

Modeling from Below: The Social Dynamics of Land Use Change in the Buffer Zone of Cordillera Azul National Park, Peru

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Introduction

The Cordillera Azul National Park (CANP), created in 2001, lies in the Huallaga Valley of northern Peru, where the Andes meet the Amazon rainforest. Portions of the departments of San Martín, Ucayali, Huánuco, and Loreto fall within CANP (CIMA 2004). CIMA-Cordillera Azul, a Peruvian non-governmental organization (NGO), manages the park, making it the first privately managed, publicly protected National Park in Peru. While CIMA manages the park, ultimate control over Cordillera Azul remains in the hands of the government's National Institute of Natural Resources (INRENA). The park protects a unique array of species, ecosystems, and geologic formations and remains largely untouched from industrial exploitation due to its inaccessibility and the recent history of drug trade and guerrilla war in the region by both Shining Path and the Tupac Amaru Revolutionary Movement (MRTA).

Present pacification and reduction of illegal coca crops are creating a new scenario for development in the region. Economic opportunities however, seem to repeat a pattern of 'boom and bust' cycles that characterize the history of the Amazon region. Trends of logging and road opening are part of agricultural

frontier expansion processes that result in high rates of forest conversion to agricultural or degraded lands, threatening the park's stated management goals of protecting biodiversity and contributing to sustainable local livelihoods (CIMA 2004). In order to address these threats, there is a need to understand the main social and economic factors behind frontier expansion in the area.

For this research, I developed a model for conceptualizing the processes underlying land use change based on a literature review and preliminary analysis. This initial model assisted in framing questions for a household survey in the buffer zone. The model was then refined to incorporate findings from the survey. The model was an iterative tool to understand the process, guide my field research, and generate recommendations on land-use change. Here I present the results from the household survey in relation to the model, highlighting locally significant factors driving land use change in the community and providing recommendations for future management.

