MANAGING RISK THROUGH FOREST GOVERNANCE: THE USE OF COLLECTIVE ACTION AND PROPERTY RIGHTS BY BOLIVIAN INDIGENOUS COMMUNITIES

by

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Abstract

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Managing risk through forest governance: The use of collective action and property rights by Bolivian indigenous communities

Thesis directed by Associate Professor Krister Andersson

This dissertation studies the impact of household-level risk (e.g. sickness and loss of assets) and community-level risk (e.g. natural disasters and outside intrusion) on rural livelihoods and forest conditions in developing countries, and the roles of collective action and property rights in risk management. Forests support the livelihoods of many rural people and act as safety nets during times of adversity. Forest users constantly encounter risk, and managing risk requires them to employ different livelihood and coping strategies based on their unique household situations. Their chosen strategies lead to varying degrees of dependency on the forests and may contribute to deteriorating forest conditions. With degrading forest conditions, users may no longer be able to rely on forests for subsistence and as insurance against future risk. These interrelationships among risk, forest users, and their resources motivate my field studies, which I conducted in Bolivia, where land reforms have given local communities more extensive user rights to their forest resources. Using household surveys and forest plot data from indigenous communities, I find that households that are considered vulnerable to community-level risk are not more prone to household-level risk, and they have various coping strategy options for dealing with risk. These are households that are headed by women or the elderly, have many dependents, and are poor. Furthermore, market exposure and past failures of collective actions hinder community members' ability to manage risks collectively. Also, the evolving environment changes the livelihood strategies and the types of risk forest users are exposed to. Therefore, many forest users have diversified their income sources and coping strategy options. Finally, forest users who have fewer coping strategy options support common property rights. These users reported fewer conflicts with other community members and engage in more forest management activities. These findings deepen our understanding of the complexity of coupled human-natural systems by exploring the relationships among forest users, their reliance on forests, and the risks they encounter. The results offer insights that can enhance policymaking in community risk management by broadening programs' coverage to assist households with diverse characteristics and promoting non-forest-based coping strategy options.

To Chishun,
whose love, patience, humor, and support make this possible

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Chapter 1

Introduction

Risk surrounds our daily lives. Natural disasters like hurricanes, floods, earthquakes, storms, extreme heat, wildfire, and tsunamis have threatened many lives in recent years. We are exposed to harmful viruses and diseases. We may experience unfortunate events like accidents, theft, and injury. All of these are involuntary risks; they are risks that we can try to prevent, but we cannot control them; they are part of life. Involuntary risk is different from voluntary risk, the latter generally referring to a risk a person takes in order to gain a higher return. In our developed society, we have various mechanisms – risk prevention strategies, insurance, and disaster management plans – to deal with all sorts of risks. We develop systems to predict and monitor when the next natural disaster will strike. We take vaccinations that reduce the likelihood of getting certain illnesses. We purchase insurance so that we will have the means to recover when the harm from risk is realized. Nevertheless, many of these risk management mechanisms are neither widely available nor commonly used in developing countries, especially in rural areas. Still, rural people are exposed to similar involuntary risks, so how do they deal with those risks?

Studies have suggested that rural people rely on natural resources, like forests, as their safety nets when they experience hardship (Arnold & Ruiz-Prez, 2001; Debela, Shively,

Angelsen, & Wik, 2012; Fisher, Chaudhury, & McCusker, 2010; Mamo, Sjaastad, & Vedeld, 2007; McSweeney, 2004; Pattanayak & Sills, 2001; Paumgarten, 2005). Besides using forest products for daily subsistence, rural people collect more supplies from the forests when they encounter food shortages or when their ability to generate income is limited. Rural people also use medicinal plants from forests to cure certain sicknesses. In addition, members of rural forest communities may trade forest products for cash during times of adversity.

Given their dependence on the forests, it is in forest users' best interest to protect the forests, to ensure access to their resources, and to safeguard the forests' sustainability so that they remain viable long-term providers. Formulating and executing an appropriate forest governance system is essential to achieving these goals. This study investigates how rural communities govern their forests to sustain their livelihoods under the shadow of risk. Since risk exposure and the ability to cope vary among households within a community, I hypothesize that forest households consider risk management in their cost and benefit calculations when making decisions about forest governance. In other words, households with different risk exposure levels and different coping abilities may prefer different forest governance schemes, which may also serve as risk management mechanisms, and forest users are very likely to select the governance scheme that has the lowest known cost to them.

I examine the role of risk in shaping forest governance decisions by comparing forest users' property rights preferences under different levels of risk. A property rights arrangement is a critical governance decision because it determines legitimate users and the acceptable use of the forests. Different property rights arrangements, and the incentives associated with each arrangement, likely influence forest users' preferences for different forest governance decisions and actions. Therefore, understanding property rights preferences is essential for explaining

forest users' decisions and actions, and for predicting likely forest outcomes. Figure 1.1 presents the conceptual model of the relationships among risk, coping strategy options, livelihoods, and preferences for property rights arrangements in this study.

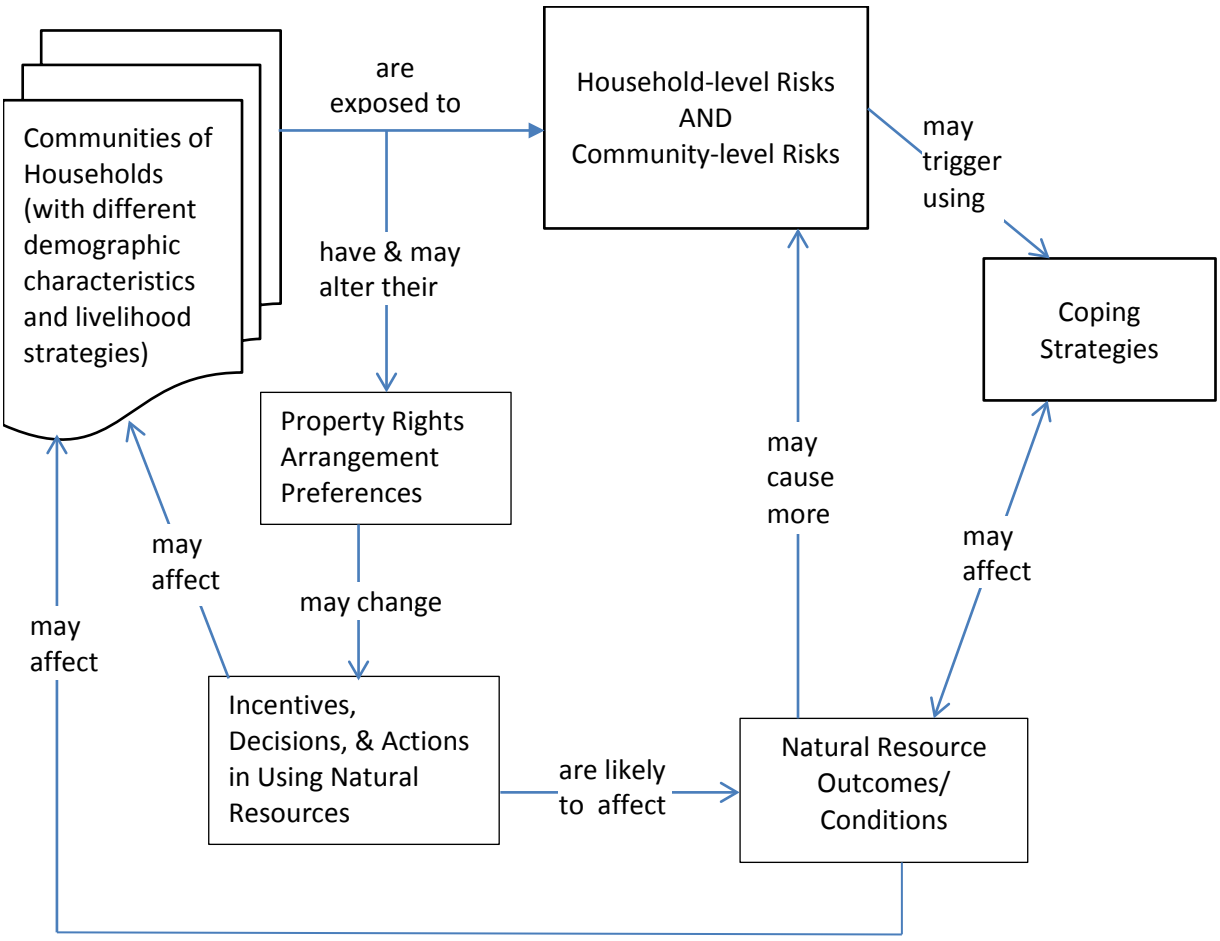

Figure 1.1 Conceptual model of interrelationships among risk, livelihood, and forest condition

This conceptual model lays out the causal relationships as follows: Forest users are exposed to different kinds of risks. Some risks, such as illness and theft, affect only certain households; I refer to these risks as household-level risks. Other community-level risks, such as natural disasters, affect many or all of the households in a community. Due to differences in household demographics, preferred livelihood strategies vary among households. For instance, households with able male members may supplement their income through labor, while other

households may rely primarily on subsistence farming. These household characteristics may also influence a household's vulnerability to certain risks, and the coping strategy options that are available for that household to deal with those risks. Households that can participate in wage labor, for example, are less vulnerable to crop failure because they can purchase food from the market. Subsistence farming households, on the other hand, may turn to using more forest products when they experience crop failure. The level of risk exposure, choice of livelihood strategy, and availability of non-forest based coping strategy options determine a household's reliance on the forest. These factors also influence how the household accesses and uses forest resources, which in turn can alter a household's property rights preferences.

Two types of property rights arrangements are commonly discussed. The first one, proposed by scholars of Evolutionary Theory of Land Rights (ETLR), suggests that private property rights arrangements can lead to secure land ownership and provide the basis for development (Alchian & Demsetz, 1973; De Soto, 2000). In this case, land is divided into parcels, and the parcels are distributed among the members of the community. Members can then obtain formal land titles and manage each parcel as private property. This approach has been effective in agricultural land reform (Feder & Nishio, 1998), but its applicability to common-pool resources (CPR) remains uncertain.

Common property rights arrangements, on the other hand, are promoted by scholars who conclude that CPR, like forests, are better governed jointly by the interested parties (McKean, 2000; Poteete, Janssen, & Ostrom, 2010). In this case, forests should be governed as a whole, and ownership and land rights should be shared among members of the community. Forest governance becomes a collective action, through which members work together to come up with

the best management approaches. Collective governance of CPR has been successful in some cases (Gibson, McKean, & Ostrom, 2000).

Despite the theoretical grounding and some success stories, neither property rights arrangement has a direct relationship with resource outcomes (Tucker, 1999). In reality, finding the appropriate property rights arrangement requires an understanding of the contextual factors that may influence resource users' decisions about livelihood strategies and risk management. Since applying different property rights arrangements creates different incentives for forest management decisions and actions, different forest outcomes can be expected. In return, changes in forest conditions may affect forest users' ability to rely on this resource to sustain their livelihoods and to cope with future risks.

I test two sets of causal relationships quantitatively, using data from Bolivian indigenous forest communities. The first analyzes the relationships among risk, household characteristics, coping strategy options, and forest condition (chapter 4). The second tests how different levels of risk exposure and ability to cope affect forest users' preferences for common property rights arrangements (chapter 7). In addition, I also analyze factors that facilitate or hinder collective actions in risk management; understanding this is important because the likelihood of governing the forest as common property can be affected by the forest users' ability to cooperate (chapter 5). Finally, I compare the changes in the forest communities, the risks they are exposed to, and the coping strategy options they used over two different time periods (chapter 6).

