeholders, although the differences across frontiers when looking at actor types are not significant. Rodrigues et al. (2009), comparing frontiers, argue that boom-and-bust patterns occur in the Brazilian Amazon because the HDI is higher in frontiers with greater deforestation activity and tends to decline in post-frontier situations, in which a larger proportion of the landscape has been deforested. Nonetheless, the latter does not appear to be an overall trend since differences emerge when considering the type of actor using the land in those frontiers.

This paper is organized in six parts including this introduction. In the second part, I discuss the methods and data sources employed for the analysis undertaken in this paper. The third part contains a literature review with regard to the main factors shaping the formation and development of frontiers. In the fourth part, I assess the interactions between actor and frontier types, and their main outcomes in terms of land use and cattle ranching expansion. I then explore the outcomes of frontier development according to the characteristics of the main actors occupying the frontier landscapes, and discuss their impacts on deforestation and agricultural income. In the final part, I present the paper's main conclusion, with some reflections relevant for policy-making.

2. Methods and data sources

The analysis in this paper is based on several methods: literature review, interviews with key informants, and analysis of secondary statistical information. The main data sources are the two

most recent agricultural censuses carried out by the Brazilian Institute of Geography and Statistics (IBGE) in 1995/1996 and 2006, and land use change data estimates from remote sensing analysis performed by the National Institute for Space Research (INPE) (Fig. 1). The previous agricultural censuses and land use change data are complemented with secondary information acquired during fieldwork undertaken in the Brazilian Amazon region in two periods, 2003–2004 and 2009–2010.

Despite some shortcomings, the agricultural census data comprise the most comprehensive source of information, disaggregated at the municipal level, for determining socioeconomic trends across the whole Brazilian Amazon. Although in theory the census constitutes a complete count of all agricultural holdings, this is not necessarily true in practice. The main shortcoming of the census relates to its coverage, particularly of remote areas which likely are not included in the census. Nonetheless, it is difficult to quantify the extent of the shortcomings of the two IBGE agricultural censuses employed in this analysis because of the lack of reports assessing the problem.

I classify the various frontiers and actors in order to assess the differentiated implications of different stages of frontier development across actor types. Frontier types are classified based on the extent of converted forests, at the municipal level, as a proxy of frontier evolution. Landscapes are then classified according to the dominant actor type (i.e. small-, medium- and large-scale landholders). In the following, I describe the main criteria used for classifying frontier and actor types in the Brazilian Amazon.

Frontier types are classified following the criteria adopted by Rodrigues et al. (2009), who define frontiers (in a range from inactive to active) according to the extent of deforestation that has occurred in each municipality. Thus, I classify frontier types based on the percentage of the original forest cover that had been lost in each municipality by 2009, according to INPE estimates. Each type corresponds to a quintile of forest cover loss by 2009 (i.e. less than 20%, 20–40%, 40–60%, 60–80%, and more than 80%) (Fig. 2). These ranges correspond to different stages of deforestation. I assume that they are correlated with the timing of frontier occupation, so that they correspond to a transition ranging from pre-frontier to active frontier to post-frontier situations.

To identify the dominant actor type, I use the distribution of landholding sizes reported at the municipal level in the 2006 IBGE Agricultural Census. I adopt the following classification of actor types: (1) smallholders (holding plots smaller than 100 ha); (2) medium-scale landholders (landholdings between 100 and 1000 ha); and (3) large-scale landholders (establishments larger than 1000 ha). To compare data available at the municipal level and actor types, I build a typology of municipalities based on the dominant landholder types located in each municipality (Fig. 3). As the proportions of landholder types differ across municipalities in the region, some thresholds were defined according to the ranges at which these different actors occur at the municipal level. A detailed explanation is provided with the analysis in Section 5 (Table 3).

Finally, I link the census data from IBGE with land use change data from INPE, which is based on remote sensing analysis to 2009, mainly to identify the outcomes in terms of deforestation and local development across different combinations of frontier development according to the dominant actor established at the municipal level.

The method adopted for the analysis undertaken in this paper has some limitations, in that it includes some fuzzy classifications of both frontier and actor types, with no clear boundaries between groups. Nevertheless, due to the availability of existing data, it provides an indication about the interactions established between frontier evolution, deforestation, and economic and human

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