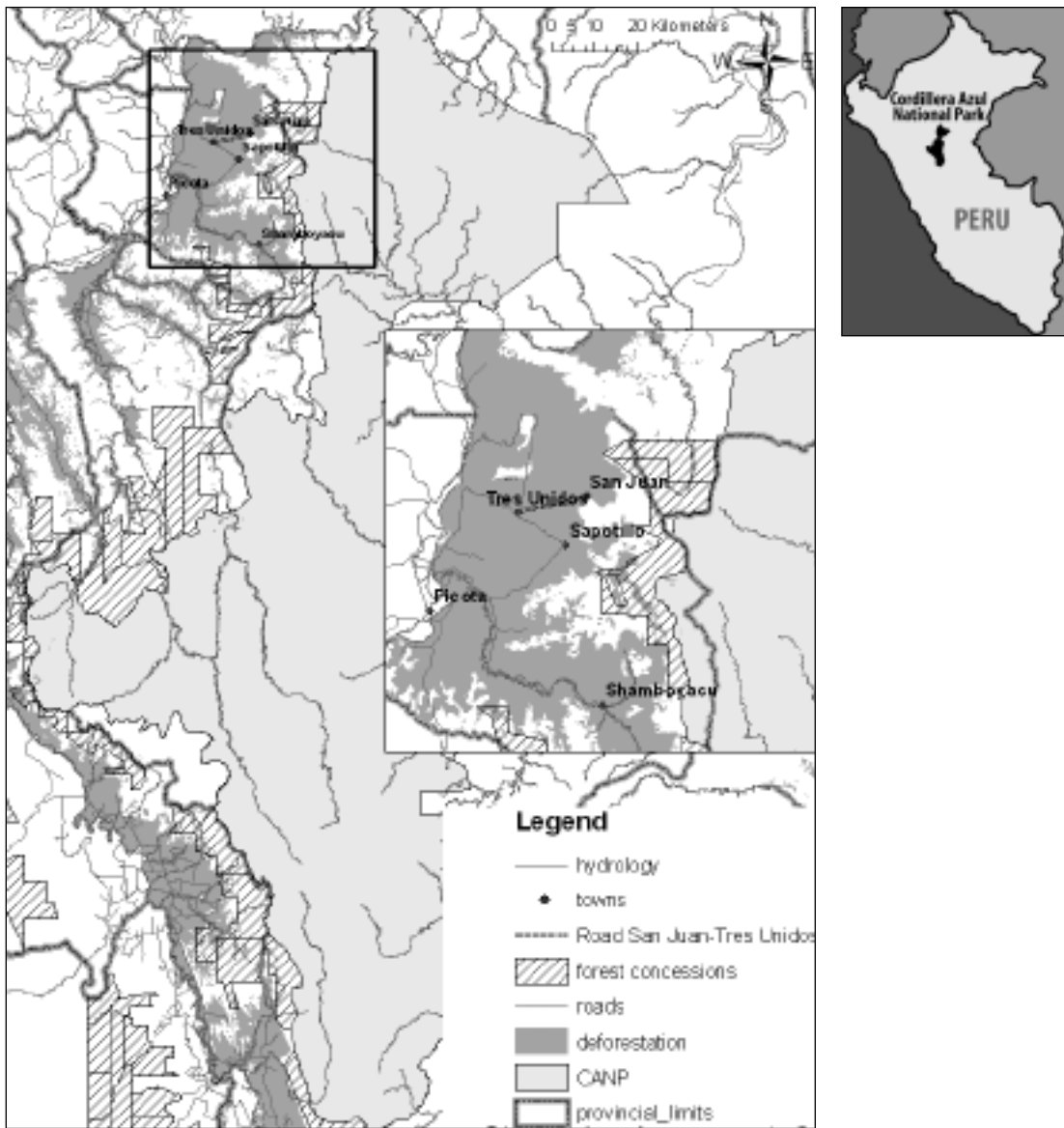
Case Study

I focused my study on San Juan, a small, recently established rural community located in the province of Picota, department of San Martín (Figure 1), composed primarily of migrants from the Andean departments. San Juan is a dynamic community whose active local authorities and good communal organization have led to the establishment of a school, the construction of a 14 km road linking San

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Figure 1. Map of the Cordillera Azul National Park

Showing the community of San Juan, uses of the land including timber concessions and areas with significant deforestation in its western buffer zone.



Source: CIMA 2004, Plan Maestro del PNCAZ.

Juan to the capital of the district, Tres Unidos, and other benefits from programs supported by USAID as part of “voluntary” substitution of coca with other crops. San Juan’s authorities have been working with CIMA to develop a zoning plan, and local farmers are working with the NGOs’ technicians to improve their agricultural practices in the park’s buffer zone.

Methodology

I conducted semi-structured interviews with officials and professionals from governmental bodies and NGOs from May to July 2004. I also conducted household surveys in the local community of San Juan. The sample for the final survey was 34 households, chosen

randomly from a total number of 95 heads of households listed in San Juan's official register. To corroborate these results, I spent several days in the San Juan community conducting additional semi-structured interviews and participating in social life. Finally, I mapped new roads and land cover changes with GPS and digital photography.

Results

A local-scale model of land use change

Models for land cover and land use changes have identified particular socio-economic drivers that determine the way in which new patterns manifest themselves in the landscape during frontier expansion (Mustard et al. 2004). Models for tropical deforestation, in particular, show "economic factors, institutions, national policies, and remote influences (at the underlying level) driving agricultural expansion, wood extraction, and infrastructure extension (at the proximate level)" (Geist and Lambin 2002: 143). Scenarios of frontier deforestation that follow the paving of roads have been studied in the Brazilian Amazon (Carvalho et al. 2001; Nepstad et al. 2002; Soares-Filho et al. 2004). In Peru, researchers found that different factors lead to land conversion by colonists versus indigenous groups. The socio-economic causes of land conversion by colonists tend to follow road access and are linked to production techniques, integration into markets, land access, and the availability of labor and capital. The most significant factors leading to land conversion by indigenous groups are access to land, size of the family's productive lands, and family labor capacity (Bedoya Garland 1995).

The conceptual model I developed through this research (Figure 2) aims to incorporate our existing large-scale understanding of frontier expansion from regions across the tropics with local and first-hand perspectives on the socio-economic causes and effects of land use change in San Juan. I

do not claim to encompass the full complexity of this process. In this article, I used a simplified version of the model, which also can be used to rank the different factors according to their importance. In the following section, I describe significant findings from the household surveys and observations and explain how these findings validate or alter proposed factors in the model.