Bolivia provides a useful context for this investigation because land reforms since the 1980s have given local people the opportunity to secure their land titles and to work with the government in defining their own Forest Management Plans. Having these extensive user rights

to their forest resources is a prerequisite to answering my research question and testing the main hypothesis regarding forest governance decisions.

The forest communities chosen for this study are part of the International Forestry Resources and Institutions (IFRI) network, which examines the relationships among forest users, governance, and resource outcomes. IFRI applies an interdisciplinary approach to studying human-natural relationships; it collects information from forest users and obtains biological data from the forests for analysis. Choosing IFRI communities offers logistical and analytical advantages over other communities because IFRI researchers have already established relationships with the communities and I can build upon existing datasets. I visited two IFRI forest communities in Bolivia during the summer of 2012. Historic data collected from IFRI communities along with data I obtained provide the basis for the analyses of this study. Sections 1.1 to 1.4 summarize the key findings.

1.1 Risk and household characteristic

Many empirical findings suggested that vulnerable households – those that are poorer, headed by women, elderly or less-educated people, and those that have more dependents – use more forest products for subsistence (Angelsen & Wunder, 2003; Debela et al., 2012; Kamanga, Vedeld, & Sjaastad, 2009; Kar & Jacobson, 2012; Neumann & Hirsch, 2000; Reddy & Chakravaty, 1999; Shackleton, Shackleton, Buiten, & Bird, 2007; Tumusiime, Vedeld, & Gombya-Ssembajjwe, 2011; Vedeld, Angelsen, Bojo, Sjaastad, & Berg, 2007). Furthermore, these vulnerable households are more likely to rely on forest resources to cope when they encounter hardship (Arnold & Ruiz-Prez, 2001; Mamo et al., 2007; Paumgarten, 2005). The heavy dependency on forest resources as both subsistence sources and as a safety net make these people more vulnerable when they are faced with more risks. Hence, scholars have raised

concerns about a poverty trap amplified by risk (M. R. Carter, Little, Mogues, & Negatu, 2007; Debela et al., 2012; Paavola, 2008): Vulnerable households that live under certain wealth threshold are less likely to accumulate assets. When they experience further hardship caused by risk, they are more likely to exploit forest resources, which they already rely on heavily. This increased consumption may lead to deteriorating forest conditions. With degraded forests, these vulnerable forest users face more difficulty in sustaining their livelihoods, and fall deeper into poverty.

Yet the relationship between the different types of risk and household characteristics is unclear: Are these vulnerable households more likely to be exposed to both community- and household-level risks than their better-off counterparts? Limited research has addressed this relationship; some relevant case studies have discovered that poverty and risk exposure are highly correlated, but most of these studies focused on community-level risks such as climate change and floods. Little longitudinal quantitative research to investigate the relationships between household-level risks and household characteristics has been performed. Therefore, I develop regression models to test these relationships.

With household survey data from five IFRI communities, I test the relationships among household characteristics, household-level risk, coping strategy options, and forest conditions. My goal is to answer three research questions: (1) How does household-level risk exposure differ among households in the rural forest communities? (2) How does availability of coping strategy options differ among these households? (3) How do household-level risk exposure and availability of coping strategy options affect forest condition? The answers to the first two research questions determine if the property trap is more prevalent in the vulnerable population.

Findings from the last research question shed light on how risk management programs may foster conditions for better forest outcomes.

Results from my analyses suggest that the "vulnerable" and the "less vulnerable" households are exposed to different household-level risks. In the study area, women-headed households are more vulnerable to personal health risks and risk of crop failure, while wealthier households or households with more children are likely to be victims of theft or robbery. These results suggest that rural household characteristics are not effective indicators of the likelihood of risk exposure.

Furthermore, "vulnerable" households are not helpless in dealing with risk; women-headed households and wealthier households are just as likely to come up with coping strategy options. In addition, there is no correlation indicating that vulnerable households harvest more forest products to cope with risk in the study area. I speculate that groups that experience more risks are more driven to find coping strategy options, so they exercise all possible options.

Finally, the forest condition reported by a user is not affected by her risk exposure level, rather by her ability to cope with risk. Forest users who have more coping strategy options are more likely to report a good forest condition than users who have fewer coping strategy options, regardless of whether these forest users use more forest products to cope or not. One way to explain this is that forest users who can find non-forest-based coping strategy options are not putting additional stress on the forest; hence, forest conditions remain good. Another explanation is that forest users who rely on forests as safety nets tend to take better care of their forests during normal times so that, in return, the forests can take care of them during hardship.

These results give us a better understanding of household vulnerability and the different types of risk, as well as the linkage between coping strategy options and forest condition.

Contrary to the common belief, the "less vulnerable" households in the study area are as likely to experience risk as their "vulnerable" counterparts. Since risks are vast and diverse, households with different characteristics can experience different types of risk. Moreover, these affected households are not helpless in dealing with risk. These findings suggest that rural risk management programs should broaden their coverage to assist households with diverse characteristics. Aid programs can aim to better prepare forest users to deal with foreseeable risks, by first improving the messages that are used to communicate the subject of risk. These messages should reduce the psychological distance and motivate the likely victims to learn more about the topic. The second step is to launch risk prevention programs in order to reduce the likely exposure and the possible harm. The last step is to identify, implement, and promote non-forest-based strategy options to help with coping. Better risk management will help forest users recover more quickly from setbacks and build their resilience against future risks. Moreover, identifying ways to assist rural households in dealing with risk could reduce the undesirable impacts on the forests and foster conditions for better forest outcomes.

1.2 Collective risk management

In order for common property rights to be an effective governance mechanism for forests, forest users must self-organize and act collectively to define and enforce rules that they agree upon. Forest users' ability to cooperate is the foundation of collective management of the forest. Various factors can affect forest users' cooperation, and Ostrom (2009) developed the Social-Ecological System (SES) framework to aid the analysis. The SES framework consists of four first-tier components – Resources Systems, Resource Units, Governance Systems, and Actors. By identifying relevant variables associated with each component, mapping their linkages, and organizing the relationships, researchers can unpack the rather complex SES into manageable

units in order to analyze interactions and outcomes. I apply the SES framework to investigate collective risk management activities of two small Bolivian indigenous forest communities[1] – Caracara and Oropendola. The research question I set out to answer is: What drives forest users to act collectively in dealing with risk? In this analysis, the risks that I am interested in are the community-level risks; these are risks that affect many (or all) of the households of a community and may lead to undesirable outcomes for forest resources.

Residents of both Caracara and Oropendola have experienced natural disasters like flooding and drought. They also encounter intrusions from outsiders who illegally harvest their trees and occupy their land. Both communities face market and population pressures to extract more forest products from their communal forests. Members of both communities struggle with certain levels of elite capture; resources that should benefit the larger population are captured by a small group of people who have higher economic, political, or social status. In order to deal with some of these risks and to benefit from forestry activities, both communities have obtained their legal land rights and developed Forest Management Plans to manage commercial logging activities. Nevertheless, the outcomes of the two communities are quite different due to variations in social and environmental conditions.

Caracara is located close (within 20 kilometers) to a market and a transportation hub. Accessible road systems have facilitated more logging activities, both legal and illegal. Proximity to the "outside world" has brought an influx of outsiders who have settled in Caracara and have changed its culture and identity. Some outsiders illegitimately occupy the remote area of Caracara's territory, while legitimate newcomers contribute to diluting Caracara's indigenous identity through marriage. In addition, a bloom of coca cultivation around Caracara has

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[1] *Fictitious community names are used to seal the identities of the research subjects*

generated enormous amounts of pressure to convert forested land to coca production. Confrontations with the illegal occupants, mainly drug gangs, have resulted in life-threatening consequences for some of the residents. Market exposure has dramatically changed the dynamic between residents and the forest. Instead of subsistence farming, many residents of Caracara take advantage of the nearby market and engage in commercial activities to support their livelihoods. Also, their reliance on forests as a safety net has decreased because more coping strategy options are available for dealing with risk. Furthermore, residents' previous efforts to establish forest governance rules and to ensure decision-making transparency have proven futile. A group of local elites has ignored the community rules and captured most of the forestry income from the communal forest. Even worse, these violators are seldom punished. All of these factors have discouraged residents of Caracara from acting collectively to defend their territory against intrusion, enforce community rules that govern forestry transactions, or participate in collective forest management activities.

In Oropendola, a much lower level of elite control is reported. Income disparity in Oropendola is also narrower compared to Caracara. All residents of Oropendola still speak their native language, and they have followed the leadership of their Chief for decades. The Chief has galvanized the residents of Oropendola to act collectively in the past, and their actions have brought improvements to the community, including community-wide adoption of sustainable forestry practices. The residents also established rules that govern their forestry activities, and those rules have been enforced. As a result, all residents of Oropendola share some financial benefits from managing their forest communally. Oropendola is located in a remote area where no established road network can reach the community. The remoteness of Oropendola upholds its residents' subsistence lifestyle and prevents any major influx of outsiders that may threaten

their indigenous identity and their ownerships of the territory. The people of Oropendola stress the importance of education, and some of the brightest children were sent to study in cities nearby. Some of those students brought sustainable forest management knowledge back to the community and have helped improve their community and their forests. The continuous reliance on the forest for subsistence and for cash income has strengthened Oropendola residents' willingness and ability to participate in collective forest management activities that will ensure the long-term sustainability of their forest and their livelihoods.

Caracara and Oropendola present two different pictures of an indigenous forest community. Although they face similar risks of land invasion, natural disasters, and elite capture, each community handles the threats differently. The residents of Oropendola band together and act collectively in dealing with some of these risks, while people in Caracara steer away from cooperation. My analysis suggests that market exposure is one of the key factors driving the different outcomes. Since individual financial rewards from market activities in Caracara outweigh the benefits of collective action in defending the group's interests, people of Caracara lean toward self-preservation. Markets not only provide new livelihood options, but also offer coping strategy options, like loans, that were not available in the past. This new relationship with the market has changed residents' dependence on the forest and affects their actions and behavior toward forest governance. Also, proximity to the market brings social and cultural changes that undermine the relationships among community members and their adherence to indigenous norms. History is another factor; past failures to enforce established community rules and to distribute financial benefits fairly stymie further collective actions in Caracara. In the end, willingness and ability to act collectively to manage the forest and to deal with community-level risk is weakened.

Findings from this analysis strengthen our understanding of collective actions carried out by forest communities. By comparing the two communities' collective actions toward risk management, I find that market exposure and history are important driving factors affecting the outcomes. Market exposure changes the forest users' relationship with their forests while outcomes from past actions affect the users' ability to act collectively in the future. These two factors affect how the forest users calculate the costs and benefits of acting collectively in risk management activities and on forest governance issues. In addition, the geographical differences between Caracara and Oropendola show how connectivity between urban institutions and rural communities can affect indigenous peoples' livelihood strategies and can undermine their land use traditions as well as their cultural identity.

1.3 Evolving communities, evolving risk

In order to understand how risk and coping strategy options are related to the different geographical and social settings of Caracara and Oropendola, I compare risk exposure of the two communities using the Participatory Risk Mapping (PRM) technique (Smith, Barrett, & Box, 2000). The PRM technique asks respondents open questions to identify the risks they have encountered. Then, the respondents are asked to rank the impact of each risk. This technique allows the respondents to name any number of risks they have experienced; the ranking captures the respondents' perception of the harm associated with each risk.

Using the data collected from my summer 2012 visit, I apply the PRM technique to analyze the risks encountered by residents of Caracara and Oropendola in the 12 months prior to the time of my visit. Results show that the respondents only cited a small number of risks – six in Caracara and seven in Oropendola. Nine combined risks were reported – floods, drought, wind, fire, pests, illness, drop in crop price, stolen animals, and animal deaths. The highest

number of risks one respondent cited was three, and some respondents reported no risk at all. The common risks identified in both communities were floods, illness, animal deaths, and wind. Residents of Caracara also experienced harm from pests and from animals being stolen, while residents of Oropendola reported fire, drought, and drops in crop prices. The most harmful risks affecting many residents were flooding in Caracara and drought in Oropendola. The other risks, although perceived as severe by the respondents, only affected a handful of people. Although both communities rank illness as the second most harmful risk, respondents from Oropendola indicated that illness is more harmful than did respondents from Caracara. The remoteness of Oropendola may explain this outcome; people in Oropendola lack easy access to medical care, and many of them rely on traditional practices to cure sickness. Interestingly, respondents from neither community indicated outside intrusion, deforestation, or uneven distribution of forestry benefits as risks. These threats were mentioned during other parts of the interviews, but were not identified in the PRM listing activity. I suspect that when respondents are asked to list risks, they focus on the risks that directly affect their daily operations and ignore the ones that are beyond their personal space.

In terms of coping with these risks, most respondents said they did nothing. When respondents did react, the most common response among Caracara's residents was to get a loan. According to the World Bank data (2013a), the interest rate in Bolivia was about 4% between 2008 and 2012, but the rate on the loans offered to Caracara's residents was likely to be much higher. For the residents of Oropendola, spending cash savings and getting financial help from the government are the most common strategy options. No respondent indicated that harvesting more forest products was a coping strategy option. I speculate that flooding and drought affected

the productivity of the communal forests, thus making forest products less reliable for forest users during the survey timeframe.

Since both communities have experienced social, cultural, and environmental changes, I also perform longitudinal analyses to understand how the communities and their forests have evolved between 2006 and 2012. In addition, I compare changes in the types of risk and coping strategy options over the same time period. Results show that population has grown in both communities – 63% in Caracara and 38% in Oropendola – and both communities are aging. Despite the population growth, demand for cropland is not higher because residents of both communities are obtaining higher yields from their land. It is likely that improvements in agricultural knowledge and technology have contributed to drops in crop failure in both communities.

Due to market exposure, people of Caracara have significantly reduced the amount of food grown (down by 56%), and purchase more food from the market. Although over 90% of Caracara's residents still consider their forest an important source for subsistence and cash income, 18% more people rated the forest condition negatively when compared to the survey result from 2006. Moreover, 17% more respondents indicated that forest rules are unfair while 11% more indicated penalties are unfair. Thirty percent more residents did not participate in forest management activities. Overall, Caracara's residents' satisfaction level with forest activities and forestry benefits dropped by 55%.

In Oropendola, residents still grow 83% of their food, and all residents consider the forest to be important for subsistence and for cash income. Their perception of the forest has turned more positive; 95% of respondents indicated that their forest is in good condition in 2012, up from only 41% in 2006. Furthermore, 30% more respondents indicated that forest rules are fair,

while 19% more indicated penalties are fair when compared to the 2006 survey results. All of Oropendola's residents receive some financial benefits from forest management or forestry activities, and their satisfaction level with forest-related activities and forestry benefits jumped by 86%.

Comparisons of the 2006 and 2012 forest data show that Caracara's forest has deteriorated much more than the forest of Oropendola. The trees in Caracara's forest are getting smaller; the average DBH (diameter at breast height) dropped by 14%. The plants are also sparser (a drop of 56%), and the plant species diversity is lower by 24%. This result is consistent with forest users' perceptions of the forest conditions. In Oropendola, only slight changes in plant size, density, and diversity were observed: 3%, -1%, and -1% respectively. Despite the optimistic perception of its users, Oropendola's forest did not improve much between 2006 and 2012 in reality. The small degrees of change indicate that the condition of Oropendola's forest remains stable. I argue that Oropendola residents' enthusiasm about their forest is partly driven by the positive financial outlook from their forestry and forest management activities.

Besides the drop in crop failure risk discussed earlier, losses of household belongings, including livestock, land, and major assets also occurred less frequently in both communities. There is also a slight decrease in illness – approximately a 7% drop in both communities. Natural disasters, on the other hand, became more prevalent. Flooding and wind affected both communities, and residents of Oropendola also experienced drought and fire.

Residents' most common response to risk in both 2006 and 2012 was "did nothing." In 2012, no residents reported harvesting more forest products, wild food, or farm products to cope with risk, even though those options were common back in 2006. One explanation for this outcome is that flooding and drought may have limited the productivity and accessibility of

forest and farm products, so those options may not have been viable options in 2012. More forest users from both communities indicated that they took loans to deal with risk in 2012 – an 8% increase in Caracara and 12% increase in Oropendola. In Caracara, the availability of loans may have reduced the need to spend cash savings, do extra casual labor, or reduce household spending during times of adversity; the drops are 7%, 4%, and 2% respectively. In Oropendola, obtaining a loan is only a secondary coping strategy option. Many residents still spend cash savings, do extra casual labor, and get assistance from the government when they experience hardship. Respondents using these three strategy options increase by 4%, 10%, and 14% respectively.

To evaluate the communities' capability in managing their risk, I calculate the "copability index" by dividing the number of valid coping strategy options by the total risk count; a high index means a higher ability to cope. For 2006, Caracara's copability index is 0.42, and Oropendola's index is 0.68. In 2012, Caracara's copability index dropped to 0.26, while Oropendola's index remains at 0.67. These data show that Caracara's residents are generally less capable of dealing with risk than residents of Oropendola. Even worse, Caracara residents' ability to cope has dropped over the years.

By analyzing how the two communities and their forests differ spatially and temporally, I discover that both communities are changing their livelihood strategies to different extents due to market exposure. For both communities, income diversification is one way that residents deal with risk and improve their quality of living. Furthermore, Oropendola residents' adoption of sustainable forestry management has kept their forest in a stable condition. This outcome contributes to residents' positive outlook on their economic and environmental conditions. On

the other hand, poorly managed forest governance activities in Caracara have led to deteriorating forest conditions and a pessimistic outlook among its residents.

In both communities, many residents still do nothing when they encounter harm from risk. For those who try to cope, getting a loan is a common strategy. These findings suggest that risk management programs can help forest users by providing affordable and accessible financial assistance during times of hardship. Finally, natural disasters have imposed harm on both communities, but neither has developed plans to manage these risks. Therefore, one way to help these forest users is by helping them develop natural disaster management plans. These plans can help forest users better prepare for risk, and can provide ways for them to recovery quickly from adversity.

1.4 Risks and property rights preferences

From theory, we learned that property rights are important institutions for governing scarce CPR like forests (Alchian & Demsetz, 1973; Barzel, 1989; Schlager & Ostrom, 1992). Different property rights regimes incentivize different behaviors by specifying how the users can access, use, manage, exclude others from, inherit, and sell the assets. Hence, sustainability of forest resources can be influenced by how property rights are assigned to the rightful owners, which in turn changes the cost and benefit calculations of different actions.

Some scholars advocate private property rights arrangements not only to enhance land security, but also to aid development (De Soto, 2000; Feder & Nishio, 1998). Benefits of using private property rights have been identified through the ETLR. However, even though some success stories were reported, this land privatization approach failed to produce the expected outcomes, especially in places where resources were traditionally used and managed by many members of the community. Meanwhile, the common property rights regime is receiving more

recognition, and the benefits of adopting common property rights arrangements in managing common-pool resources have been documented in case studies worldwide (McKean, 2000).

In practice, Bolivian forest communities employ both property rights regimes. They have divided portions of their land and have given residents individual parcels for farming, while retaining the remaining portion to be used and managed as common property. This practice was mainly driven by the country's agricultural land reform regulation to ensure smallholders receive a land parcel size up to 50 hectare for farming.

Some of the 23 Bolivian forest communities studied by IFRI researchers adhere to the rule and have given each household in their communities a 50-hectare plot for farming. When a household is eligible for a new plot, e.g. when an adult child starts his own family, the community will allot a new 50-hectare plot from the communal forest or from unassigned plots. Another group of communities follows the rule loosely. Although each household owns a farming plot, the plot sizes vary. The amount of land cleared is mainly driven by the demand for self-grown food in that household. In these communities, the uncontrolled expansions of farming plots are practically converting communal forest into private property. It is unclear if there is a limit on the size of the communal forest that can be converted into farming plots. An exponential growth in population would threaten the communal forest; however, this situation is less likely to arise in the near future because of the large forested areas. At least one of the 23 communities does not even follow the rule. This community still practices rotating slash-and-burn agriculture. Households of this community clear new land when needed but they usually return to the previous cleared sites every 10 years.

Some communities enforce strict rules in regulating access and usage of communal forests, they even setting up zones to separate locations for hunting and gathering from locations

for timber harvesting and regeneration. Some communities have organized groups to patrol their territories and hand down punishments to violators. On the other hand, other communities lack any rules that control access and usage of the communal forests. In some cases, communities have given up on enforcing rules that are no longer functional in their communities; most areas of their communal forests are practically open-access properties that are free for anyone to use.

All these variations have shown that a *de facto* property rights practice is quite different from the *de jure* arrangement. A community chooses a particular property rights arrangement according to its contextual factors – political, financial, cultural, and social. The effectiveness of the chosen property rights arrangement highly depends on the cooperation of the community members. A member who supports the chosen arrangement is likely to engage in its enforcement and improvement. For example, she may attend community meetings frequently to discuss rules enhancement or to report violations. However, a member who objects is likely to refrain from any participation and may even disturb the arrangement. For instance, she may organize with other opponents to expand their farming plots by clearing more communal forest.

I argue that a community member's preference for certain property rights arrangements indicates that she is aware of the benefits of different property rights regimes, and she seeks to capture the benefits that are most helpful to her household. I hypothesize that a forest user's preference for a property rights arrangement is related to her household characteristics, which determine her degree of reliance on the forest resource. Many empirical studies have looked into the biophysical conditions of resources, the governance structures and the institutional settings of the rule-making entities, and the attributes of the actors who influence property rights decisions (Acharya, 2005; Dietz, Ostrom, & Stern, 2003; Netting, 1976). However, limited research has focused on the role of risk in forest users' property rights preferences. This analysis addresses

this issue by examining how risk and coping strategy options shape those preferences. In addition, I investigate how households that prefer a higher level of common property rights behave differently from households that prefer a lower level.

McKean cites (1992, 2000) four advantages of common property rights regimes for managing CPR, one of which suggests that common property rights can act as a collective insurance policy to manage risk. Since environmental risks are spread across a larger forest, common property rights arrangements reduce the likelihood that individuals will have to bear the entire loss from realized risk. Researchers have documented this dynamic in case studies (Axelrod & Fuerch, 2006; Banks, 2003; Nugent & Sanchez, 1998; Pattanayak & Sills, 2001). However, limited research has tested this relationship quantitatively, and there is a lack of systematic study explaining how different degrees of risk exposure and coping ability lead to variations in common property rights preferences. This analysis addresses this gap.

I hypothesize that a forest user who has experienced or anticipates a higher level of risk exposure wants a greater portion of the forest to be governed as common property. In addition, the importance of coping strategy availability in shaping forest users' perceptions of risk and forest condition leads me to hypothesize that when a forest user lacks valid coping strategy options, she is more likely to want a larger proportion of common forest property. I test these hypotheses using the data collected from Caracara and Oropendola. Finally, I examine how households that prefer a higher level common property rights perceive forest issues differently or behave differently from other households. Existing research suggests that applying a common property rights system does not necessarily lead to desirable forest outcomes; therefore, there is a need to understand how common property rights are linked to user actions and behavior that produce favorable outcomes.