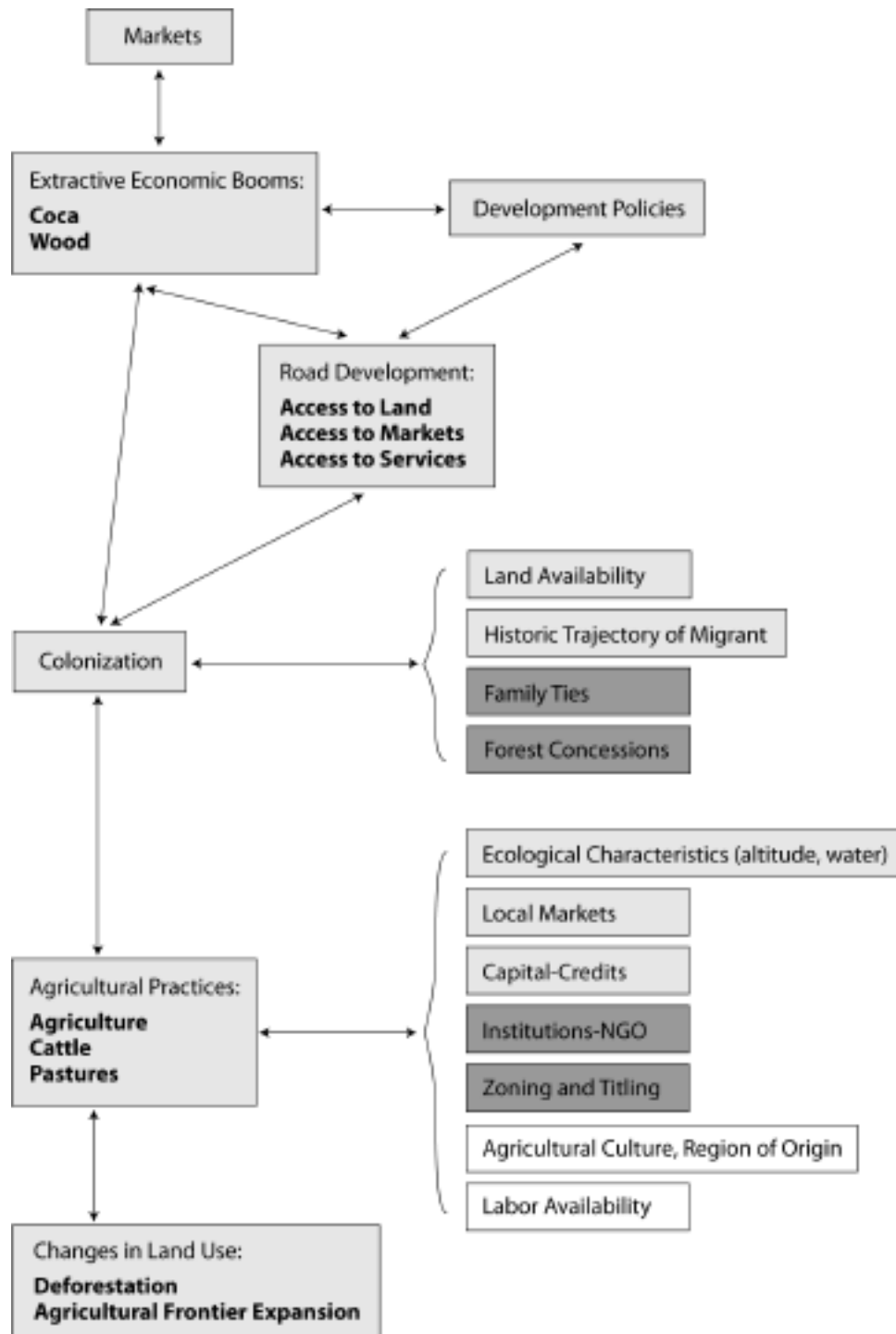
Road development and access

While roads are fundamental for development and service access during frontier expansion, their effects on ecosystem degradation and deforestation are well known (Imbernon 1999; Mahar 1989; Carvalho et al. 2001). However, good transportation systems are essential to community livelihoods and key to economic development. Two main processes are contributing to the opening of roads in the San Juan area: (1) legal and illegal logging activities, and (2) the establishment of Alternative Development Programs (ADPs), a major component of the Peruvian government's coca substitution policies, which are financially supported by the US Agency for International Development (USAID).

Roads opened by illegal loggers have been the vanguard for land conversion in the district of Tres Unidos. Road openings sometimes transpire through agreements with local landholders who pay for increased road access by giving loggers rights to the trees on their land. Illegal loggers need roads to access wood, while landholders want better access to transport their products to markets. These poorly designed roads constitute a short-term solution for farmers, but they can also cause erosion or landslides.

The effects of deforestation on USAID-financed road improvements were shown in several studies (CARE 2002; CDC 2003). In areas under ADP jurisdiction, 80% of deforestation has been linked directly to road access, the main impact resulting from improvements in penetration roads funded by ADP (CARE 2002), as was the case from the road built in 2002 linking San

Figure 2. The most significant factors determining land use trends in the study area. Light gray boxes were considered in the initial conceptual model based on literature research and initial observation and have remained as significant in this case study. White boxes represent those factors that were initially considered in the model but not found to be particularly relevant. Dark grey boxes were factors that were added as a result of new findings from the research.



Juan to Tres Unidos. As a result of these findings, USAID has increased precautions when undertaking new road projects, one being the requirement of an indirect impact assessment for major road improvement projects.

Improved roads dramatically change access to markets. In the poorly drained soils of the Peruvian Amazon, transportation of agricultural products on the farmer's back or by horse after a rainfall requires a great amount of effort. The combined effects of poor roads, high transportation costs, and the need for significant investments of labor and time often become a considerable barrier to new colonization. However, in San Juan, roads have reduced the transactional costs of farming and have improved the standard of living. Before the road to Tres Unidos was built, transportation costs for some farmers amounted to as much as 5% of coffee's gross income.

Colonization

As throughout the Peruvian Amazon (Bedoya Garland 1995; Maki 2001), colonizers (*colonos*) arrived in San Juan seeking land and escaping economic constraints in both the highlands and the coast. San Juan is composed mainly of migrants from the highlands (60% of respondents) and the primary commercial crop there is coffee, generally planted in diverse agroforestry systems with plantains and manioc, which may reduce rates of slash-and-burn agriculture. Maize is also widely planted, but mainly as a subsistence crop. Once settlers acquire lands in San Juan, they typically conduct burns to create the initial fields and then keep planting within them, leaving the land fallow for one or more years between annual crops. Most recent migrants to San Juan have acquired the land through purchase rather than occupation; free land around San Juan is rarely available. This absence of free land reflects the stage at which San Juan is, in a colonization process that began approximately 10 years ago and has accelerated in recent years due to the construction of the

road to Tres Unidos. The growing population is a relatively new phenomenon (Table 1). The new regional access created by the road and the increase in colonists is pushing the frontier past San Juan, towards the Cordillera Azul National Park and into the nearby timber concessions.

To understand the colonization process, research must address family, communal, and extra-communal ties – in Enrique Mayer's words, the “complex network of kinship, social and political obligations that link a household to others, to the rest of the community, and to the larger social world” (2002: 27). The importance of these links and their relevance to the development of a model for land conversion processes can be inferred. For example, there is a close link between newly arriving immigrants and the presence of family ties to residents in San Juan. Fifty-six percent of the farmers stated that relatives had immigrated to San Juan before them, and 68% stated they had other relatives in San Juan (whether these had come before or after their own arrival).

Deforestation and wood extraction

Between San Juan and the adjacent park, there are newly established timber concessions created under the Forest and Wildlife Law of

Table 1. Number of people interviewed according to year of arrival.

Year of Arrival	Number of Respondents
1994	3
1995	0
1996	0
1997	2
1998	3
1999	2
2000	5
2001	3
2002	6
2003	8

2000 (Gobierno del Peru 2000). The concessions have contributed to a larger regional demand for high quality wood, boosting the extraction and commerce of old and new timber species. Concessions bring in a large working force and accompanying machinery (such as bulldozers and chainsaws), which, once present, can be used for illegal extraction – illegal logs are sometimes “laundered” by declaring them as originating from the concessions. Finally, ongoing colonization was observed inside concessions next to roads opened for timber management, even though it is illegal to colonize lands inside a concession. In some cases, this is encouraged or tolerated by the concessionaries as a way to avoid further obligations of replanting and managing their land.