A regression model is created to test the relationships among risk exposure, coping ability, and common property rights preferences. Findings reject the hypothesis stating that risk exposure drives preferences toward a higher level of common property rights. However, results indicate that the lack of valid coping strategy options for dealing with risk is a significant factor. Although a forest user may experience high levels of risk, her preference for common property rights will not change unless she lacks valid coping strategy options. This result supports McKean's argument that common property rights can be used as a viable risk management strategy, and this practice is especially true for the forest users who lack other coping mechanisms. Furthermore, women-headed households and households in Oropendola are more likely to prefer a common property rights arrangement.

I also run chi-squared tests to compare correlation coefficients for situational and behavioral differences between the two groups of forest users – the group that prefers a higher level of common property rights vs. the group that prefers a lower level. Results show that (1) a lack of trust among community members likely leads to lower preferences for common property rights, (2) forest users who consider the forest a very important source of subsistence and cash income are likely to prefer a higher level of common property rights, and (3) forest users who favor common property rights are likely to participate in more forest monitoring activities. These findings align with the theory that a trusting relationship among community members is important for shaping community members' ability to act collectively to manage the forest as common property (Ostrom, 2005). Also, the perceived importance of the resource is likely to affect common property rights preferences. Finally, in order to protect their property, forest users who favor a higher level of common property rights are more likely to participate in

monitoring activities. This outcome is consistent with the argument that rule enforcement is crucial to effective natural resource governance (Gibson, Williams, & Ostrom, 2005).

Findings from this analysis suggest that common property rights arrangements can be promoted as a viable risk management mechanism. Furthermore, to facilitate the use of common property rights arrangements, policies or programs can help communities build trust among their members, and secure forest users' rights to access the forest resources that support their livelihoods.

1.5 Conclusion

This study investigates how risk affects Bolivian forest users and how they cope. The findings contribute to our understanding of the relationships among (1) household characteristics and risk exposure, (2) the role of collective action in risk management, and (3) the influence of risk on property rights preferences. Furthermore, by unveiling the drivers behind forest users' preferences for a particular property rights arrangement, we can understand how some communities are able to use the two property rights arrangements – private and common – to manage their forest resources.

It is important to study risk because it creates uncertainties that could affect forest users' livelihood strategies. These uncertainties may drive forest users to behave differently than they would under normal circumstances, and their responses to uncertainty can affect forest conditions. Risk management requires forest users to balance current and future costs and benefits; risk not only affects the current actions of the users but also influences future actions. Finally, risk can be idiosyncratic or predictable, and harm from risks can have long-term and/or short-term impacts. Hence, improving knowledge in risk management can help support appropriate programs that address the wide variety of risks and their associated outcomes.

Case studies, including the cases in Caracara and Oropendola, have shown that subsistence forest users have very limited coping strategy options for dealing with risk. Their vulnerability to the different risks and the harmful impacts that risk can impose upon them call for the attention of policy makers. I suggest that risk messages should reduce the psychological distance between different risks and their likely victims so that they are motivated to seek out information about ex ante and ex post risk management options. Furthermore, rural risk management programs should target households with diverse characteristics. These programs should not only help forest users prepare for foreseeable risks, but they also should provide different coping strategy options to deal with various risks that cause different degrees of harm. Programs that promote non-forest-based coping strategy options can help forest users build resistance against future risk and reduce their reliance on forest resources.

Risk has been studied in many disciplines in the developed world. We have accumulated a vast body of knowledge in risk assessment, preparedness, response, recovery, management, and education. Policies or programs that transfer this knowledge to developing countries will provide their people with a better and wider set of tools for dealing with risks. The findings from this study create a better picture of how rural forest users in developing countries manage risk. This knowledge can help policy makers develop, promote, and implement proper risk management programs that account for the local context. Furthermore, by knowing which effective coping strategy options are used by rural communities, policy makers can develop risk management knowledge exchange programs to facilitate learning among communities. Advancements in risk management knowledge are also likely to help forest users come up with more appropriate responses, which could help them cope better and reduce the likelihood of putting unnecessary stress on the forests.

Risk is a burden to rural people and a barrier to development. Rural people who have to struggle constantly with sickness and theft, worry about pests that may destroy their crops or livestock, or live under the threat of natural disasters that may wipe out their assets or even take their lives, are unlikely to have the energy and resources to invest in activities other than sustaining their daily lives. As a result, these people are more likely to remain subsistence farmers who rely heavily on natural resources to provide for their daily needs. In other words, rural people under constant stress of risk are less likely to find ways to accumulate wealth so that they can improve their quality of life, or to seek out other livelihood strategies that can lead them away from subsistence living. In order to help these rural people deal with risk and to foster the conditions for better forest outcomes, it is important to focus on improving forest users' preparedness and knowledge of risk management, and to make a wide variety of affordable, accessible, and reliable coping strategy options available.

Chapter 2

Literature Review

2.1 Introduction

This chapter presents studies and findings related to the focus of this research. I also review theories proposed by other scholars explaining the interrelationships among risks, coping strategy options, livelihoods, property rights, and resource outcomes. To understand how forest users use and manage the resource, I start by exploring the dependency between forest users and their forests. Then, I discuss the commonly used property rights arrangements that users can choose to govern their forest. Finally, I present some known factors that could drive users' preferences towards a particular property rights arrangement. To support the main hypothesis that forest users with different risk exposure levels and different abilities to cope may prefer different property rights arrangements, I analyze how risk affects rural livelihoods and how forests are used as safety nets. Finally, I present studies that document the use of common property rights regimes to manage risks.

The review of the relevant literature reveals four key findings. First, rural forest users, especially the more vulnerable populations, depend on their forests for subsistence. Second, forest users face many risks that affect their livelihoods, and the realized harm from risks may not only decrease the productivity of the forests, but may also increase users' dependence on

forest resources. Third, many factors affect a user's decisions about property rights arrangements, and the consideration of current and future risks is one of them. Fourth, although a certain property rights arrangement does not consistently lead to a particular forest outcome, different property rights arrangements do influence how the forests are used and managed. When we consider these four findings together, it is evident that risk affects the livelihoods of forest users, and that the impact to livelihoods or livelihood strategies can influence their property rights preferences and decisions about the forests. A change in the property rights arrangement can also affect forest outcomes. As a result, availability of forest resources may differ, and the likelihood that forest users can continue to rely on the forests for subsistence and mitigate future risks can be affected. This cycle of "risks–livelihood–property rights–forest outcome" prompts me to conduct further investigation of the interrelationships.

2.2 Forest usage and rural livelihoods

According to the United Nations State of the World's Forest report (2011), over 1.6 billion people worldwide depend on forests for their livelihoods. Among them, some 300 million rural poor call forests their home and use forest products for their subsistence needs. These people derive as much as 25% of their total income from forest resources (WRI, 2005). Forests offer a variety of products for different groups of rural forest users. To understand the relationship between forests and the rural users, researchers from around the globe have examined consumption patterns and livelihood strategies of forest users, and have documented their usage of forest resources. Several consumptive use patterns emerged from these studies, and they are grouped into three different functions that describe rural users' dependency on forests (Angelsen & Wunder, 2003; Vedeld, Angelsen, Sjaastad, & Berg, 2004).

First, forests are used to support current consumption of basic necessities (Kamanga et al., 2009; Kar & Jacobson, 2012; Shackleton et al., 2007; Takasaki, Barham, & Coomes, 2004; Vedeld et al., 2007). Billions of rural poor gather fuelwood from forests for cooking and heating, and forests provide the grounds for them to hunt animals and collect non-timber forest products (NTFP) such as vegetables, herbs, honey, fiber, fruits, nuts, and mushrooms. Some of these food items are the principle sources of nutrition, while others are commonly used to supplement the standard diet. Moreover, many forest users treat diseases using medicinal plants collected from the forests. Forests provide the primary source for building materials like poles and grasses, and many forest users also collect fodder from forests to feed their livestock. Forests, in this sense, supply many of the necessary products for these rural populations to sustain their lives.

In addition to providing basic necessities, forest products can create a pathway out of poverty for the rural poor (Fisher, 2004; Mamo et al., 2007; Shackleton et al., 2007; Sunderlin et al., 2005). Studies have shown that forest resources offer an income-equalizing potential among rural forest users (Babulo et al., 2009; Cavendish, 2000; Heubach, Wittig, Nuppenau, & Hahn, 2011; Kamanga et al., 2009). For instance, forest users can collect extra NTFP to sell as raw materials or processed products in the market. Furthermore, by using more NTFP as food, they may consume fewer self-grown products, which can instead be sold in the market. Cash income from these trades allows the forest users to accumulate capital, and this additional capital can be used to invest in other livelihood strategies that could lead them out of poverty eventually. Moreover, diversifying income sources and saving up emergency cash can protect forest users against the shortfalls that often lead to deeper poverty. In some better-developed areas, employment in sectors such as forestry, forest management, and biodiversity-based tourism

provides earning opportunities that also help alleviate poverty in rural forest communities (Angelsen & Wunder, 2003; Reddy & Chakravaty, 1999; Shackleton et al., 2007).

Finally, forests function as safety nets to overcome unexpected events that lead to income or food shortages (Arnold & Ruiz-Prez, 2001; Debela et al., 2012; Fisher et al., 2010; Mamo et al., 2007; McSweeney, 2004; Pattanayak & Sills, 2001; Paumgarten, 2005). When dealing with adversity – like natural disasters, food deficits, or illness or death of productive household members – the resource-strapped poor rely on forest products to provide the most basic necessities for survival. For instance, they may seek out food items that they do not normally consume, e.g. meat from small mammals and birds. Moreover, they may increase their consumption of NTFP that they normally use to substitute for purchased commodities, or they may sell products collected from the forests on a temporary basis to earn cash income (Fisher et al., 2010; Shackleton et al., 2007). In sum, the forest is the reliable last resort that the rural poor depend on to overcome hardships.

The dependency on forests and forest products varies among different groups of users. For larger households, the forest is the source of many essential materials (Debela et al., 2012). Furthermore, an overwhelming amount of literature suggests that the poorest of the poor rely more on forests, especially for NTFP (Angelsen & Wunder, 2003; Debela et al., 2012; Kamanga et al., 2009; Kar & Jacobson, 2012; Neumann & Hirsch, 2000; Reddy & Chakravaty, 1999; Shackleton et al., 2007; Tumusiime et al., 2011; Vedeld et al., 2007). For the poorest households, forest income is more important than all other income sources combined (Mamo et al., 2007), though variations do occur. One case study reports that richer households, which need more fodder to feed bigger herds of cattle, collect more from the forest than the asset-poor households that have fewer or no cattle (Adhikari, Di Falco, & Lovett, 2004). Heubach et al.

(2011) discovered that the poorer households consume more NTFP to fulfill basic needs while the wealthier ones extract more NTFP for cash income. Finally, Angelsen and Wunder (2003) reported that richer households capture most of the benefits from timber sales because they have the capital and skills necessary for facilitating those trades.

Older people generally have a higher reliance on forest resources than other demographic groups; the elderly are less likely than their younger counterparts to secure paid employment, and they may have difficulties in performing arduous farming activities (Cavendish, 2000). Furthermore, older people may have more knowledge of uses for various forest products, such as medicinal plants and wild food, which results in higher consumption of these forest products (Mamo et al., 2007).

In communities that seek skilled workers, less educated workers are unlikely to secure jobs. As a result, households headed by less educated residents are likely to rely more on farming and natural resource extraction for subsistence and, therefore, consume more forest products than households with skilled workers who earn wages and purchase commodities in the marketplace (Adhikari et al., 2004; Fisher, 2004).

For rural forest households, adult labor availability determines the livelihood strategy that a household should use to secure necessities for its members. Resource collection activities have a low barrier of entry because they require less physical strength and fewer skills. However, collecting NTFP is a low-yield activity, and in many cultures it is often the women's or kids' job. Adult males, who have higher opportunity costs on their time, often prefer wage labor or farming to collecting NTFP, whereas households lacking ample adult labor, such as women-headed households or households dominated by children, are more likely to gather forest resources to meet their needs (Brown & Lapuyade, 2001; Kamanga et al., 2009; Mamo et al., 2007).

While rural people employ diverse livelihood strategies, they share a heavy reliance on forests and forest products. Forests not only provide them with some basic subsistence items for everyday consumption, but also offer products that can be sold in the market for cash income. In times of adversity, forests are the safety nets for the rural poor, and the dependency on forest resources is especially critical for households that do not have adults who can engage in other income-generating activities.

2.3 Property rights and their importance

In order to secure access to and use of the forests, forest users must have property rights. The term "property rights" has two meanings: From the legal perspective, they specify which rights a person is assigned towards the property. From the economic perspective, they provide the owner her ability to enjoy the property. The economic rights are the end, while the legal rights are the means to the end (Barzel, 1989). Property rights are social institutions; they fundamentally specify the legitimate user(s) of a property and the acceptable use of that property by the user(s) (Edwards & Steins, 1998). The need for defining property rights arises when there is an increase in scarcity of the resources (Alston & Mueller, 2004), which could be driven by an increase in demand, and/or a decrease in supply. Factors driving higher demand include population growth, increased market pressure on certain forest products, and the arrival of new claimants. Unintended fire, floods, drought, or windstorms could cause a decrease in the supply of forest resources. When the availability of forest resources is threatened, existing forest users are likely to stake a claim to the forests in order to protect their individual long-term interests. In other words, to safeguard their rights to the resources, forest users must obtain and defend their property rights.

Property rights refer to a bundle of rights. Schlager and Ostrom (1992) grouped four separate rights in the bundle: the rights to access and withdraw, manage, exclude, and alienate. Alston and Mueller (2004) added two more to the bundle: the right to derive income from the resource, and the right to bequeath. These different facets of property rights further define the range of activities the rights-owner can carry out on the property. In many developing countries, local users typically have the rights to access the forests, to withdraw forest products for their own consumption, to derive income by selling the forest products in the marketplace, and to exclude illegitimate users from capturing benefits from their forests. Sometime, rights to manage and rights to bequeath are granted. However, rights to alienate are usually held by the state and are seldom granted to individual forest users (Cronkleton, Pulhin, & Saigal, 2012; Takasaki et al., 2004). These confusing details sometimes lead to conflicts of interest and disputes between the state and the local population (Azhar, 1993). Finally, property rights can be classified based on their legal standing. Property rights that are given lawful recognition are *de jure* rights. Rights that are agreed upon by local users and are not recognized by government authorities are referred to as *de facto* rights (Schlager & Ostrom, 1992). Conflicting claims between *de jure* and *de facto* property rights have been the culprit of many land disputes (Mwangi, 2007; Platteau, 1996).

Although defining property rights is important, it is not sufficient for protecting one's property if the rights are not enforced. Therefore, in addition to establishing property rights, the forest users must exercise their rights and defend their claims on the property when necessary. However, protecting property rights may require a high transaction cost, which could discourage the legitimate users from fully exercising their rights (Barzel, 1989). Studies have shown that enforcement can be costly, but it is essential in order to uphold the rights and to achieve the

expected outcome (T. L. Anderson & Hill, 1975; Gibson et al., 2005; Goebel, 2000; Ruttan, 1998; Sivaramakrishnan, 1998; Watts, 2003).

Due to the differences in how property rights are structured and enforced, different incentives influence owners' decisions and actions in managing the resources (Libecap, 1989). For example, owners with rights of exclusion will have a greater incentive to undertake long-term investments because their return on investment is relatively secure. On the other hand, owners with only access and withdraw rights may overexploit the resources in order to capture most of the short-term gain; this is especially true for users who apply a high discount rate on the resource (Barzel, 1989; Schlager & Ostrom, 1992). In general, the more exclusive the property rights are, and the better protection of the rights one has, the greater the incentive to maintain the value of the asset (Alston & Mueller, 2004; Barzel, 1989)

In order to fully understand the essence of property rights and the different regimes available, it is necessary to understand the distinctions among the four different types of goods. Certain property rights arrangements are known to be more effective than the others for governing certain goods. These four types of goods can be classified based on two different attributes – cost of exclusion and subtractability of use (Ostrom, 2005). "Exclusion relates to the difficulty of restricting those who benefit from the provision of a good or a service. Subtractability refers to the extent to which one individual's use subtracts from the availability of a good or service for consumption by others" (Ostrom, 2005, p. 23). Figure 2.1 shows the four types of goods and their classifications.

		Subtractability of use	
		Low	High
Difficulty of excluding potential beneficiaries	Low	Toll goods	Private goods
	High	Public goods	Common-pool resources

Figure 2.1 Four basic types of goods. Source: Ostrom (2005, p. 24)

The first type of goods is public goods – for example, fresh air and world peace. These goods have a high cost of exclusion and low subtractability. For instance, one's enjoyment of fresh air does not subtract from the quantity of fresh air that is available for others to enjoy. Also, excluding others from breathing "my" fresh air is infeasible. This type of goods does not render any need to establish property rights.

The second type of goods is private goods, which have a low cost of exclusion and high subtractability. Consumer products such as computers, plane tickets, and bottled water are examples of private goods. When a person acquires ownership of a private good, the quantity available to other people is reduced, and the owner can easily exclude others from using the item. Private ownership is the best approach to securing the rights for this kind of goods.

The third type of goods is toll goods, also known as club goods. Toll goods have low cost of exclusion and low subtractability. A country club is one example; a private club can easily exclude certain people from becoming members. In addition, my enjoyment of the club facilities will not reduce other members' enjoyment of the club, at least up to a certain point. Private or shared group ownership is appropriate for these goods.

Finally, the fourth type of goods is common-pool resources (CPR). CPR are characterized by a high cost of exclusion and high subtractability. It means that one user's consumption of the CPR will reduce the quantity available to other users. Nonetheless, it is very costly and practically impossible in the long run for individual users to exclude other users from consuming the CPR. Most of our natural resources, such as forests, groundwater, and fisheries, may be considered CPR. Since CPR are scarce resources, and exclusion is difficult, efforts to define and enforce ownership have encountered difficulties. The following sections discuss the attempts and the challenges.

Three property rights arrangements – public, private, and common – are commonly used in managing forest resources. Public rights refer to state ownerships when the government has the control of the forests. During the late-1900s, many developing countries designated state-owned forests to secure the financial benefits from the resources. Public ownership of forests was also considered a way to protect the habitat. However, the governments' lack of motivation or resources to secure the rights led to insignificant or unsatisfactory outcomes (Ascher, 1999; McKean, 1992; Repetto & Gillis, 1988). In some cases, government programs even created perverse incentives or failed to ensure distribution fairness among forest users. As Ascher (1999) reported, overpriced reforestation subsidies actually encouraged deforestation. Colchester (1994, 2000, 2006) recorded that abusive governments used "conservation" as an excuse to rob land from indigenous groups.

Moving away from public ownership has become a trend in recent decades. Furthermore, the public property rights arrangement is not a valid option for forest users to choose when designing their own property rights arrangement, so it is not a focus of this study. Instead, the following sections discuss in detail the other two property rights arrangement options that are relevant to this study.

2.3.1 Privatization and the Evolutionary Theory of Land Rights

Private property rights are assigned to an individual or a single entity. The appeal of a private property rights regime was bolstered by Hardin's *Tragedy of the Commons* (1968) and later supported by the Evolutionary Theory of Land Rights (ETLR). The analysis of ETLR by scholars (Barnes & Griffith-Charles, 2007; Platteau, 1996) goes as follows: Population growth and increased demand for agricultural products lead to higher demands for productive land. This demand increases competition for a static amount of land, including forests, and raises land

values. The scarcity of land destabilizes the traditional communal land ownership arrangement and triggers a change in consumption patterns of land-based resources, which can lead to overexploitation and mismanagement of the resources. The change in incentive structures may also discourage efforts to conserve the resources for future use or invest in activities that will retain or improve the productivity of the land. These misguided incentives under communal property rights arrangements can then create higher social costs and insecurity. Alchian & Demsetz (1973) argue that the solution to these issues is to formulate private ownership arrangements: "Capitalism relies heavily on markets and private property rights to resolve conflicts over the use of scarce resources" (Alchian & Demsetz, 1973, p. 16). To summarize ETLR:

> "A central tenet of this theory is that under the joint impact of increasing population pressure and market integration, land rights spontaneously evolve towards rising individualization and that this evolution eventually leads rightsholders to press for the creation of duly formalized private property rights - a demand to which the state will have an incentive to respond." (Platteau, 1996).

According to the supporters of land privatization and formalization (Alchian & Demsetz, 1973; De Soto, 2000; Feder & Nishio, 1998), private property rights arrangements reduce the free-rider problem that commonly arises under traditional communal land ownership agreements; land privatization has lower transaction costs, and it eliminates the incentives to internalize communal benefits. Moreover, private property rights align the owners' incentives to invest and care for the resources for the long run. Formalization of property rights is also a key to development because resources can be easily transferred to the most effective user, and land title-holders can access credit for investment using their secured properties. As a result, states can increase their revenue through tax collection. This approach not only promotes sustainable development through long-term investment in property, but also boosts food security. As the

theory goes, land privatization and formalization will eventually lead us to a more peaceful and harmonious world. Land-titling projects in Thailand provide empirical support of the theory (Feder & Nishio, 1998).

Given the challenge of sustaining a growing population with a scarce amount of land, the need to formalize land rights is justified. In addition, policies driven by the ETLR have shown success in some places, particularly in agricultural settings (Deininger, 2003; Feder & Nishio, 1998). However, other scholars have questioned the presumed benefits and the universal applicability of the theory (Bardhan, 1993; Barnes & Griffith-Charles, 2007; Runge, 1986). Platteau (1996) reported that the post-colonial cultures of many Sub-Saharan African countries do not grant full private property rights to individuals. Furthermore, in order to make private property rights effective and to address current or future land disputes, the state is required to implement land-titling programs to formalize land rights. Nevertheless, many of these countries lack institutions and resources to carry out land-titling activities. Even though some titling programs have been implemented, officials are faced with a slew of conflicting claims of ownership. Marginalized groups, such as women, hunter-gatherers, and former slaves, are typically denied their customary land rights, and continuous disputes between the new title-holder and the original users are common. In some cases, government officials manipulate land records to favor the local elites. Even in places where dishonest acts are rare, the cost of registration and the knowledge required to participate in the registration process favor those who can pay and navigate the system. Jansen and Roquas (1998) also observed land conflicts caused by titling in Honduras; although the initial process was successful, the effects were not long-lasting. Barnes and Griffith-Charles (2007) found that formalized property titles in St. Lucia are not kept up to date because of unregistered inheritances. As a result, land ownership is reverted

back to an informal system. In Pakistan, Azhar (1993) reported that privatization resulted in predatory redistribution of income, because the process favors those who have the means to obtain the title, as well as the bureaucrats who have the power to assign the rights. Mwangi (2007) recorded another case of elite capture, when unequal parcels were produced through a subdivision program on rangeland in Kenya. The committee members who headed the subdivision activities allocated larger parcels to themselves and their affiliates. This unfair outcome has motivated small-parcel owners to reaggregate their land in order to pursue joint management. In sum, land privatization is a costly process with uncertain outcomes. It can lead to more land conflicts for all, increased land insecurity, and livelihood threats for the marginalized groups.