Most of the villagers interviewed in San Juan (70%) did not find any commercially valuable wood growing on the lands they acquired, even though almost all of them (88%) cleared land to plant their crops (mean: 3.2 ha/person, with 77% having cleared <4 ha). This figure confirms that loggers are leading the frontier expansion, which reduces the lands’ potential to support sustainable livelihoods associated with the forests when settlers arrive. Villagers see good quality timber on their lands as a valuable asset since it can be sold in difficult times or utilized (e.g. in construction) in the future.¹

Lack of enforcement by police in controlling illegal logging has caused communal authorities to take efforts into their own hand by confiscating chainsaws in areas outside concessions. These efforts, however, have led loggers to file a judicial penal demand against them for stolen property (still in process as of August 2004). This lack of control curtails residents’ ability to protect their lands. It is crucial that park managers work to provide institutional support for community concerns and facilitate official enforcement, possibly through the establishment of channels or mechanisms that provide quicker responses to claims made by local authorities.

Credit and property titles

Seventy percent of the farmers interviewed mentioned a lack of credit availability (e.g. loan programs) as the main reason they have not requested one. Only one-fifth of the people interviewed stated that they have never sought credit. These people stated that they either had no desire to generate debts or were able to draw on alternative family support mechanisms. The majority of farmers suffer from a lack of credits resulting from non-formalized land titles and a lack of appropriate loan programs. Lack of credits has been hypothesized as a barrier to investment in production and hence development (de Soto 2000). Others, however, argue that increased participation in market systems may decrease the subsistence capacity of small farmers by placing them in a situation where they can no longer support themselves on subsistence agriculture, but they are not yet fully integrated into the market (Mayer 2002). Most settlers in San Juan have only a “certificate of acquisition” for their land; some claim to have a legal certificate of possession or title. In either case, the San Juan farmers are dependent on commercial crops, and a system of soft credits² is crucial for farmers’ security.

Agricultural practices and labor

In the San Juan region, the proportion of cultivated land decreases with the size of the property (almost all farmers with >2 ha planted <40% of their plots). The inverse relation between intensity of land use and size of property has been observed for the Amazon’s colonists and has been linked to the lack of a labor force, mainly in coca growing regions (Bedoya Garland 1985). This lack of labor, however, does not seem to be a significant factor of land use in San Juan. The majority of the farmers (~60%) have stated they hire workers during harvesting, and some (~20% of those interviewed) also use a system of collective help, called *minka*. In addition, there is no correlation between the number of family members that help with production and the size of crop harvests.

Cattle

The dynamics of expanding clearings to establish extensive cattle ranching have been widely studied in Brazil (Hetch 1993; Mattos and Uhl 1994; Fearnside 1989). In Peru, small-holder peasant agriculture seems to be a more important factor than ranching in driving the process of frontier expansion (Bedoya Garland 1991; Wood 2000). In the department of San Martín, preferential land use estimates identify pasture as between 1.9% and 6.8% of the total land base (MINAG 2002). Nevertheless, San Martín's meat production has increased by 57% in the period of 1998 to 2001 (*ibid.*). Ten percent of the farmers interviewed in San Juan owned cattle (mean of six heads). These people also occupied disproportionate total land area (22% of total lands among survey sample), although the fraction of land they had under production (crops plus pastures) was similar to the average for other colonists. Precipitously falling coffee prices – now at one-fourth of their 1992 value (JNC 2004) – has increased cattle's importance as a source of financial stability; people also value grasslands as a proof of land tenure. Therefore, it would not be surprising to see an increase in cattle in the region over the next few years.

Future projections

Colonists are willing to diversify their agricultural activities (e.g. planting cacao). When asked what they thought their situation would be like in three years with respect to land, crops, and cattle, the farmers, in general, aspired to increase their properties on average by 20%. With respect to crops, they projected an average increase of 65% in cultivated lands.

Overall, people projected expanding their cattle pastures four-fold in terms of area and five-fold in herd size. Although this only reflects aspirations, San Juan seems to be no exception to the general increase of cattle in the Peruvian Amazon, an important consideration in any zoning plan.