The movement towards land privatization grounded by ETLR focuses primarily on the economic aspect of the land, but ignores the psychological and social dimensions of land ownership. It also overlooks the sentimental value people place on the land, especially on ancestral land. Land does not only provide the users the means to livelihood; it is also an insurance against shortfall and a symbol of their heritage. These three functions of land do not necessarily point to private ownership as the effective management regime, rather to a system that honors the importance of each.

2.3.2 Common property rights

The inappropriate use of private property rights regimes to manage common-pool resources; the disappointing outcomes from privatization; and evolving economic and environmental conditions prompt interest in taking a second look at the customary property rights arrangements used by communities and indigenous groups (Barnes, Forthcoming; Platteau, 1996).

"A common-property regime is a property-rights arrangement in which a group of resource users share rights and duties toward a resource" (McKean, 2000, pp. 29-30). It is a form of secured land tenure that grants resource access to specific groups of users whose long-term interests are aligned with ensuring the sustainability of that resource. Managing forests as common properties requires forest users to participate in collective decision making and joint management. Under a common property rights arrangement, forest owners can self-organize forest management activities. They also share the duties and the costs of management, investment, monitoring, and sanctioning. In return, all the owners from the group share the benefits from the resources. Through her life-long research, Ostrom (Ostrom, 1990; Poteete et al., 2010) has shown that forests are a form of CPR and that protecting CPR from exploitation is a collective-action problem. A collective-action problem describes how a group fails to obtain the best outcome for the entire group, due to the high transaction costs and the rent-seeking nature of individual actors (Olson, 1965). Addressing the collective-action problem of natural resource governance does not lead to certain property rights regimes, rather to strong institutions that support rule formation and enforcement.

Contrary to outdated beliefs that forests should be protected through defined public- or private-property rights, common property rights offer a different avenue. Common property rights go hand-in-hand with decentralization reforms in many developing countries, where central governments give local governments and local users the power and the financial and technical support to manage their natural resources (Agrawal & Ostrom, 2001; Nygren, 2005). The expected outcome of decentralization, along with common property rights, is a stronger sense of ownership of the resources. Such empowerment can lead to better decisions and actions in planning, management, monitoring, and rule enforcement for the protection of the resources.

McKean (1992, 2000) outlined four advantages of using common property rights regimes for managing CPR: (1) Since a forest ecosystem is more productive as an undisturbed whole, defining proper common property rights, rather than parceling a forest, keeps the resource and its productivity intact. (2) A common property rights regime can act as a collective insurance policy to manage risk; since environmental risks are spread across a larger forest, this regime reduces the likelihood that individuals will have to bear the entire loss. Also, all seasonal productive zones within the forest are shared among the users, providing more resources for the users to sustain their livelihood. (3) Externalities can be internalized because co-owners are calculating the costs and benefits of the resources of the whole forest rather than just their individual parcels. This suggests that common property rights give secured property rights to the co-owners, and create the incentive for them to protect the entire forest. (4) Monitoring abusive use is easier because each co-owner is keeping an eye on the others for his or her own benefit. Also, co-owners can band together to patrol the entire forest from intruders more efficiently and effectively. These advantages are even more prominent for forests that cover vast areas where property rights are vaguely defined. Other scholars also point out that using common property rights regimes to govern resources aligns with the traditional land tenure customs of many indigenous cultures, which have long histories of balancing their daily livelihoods with environmental foresight (Bardhan, 1993). Empirical studies have shown that groups, under the appropriate conditions and institutional arrangements, can self-organize to govern CPR sustainably, and some forms of common property rights are employed (Berkes, Feeny, McCay, & Acheson, 1989; Conroy, Mishra, & Rai, 2002; Gibson et al., 2000; McKean, 1992).

Despite the encouraging cases, common property rights arrangements have limitations, including a negative influence on social equality. The textbook definition of common property

rights suggests that property rights are granted to all members of the community, and that they share the property in an equal manner. However, field cases have discovered that household characteristics affect the presumed egalitarian access to the resource. In Nepal, Adhikari et al. (2004) showed that households belonging to a higher caste obtain more resources from the communal forests than the so-called untouchable castes. These higher caste households are richer, own more land, and require more fodder from the forest to feed their livestock. Nygren (2005) reported that women in Honduras have limited access to forestry activities and receive less forestry revenue from their community forests than men do.

Also, the assumptions that communities using common property rights will jointly manage their resources and equally share the benefits were challenged by Watts (2003), who documented disappointing outcomes in Namibia and suggested a state-community/private partnership in which the state maintains the ownership of the forests but allows communities to carry out the day-to-day management activities. In Nepal, Acharya (2005) reported that local elites have manipulated the collective system to benefit themselves, since participation of all members in decision-making is not possible. Azhar (1993) discovered similar activities in Pakistan, where bureaucrats compete against each other to control the common forests for personal gain. Finally, context matters in property rights effectiveness. Kellert et al. (2000) found that the environmental and socioeconomic objectives of community natural resources management – equitable distribution of power and financial benefits, reduction of conflicts, empowerment of locals, protection of biodiversity and sustainable use of resources – were not achieved in Nepal and Kenya, but were attainable in North America. Results from a case study in Zimbabwe even questioned the applicability of the common property resource management approach given the historical, social, and political context (Campbell et al., 2001).

Resource outcomes under common property rights regimes have produced mixed results. There is only a limited association between property rights regimes and the condition of natural resources (Agrawal, Chhatre, & Hardin, 2008; Casimir & Rao, 1998). Baird (2010) found that wood resin trees managed communally by small groups in Cambodia are in better condition than trees managed privately, because peer pressure and social norms encourage proper treatments of communal trees and shun those who are irresponsible towards the common properties. In Honduras, Tucker (1999) reported that there is no significant difference in vegetation or soil conditions between the privately-owned forests and forests that are owned commonly with open access to community members. Rather, strong institutions that formulate and enforce rules are associated with better forest outcomes (Tucker, Randolph, & Castellanos, 2007). The finding that strong institutions are a more powerful predictor of forest outcomes than the property rights regime was echoed by cases in Guatemala (Gibson, Lehoucq, & Williams, 2002). In conclusion, there is a lack of evidence to support claims that one type of property rights arrangement, either common or private, produces better outcomes. In reality, too many factors influence the effectiveness of a property rights regime and the users' decisions in choosing a property rights arrangement.

2.4 Determinants of property rights decisions

Various contextual factors contribute to the effectiveness of a property rights arrangement and, in turn, influence the preference of the property owners. These factors can be grouped into two categories: environmental and social.

From the environmental side, the flow of the future benefits plays an important role (Barzel, 1989). When the flow is known and predictable, owners with enforceable rights can be assured of those future benefits, and there is no need to consume the resources immediately.

However, if the flow is variable and not fully predictable, owners' desire to maximize wealth may lead to the heightened consumption of the resources whenever they are available (Libecap, 1989). Such a tendency is likely to lead to a preference for private property rights (Netting, 1976). When the resource area is big, when productivity is low, and when the conditions require more labor, resources, and investment in order to yield the marginal return, a common property rights arrangement is preferred (Netting, 1976; Tucker et al., 2007). In addition, proximity to roads and markets is also a factor. Tucker, Randolph and Castellanos (2007) found that closer proximity to roads and markets makes commercialization of forest products easier, and creates a preference for private property rights. Acharya (2005) also found that a low market intervention rate leads to successful collective arrangement.

For a common property rights arrangement to work, users must have the ability to act collectively. Acharya (2005) stated that strong social cohesion is essential to the success of a collective institutional arrangement. Ray and Bhattacharya (2011) also showed that land inequality, caste and political heterogeneity, lack of trust among community members, and lack of leadership hinder an individual's willingness to collaborate. Agrawal (2000) suggested that medium-sized communities are more likely to succeed in their collective actions because the transaction costs of establishing rules and enforcing those rules are lower than they are for small or large communities. This suggestion is supported by Acharya (2005), who also concluded that forests with fewer users favor a collective system. Moreover, a common property rights arrangement works for groups that have a high dependency on the resources (Acharya, 2005; Netting, 1976). Finally, when access to valid and relevant information is available; when monitoring and enforcement of the rules is effective and inexpensive; when the rate of population and technological change is moderate; and when communication can occur frequently

and face-to-face, there is a higher likelihood of achieving effective governance of the commons (Dietz et al., 2003).

To summarize the findings: Many factors affect the users' ability to act collectively and their decisions to use a common property rights arrangement. "Common property tends to occur where resources are scarce, dispersed, mobile, or variable in predictability" (Tucker et al., 2007, p. 271). Scholars have produced informative findings about these drivers. However, existing research has not investigated the role of risk in this decision-making process; this study aims to fill this gap. Before drilling into the research question, I first present additional literature that examines how risk affects rural people and how property rights are used to manage risks.

2.5 Risk and the rural poor

Rural households face many kinds of risks, and studies have shown that rural people rely on forests as safety nets (Arnold & Ruiz-Prez, 2001; Mamo et al., 2007; Paumgarten, 2005). According to Scoones (1998), risks can be classified based on their predictability and impact level. Risks that are hard to predict are commonly referred to as shocks. Shocks usually happen infrequently, cause immediate impact, and affect all or many of the households in a community. Examples of shocks are societal or political crises, and natural disasters, such as drought, fire or flood. The other kind of risk is called stress. The impact of stress is usually smaller and cumulative. Stress may affect only particular groups of households in a community because certain characteristics of those households make them more vulnerable. Stresses are predictable risks – for example, climate change, population growth, and in-migration that lead to land, food or fuelwood shortages. All risks discussed in this study are involuntary risks; the affected parties are not willingly incurring a higher level of risk in order to obtain a better return of investment.

Exposure to risks varies from household to household. Some households are more susceptible to certain risks because of their household characteristics. For instance, it is common for older people to experience more episodes of sickness, a predictable stress. Fisher and Shively (2005) conclude that the poor are more vulnerable to income and consumption risks, but Carter et al. (2007) suggest that the poorer households are not more vulnerable to environmental shocks since they have relatively little to lose. However, they are more sensitive to shocks, and require a longer time to recover. Gentle and Maraseni (2012) documented that the changing climate patterns have become an additional burden on the mountain communities in Nepal. This stress is especially harmful to the poorer households that live in poverty or in hazardous zones, depend on rain-fed subsistence agriculture, face scarcity in food and basic services, and lack alternatives to cope. After a flood in Bangladesh, Rayhan (2010) reported that smaller households that are headed by better-educated males were less vulnerable to the flood's impacts. Rayhan's study also found that factors that correlate with poverty also correlate with flood vulnerability; this correlation indicates that poorer people are more likely to be exposed to flood risks. Worst of all, poverty and aggregate risk are strongly correlated; this suggests that risks amplify the likelihood that the poorer will fall into the poverty trap (Rayhan, 2010).

Due to the differences in their characteristics and in the nature of the risks, households develop different strategies to deal with risks. Households that are likely to turn to forests as safety nets are the ones with a higher dependency on forest products at a predictable time. In Southern Cameroon, Brown and Lapuyade (2001) reported than women rely more on the sales of NTFP for cash income when they face an economic crisis. Poorer households that are headed by young males and that have more dependents sell more forest products when they are experiencing hardship (McSweeney, 2004). Fisher and Shively (2005) reported similar results,

stating that households headed by younger males more often use forests as natural insurance. Also, households that live closer to the forests use more forest products to help cope with hardship (Debela et al., 2012; Fisher & Shively, 2005). In the Brazilian Amazon, households without other options depend on forests to smooth consumption (Pattanayak & Sills, 2001). Fisher et al. (2010) found that households that are poorer, live close to the forest, and are headed by older and less educated heads have a higher reliance on forest products for reactive adaption to climate variability. In Uganda, households that are asset-poor and headed by women use more forest resources after they experience large economic shocks, because financial help is typically not available to these two groups (Debela et al., 2012). Takasaki et al. (2004) documented that gathering NTFP is an important strategy for coping with flood risk for the peasant households in Peru, especially for the young poor who lack equipment and skills to pursue other options. These findings suggest that "the downward spiral of the poverty-environmental link can be exacerbated by shocks" (Takasaki et al., 2004, p. 221) since the poorest of the poor may over-consume the natural resources they heavily rely on in order to cope with the immediate needs. In sum, households that lack another asset base are more likely to rely on the forest as their safety net during hard times (Paumgarten, 2005). This increased dependency can lead to higher consumption or even overexploitation. As a result, forest resources become scarcer. Moreover, some environmental shocks may damage the productivity of the forests, thus reducing the availability of the resources even further. Eventually, forest users can no longer depend on forests for their livelihoods or to recover from hardship. This vicious cycle, referred to as the poverty trap, is especially detrimental to the poorest of the poor (M. R. Carter et al., 2007; Debela et al., 2012; Paavola, 2008).

Fisher and Shively (2005) came up with three reasons to explain why forests are an attractive natural insurance option. First, collection of forest products requires less skill, investment, and physical strength; therefore, it is an easy fallback option for women, children, and the elderly when times are tough. Second, forests provide a wide range of products, both seasonal and non-seasonal, that can satisfy many urgent needs. Most importantly, forests and forest products are usually accessible to members of the community, so accessing forest resources is easier than accessing other insurance options, such as loans or alternative income. Property rights arrangements also play an important role in determining whether the rural poor will use the forests as a safety net. Given the importance of forests to the livelihoods of their users, and users' reliance on forests as safety nets, it is critical to ensure the sustainability of the resources and to define and enforce property rights (Brown & Lapuyade, 2001; Takasaki et al., 2004). Property rights arrangements that restrict access to forest resources can undermine the well-being of the poor and further impoverish the most vulnerable (Debela et al., 2012; Fisher et al., 2010; Kamanga et al., 2009; Paumgarten, 2005; Reddy & Chakravaty, 1999; Tumusiime et al., 2011).

2.6 Property rights and risk management

Forest users have to deal with both current and future risks, and many of them rely on scarce forest resources as natural insurance. Formal and informal property rights regimes mediate access to resources, and affect the livelihood strategies and coping strategy options available to rural forest users (Scoones, 1998). Property rights arrangements also determine forest users' ability to access the resources in the future, and a particular arrangement could influence their decisions about the management of the resources. For instance, in the Brazilian

Amazon, the local Tapajós people rely on the forest for natural insurance, and they vigorously defend their access to their forests (Pattanayak & Sills, 2001).

A common property rights arrangement has been recommended as a mutual-insurance system to manage risk. In India, Axelrod and Fuerch (2006) documented that "[r]isk avoidance in the context of scarcity is, perhaps, the main basis for the communal shareholding system in Goa" (Axelrod & Fuerch, 2006, p. 94). Banks (2003) found that in Xinjiang, China, households temporally deploy internal open access of pastoral resources when the pasture is patchy. This strategy demonstrates that sharing ownership of resources is a form of social insurance for managing environmental risks. Li et al (2007) recalled that the Mongol herders used to manage environmental risks by organizing themselves into groups of two to twenty households that shared labor and access to resources. But this type of collective management arrangement was disrupted by a regulation that promoted semi-private property rights and resulted in degradation of the grassland. Nugent and Sanchez (1998) observed that increasing weather variability triggered a shift from a private property rights regime to a common one in order to reduce exposure to risks. In Africa, Robledo et al (2012) documented that various communities within a region develop "local conventions" to prevent overuse of resources during periods of food scarcity. These conventions address issues regarding the control, access, and management of a specific forest, and grant rights equally among community members who belong to the same conversion. All of these cases confirm that people are risk-averse, and that they weigh the costs and benefits of using different property rights arrangements for managing their resources.

In conclusion, rural users need forests for daily subsistence and as safety nets, and they face a variety of current and future risks that could change their reliance on forests and forest products. Property rights are important institutions that shape forest resource governance and

determine users' access to forest resources. The property rights arrangement is set at the community level, but variations in preferences could occur at the household level. I argue that these variations are caused by household characteristics that are associated with different risk exposure factors – how forest users obtain their livelihoods, which risks they may encounter, and how they deal with risk. In other words, households within a community are not homogenous; their property rights preferences are partly shaped by their risk exposure and tolerance levels, and by the individual cost and benefit calculations that help them identify the best ways to sustain their livelihoods. As Libecap stated, " bargaining stands [to install or to modify the property rights arrangement] taken by the various interest groups depend upon their private expected gains from institutional changes" (Libecap, 1989, p. 19). The preferences driven by the individual cost and benefit calculations may lead households to compete with each other, to cooperate, or to do both at the same time (Enters, 2000; McCay & Jentoft, 1998). The empirical case studies discussed in this chapter show that, when dealing with risk and minimizing the cost associated with risk, households try to socialize their exposure by risk pooling. Applying common property rights happens to be an easy and effective way to accomplish this goal.

Chapter 3

Research Design

3.1 Introduction

This chapter presents a conceptual model that is built from the findings of the literature review. It also discusses how this study tests the relationships presented in the model in order to answer the main research question: How do rural communities govern their forests to sustain their livelihoods under the shadow of risk? So far, we know that rural livelihoods, risks, coping strategy options, property rights, and forest conditions are linked and that they affect each other. The conceptual model is a structural way to make all of the connections and to illustrate their interrelationships. The model (see Figure 3.1) lays out the causal relationships as follows: Forest users are exposed to different kinds of risks. Some risks affect only certain households, and some affect many or all of the households in a community. Due to differences in household demographics, preferred livelihood strategies vary among households. Household characteristics may also shape a household's vulnerability to certain risks, and the coping strategy options that are available for that household to deal with those risks. Risk exposure, choice of livelihood strategy, and coping strategy options influence a household's reliance on the forest, and how the household accesses and uses forest resources. Therefore, these factors can alter a household's property rights preference. Applying different property rights arrangements to a forest is likely

to create different incentives associated with the management of the resource, so different decisions will be made and different actions will be performed. The variations among forest users' decisions and actions are highly likely to lead to different forest outcomes and may alter forest users' livelihood strategies. In return, changes in forest conditions may affect forest users' ability to rely on this resource to sustain their livelihoods and to cope with future risks.

This study tests several relationships outlined in this model, using data from Bolivian forest communities. Bolivia is a good context for this investigation because land reforms since the 1980s have given local people more extensive user rights to their forest resource. The forest communities that are part of the International Forestry Resources and Institutions (IFRI) network were chosen because IFRI communities offer logistical and analytical advantages over other communities. The IFRI network is discussed in detail in this chapter, along with the data collection methods used in the field during my summer 2012 visits to these communities.

3.2 Key terms

Before discussing the conceptual model, this section clarifies key terms and definitions that are commonly used in this study but have not been covered in the previous sections:

Rural: refers to places that are far from major cities or towns, and where economic and technological changes can be slow to penetrate. Rural households tend to obtain their livelihood from swidden and sedentary cultivation, and with a combination of hunting and gathering activities (Sunderlin et al., 2005). Rural communities are typically located far from the market with limited road access. Rural forest communities are forest-based populations that rely heavily on forests and forest products for subsistence.

Livelihood: the capabilities, the assets (natural, physical, human, financial, and social capital), and the activities that determine the means of living by the individual or household (Ellis, 2000; Scoones, 1998).

Forest: "an area of at least 0.5 hectares, containing woody vegetation (trees, bushes, shrubs, etc.), exploited by at least three separate households and governed overall by the same legal structure" (IFRI, 2008, pp. III.A.2-1).

Household: "In some societies, household will have the same meaning as "nuclear family," defined as a unit consisting of parents and their children only. In other societies, a household will consist of several generations (children, parents, grandparents, and great-grandparents) of the same family" (IFRI, 2008, pp. III.A.4-3). For this study, the term household refers to a family or an extended family that lives under the same roof and acts as a single entity in sustaining livelihoods.

Vulnerable: a "sense of insecurity, of potential harm people must feel wary of—something bad can happen and 'spell ruin'" (M. R. Carter et al., 2007, p. 836). Vulnerability is the cumulative result of risk, and the response, or the lack thereof, to risk (Rayhan, 2010). Households are vulnerable if some random risks can put them below a predetermined welfare threshold and force them into a worse-off state permanently.

Risk: contains the element of "exposure to potentially unfavorable circumstances, or the possibility of incurring nontrivial loss" (Smith et al., 2000, p. 1946). There are two types of risk: shocks are hard to predict and can cause major negative impacts, while stress is more predictable and usually has smaller, and cumulative, harmful impacts. High risk exposure does not necessarily lead households to become more vulnerable; only when the

affected households lack ways to adapt, mitigate, or cope with the risk do they become vulnerable.

Uncertainty: refers to a situation that "reflects imperfect knowledge without any particular value assessment about consequences" (Smith et al., 2000, p. 1946). For example, forest users may not know the long-term objectives of the government's forestry policy; such imperfect knowledge will lead to uncertainty but not necessarily risk.

Perceived risk: refers to risk that an individual has perceived will occur. Due to the various types of risk, the difficulty in making sound predictions, an individual's risk tolerance level, and an individual's perception, the same risk may have different occurrence likelihoods based on the opinion of different individuals.

Problem: is in general a bad situation that an individual would like to avoid. Problems usually refer to current or past incidents. Problems that are likely to recur are considered as risk.

Risk vs. Uncertainty vs. Perceived risk vs. Problem: these four concepts are distinct but interlinked. Uncertainty may not lead to harmful consequences, but risk entails the probability that harmful outcomes will occur. Perceived risk is a person's belief that something bad is likely to happen, although that individual may still be uncertain about the timing and the level of impact. Problems refer to past harmful incidents, while risk refers to possible future harmful incidents. The frequency and the harmful impact of problems are highly likely to influence an individual's perception of perceived risk.

Harm: the undesirable consequences one has to bear. Harm can be inflicted by one entity upon another and may lead to physical or economic losses. Harm can also be caused by nature, e.g. natural disaster. For this study, I focus on harm caused by the realization of risk.

Coping Strategy: "[is] characterised by a households resilience to shocks and ability to return to a former livelihood status by relying on a diversity of incomes, food sources, accumulated skills and kinship networks" (Paumgarten, 2005, p. 191). Coping strategies are temporary adjustments an entity uses in dealing with the immediate impacts of a harmful event. Coping is different from adaptation or mitigation; the latter behaviors suggest a longer-term shift in livelihood strategies (Scoones, 1998).

3.3 Conceptual model

Based on the findings from the literature, a conceptual model (Figure 3.1) linking household characteristics, livelihood, risk, coping strategy options, property rights, and forest conditions can be formulated. Starting from the top left-hand side, we know that households of rural communities have various characteristics. They have different compositions of household members, as well as different capacities for dealing with everyday routines. The differences in household characteristics determine which livelihood strategies are best for each unique household situation. Some households rely more on forests, while others have more diverse income sources. Also, households are exposed to a variety of risks (labeled as relationship #1 in Figure 3.1). Some risks affect households with certain characteristics; I call those household-level risks, and examples are sickness, theft and death. Others risks affect all or many of the households within the community; I refer to these as community-level risks; examples are natural disasters, such as drought and flood.