Role of NGOs and institutional framework

As is typical in the Amazon region, a strong legal framework prohibiting logging and land conversion through slash-and-burn agriculture exists, but there is a lack of enforcement capability. One indicator is the lack of regulatory awareness in community members. Less than 10% of the farmers interviewed in San Juan correctly identified the existing environmental regulations and over 90% had not changed their practices as a result of the prohibitions, with the exception of the ban on coca planting/harvesting.

This area's history of coca production, together with its conservation value, has led programs by NGOs and cooperation institutions (like USAID) to significantly affect land use change in the region. Making coca eradication a national priority, USAID funding of Alternative Development Programs (ADPs) has had large impacts on the economy of farmers and local development, and these programs have faced a great deal of opposition. Given coca's cultural importance, and the fact that it is the most profitable crop, these controversial programs continue to be a source of social unrest.

CIMA's strategy, as CANP's manager, is to avoid a traditional "aid to passive subjects" approach and instead focus on developing the strengths or potentials of the communities. This strategy increases the people's trust despite generalized suspicion towards NGOs associated with the ADPs. Trust has been found to be a crucial value in building robust social processes in protected areas (Stern 2004). CIMA is currently generating a participatory zoning process to help communities define land use and to acquire land titles from governmental organizations. The administrative, legal, and technical support of CIMA in this process can contribute to sustainable management plans. Moreover, extending this support to articulate demands by communities to the government for basic services can be one of the most significant ways the park's management can contribute to communities in the area.

Discussion

This research shows the utility of cross-referencing general models with local contexts in order to understand both the large-scale forces at work – which are often similar between countries and over time – and the specific context that enables management to succeed.

Trends observed through my fieldwork in San Juan confirm the linkage between road opening and an increasing rate of land conversion. The most salient findings of this study, in terms of factors behind land conversion in San Juan, include (a) the importance of family ties as a contributing factor to immigration, (b) the role of logging in the colonization process, (c) labor availability not appearing to be a limiting factor in crop production, and (d) the importance of property titling for credits and as a component in zoning plans. My research also suggests that the “agricultural culture,” or previous practices in the life of the *colono*, does not seem to influence the main types of crops grown in the new setting, although it may have an impact in conversion of forests to pastures. Finally, the influence of ADPs and environmental organizations emerged as a notable factor due to the amount of interventions in the area.

Table 2 briefly summarizes actions that

can reduce the impacts of key factors that lead to land conversion and deforestation, as suggested by linkages in the land use change model. Overall, this research confirmed the importance of legalizing land titles in the current CIMA land-zoning plans, and the importance of considering family ties when working with the communities to slow down immigration rates. INRENA efforts to control illegal logging should be complemented with efforts to make sure that the concessionaries control colonization within their forest concessions.

To achieve appropriate regulations regarding land use and the maintenance of forest cover, the CANP managers can make a fundamental contribution to residents by strengthening community authority and control and by providing legal, administrative, and technical support to communities. This will help empower the community to face the demands of loggers and other actors in the frontier expansion process. Increasing colonization trends moving past San Juan towards the park are indicating that it is crucial to work with communities in the early stages of the colonization process, and to reach long-term alternatives that contribute to both the park’s goals and to the development of the communities in the region.

Table 2. Potential actions to address key factors in local land-use change

Factor	Possible Actions
Family Ties	CIMA could work with community to influence spatial and temporal immigration trends
Forest Concessions	Greater control by INRENA to avoid settlements inside concessions
Institutions, NGO	CIMA could provide legal and administrative support to communal demands of services made to governmental bodies, and support increased governance with communal participation
Zoning- Land	Improve land use patterns by including current and desired land use of the property communities into micro-zoning plans, linking it to title formalization and research on market alternatives.
Capital and Credits	Further research needed on credits and loans programs for agriculture

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Many of the concepts expressed in this document are a result of discussions with professionals of CIMA, Cedisa, and other organizations, even though they may not be explicitly mentioned in the work.

Endnotes

¹ According to César Flores, a Yale PhD candidate working with WWF, in the cultural landscape of the *sierra*, or Andean highlands, forests do not usually play a fundamental role in agricultural or subsistence activities; this reduces the value that new settlers may attribute to forests. This is a point that deserves further study. Work is being done by local NGOs to incorporate values of the forests into the farmers' subsistence strategy.

² "Soft credits" are credits with low interest rates or that incorporate subsidies in order to support investments in agriculture. They are generally provided by the State's agricultural and development programs.

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