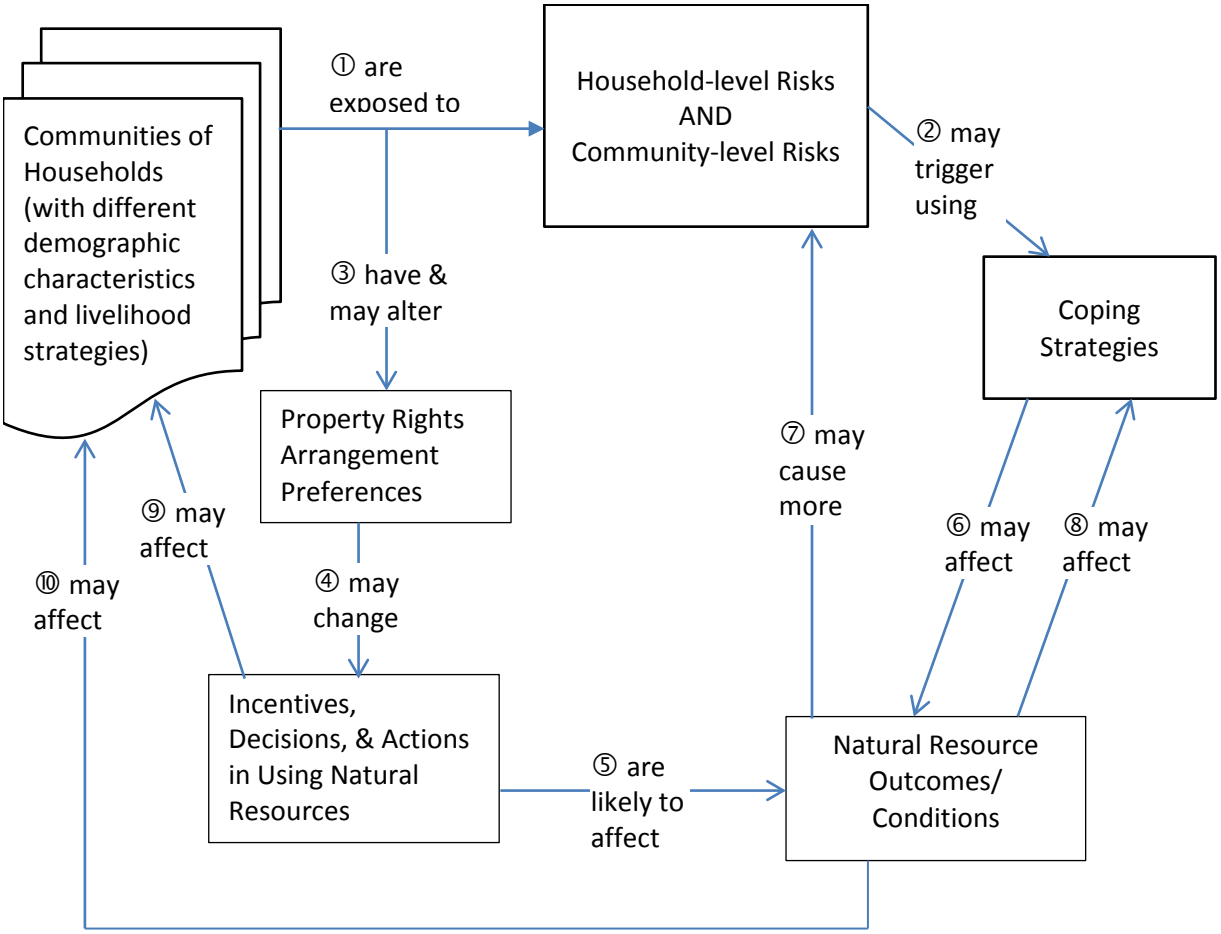

Figure 3.1 Conceptual model (with numbered relationships)

Due to the different nature of risks and household characteristics, households will use different strategies to cope (labeled as relationship #2). In some cases, households use forests as their safety nets and consume more forest products. The increased demand on forest resources is likely to affect the condition of the forests (labeled as relationship #6). As a result, the change in forest conditions may expose forest users to more risk (labeled as relationship #7). This change can also affect whether the users can rely on forests to sustain their livelihoods and to cope with future harm (labeled as relationship #10 and #8 respectively).

Results from empirical studies discussed in chapter 2 have shown that vulnerable households that are poorer or have lower availability of adult labor to engage in other income-generating activities have a higher dependency on forests and forest products. These households

are usually headed by the elderly, the less-educated, or women. In addition, these vulnerable households also have a heavier reliance on forests as safety nets during times of adversity. Given these conditions, scholars have raised concerns about a poverty trap: vulnerable households living under a certain wealth threshold are forced to overexploit the forest resources they heavily rely on in order to sustain their living and to cope with the hardship caused by risk. If forest conditions keep deteriorating, forest users are likely to face more difficulties in sustaining their livelihoods using forest products. Thus, they may fall into deeper poverty.

Nonetheless, it is unclear how different risks affect households with different characteristics. Limited research has addressed this relationship; some relevant case studies have discovered that poverty and risk exposure are highly correlated, but most of these studies focused on community-level risks such as climate change and flood. Little longitudinal quantitative research to investigate the relationship between household-level risks and household characteristics has been performed. Therefore, I design chapter 4 of this study to address the gap in our understanding of the relationships between household characteristics and household-level risk exposure.

Quantitative analyses in chapter 4 examine three relationships: household characteristics and household-level risk, household characteristics and coping strategy options, and risk and forest conditions. With household survey data from five indigenous rural forest communities in Bolivia, I tested these relationships to answer three secondary research questions that are relevant to the main theme of this study: (1) How does household-level risk exposure differ among households in the rural forest communities? (2) How does availability of coping strategy options differ among these households? (3) How do risk exposure and availability of coping strategy options affect the forest condition as reported by the forest users? Findings from chapter 4 give

us a better understanding of household vulnerability and household-level risk, as well as the resulting changes in users' relationships with the forests. Advancing knowledge in this area can improve policies and programs to better assist rural households in dealing with risk.

On the left-hand side of Figure 3.1, we can explore the relationships among household characteristics, risk, and property rights preferences. From theory, we learned that property rights are important institutions for governing scarce resources like CPR. Different property rights regimes affect how the users can access, use, manage, exclude others from, inherit, and sell the asset. In other words, property rights influence the costs and benefits of ownership of a resource. Supporters of ETLR argue that privatization is a desirable approach to secure land tenure and to aid development. Meanwhile, advocates of common property rights present arguments and case studies that demonstrate the advantages of using common property rights to manage CPR.

In order for common property rights to be an effective governance mechanism for forests, forest users must self-organize and act collectively to define and enforce rules that they agree upon. Various case studies have documented that self-organization to achieve better outcomes is possible, but numerous factors can hinder the process. Using the Social-Ecological System (SES) framework, Ostrom (2009) identified 10 frequently cited variables that affect the likelihood of self-organization. Chapter 5 applies the SES framework to two Bolivian forest communities to understand how likely these two groups of forest users are to self-organize and act collectively to manage risks that are affecting their livelihoods and forests. This analysis addresses the research question: What drives forest users to act collectively to deal with risk? The qualitative analysis begins by investigating which community-level risks these two communities face, and which coping strategy options have been used. Based on this

understanding of the different coping strategy options available and the outcomes, I study factors that affect the likelihood of collective action. This analysis not only looks into the 10 variables Ostrom suggested, but also any additional drivers that are unique to these two communities. Findings from this chapter strengthen our understanding of collective actions carried out by rural forest communities.

The Participatory Risk Mapping (PRM) technique (Smith et al., 2000) is used to analyze how risk affects forest users. Researchers using PRM ask respondents open questions to identify the risk they encountered and then to rank the impact of each risk. With these data, three indices are calculated for comparison, and a risk map is created to provide a visual representation. This approach allows the respondents to name the risks they have experienced, rather than just answering yes or no to a list of risks identified by the researcher. Moreover, the ranking allows the respondents to reflect on which risks imposed more devastation than others. Finally, the indices, along with the mapping, provide a systematic way to compare and analyze the data. Chapter 6 presents an in-depth discussion of PRM. Then, using the data collected from my summer 2012 visit, I apply the PRM technique to analyze the risks encountered by the two forest communities.

Furthermore, longitudinal analyses are performed in chapter 6 to understand how the communities and their forests have evolved. Comparisons of changes in demographic and forest conditions of these two communities between the 2006 and 2012 visits are presented. Additional analysis of the changes to risk management by these two communities over the 2006–2012 time period is also presented. The research question guiding the chapter is: How do users' perceptions of risks, availability of coping strategy options, and forest conditions change over time?

The last part of this study examines the relationship between risk and property rights preferences. Existing analysis of the relationship between property rights regimes and natural resource conditions produced mixed outcomes, but property rights are still crucial factors in understanding forest governance. Risk affects forest users' preferences for the property rights arrangement that will manage their forests (labeled as relationship #3 in Figure 3.1). The different costs and benefits associated with the selected property rights regimes are likely to influence forest users' actions and behavior towards the forests (labeled as relationship #4). Subsequently, the different decisions and actions carried out by the forest users will affect the condition of the forest (labeled as relationship #5). Eventually, the changes in forest conditions will determine how well the forests function as livelihood sources and safety nets (labeled as relationship #10 and #8 respectively). Lastly, the different incentives in managing and using the forest may also alter forest users' livelihood strategies (labeled as relationship #9).

I hypothesize that since forests have shown to be used as natural insurance, forest users who face more risk will favor a higher level of common property rights arrangements. This way, they can distribute the risk among more people and receive better protection. In addition, applying common property rights as a coping strategy option is easier for certain households. For example, women and poorer households face barriers in getting financial assistance like a loan. As mentioned in chapter 2, some studies have documented the use of common property rights to manage risk, but these studies primarily report the researchers' observations and the outcomes. In other words, there is a lack of quantitative research explaining how different degrees of risk exposure lead to variations in common property rights preferences. Chapter 7 addresses this gap.

Two research questions guide the investigation in chapter 7. First, how do risk and coping ability affect property rights arrangement preferences? Results of this analysis will determine if the hypothesis suggesting that risk and coping ability affect property rights preference is supported. Second, how do households that prefer a higher level of common property rights behave differently from other households on forest-related issues? Existing research suggests that applying common property rights does not necessarily lead to desirable forest outcomes, so there is a need to understand how common property rights supporters act differently to produce favorable outcomes. Findings from chapter 7 explain this relationship, and the results help us understand the influence of property rights arrangements on users' behavior toward forest resources; thus, we can anticipate likely forest outcomes.

This conceptual model is built with the assumption that people are risk averse. Given the importance of forest resources to the rural users, it is in the forest users' best interest to define the property rights arrangement that allows them to satisfy their immediate needs while conserving some of the resources for future consumption. Policymakers are aware that top-down privatization policies driven by ETLR have limitations; less-than-satisfactory results from land privatization, and the acknowledgement of the importance of engaging local communities in decision-making, have led to a movement towards decentralization (Agrawal & Gibson, 1999; Hyden & Court, 2002). The essence of decentralization is to give local people the rights to govern their natural resources as they see fit. Having extensive user rights to their forest resources is a prerequisite to answering my main research question and testing the hypotheses. Bolivia is an ideal study site because its decentralization and land reforms satisfy this prerequisite condition.

3.4 Case selection

Decentralization efforts distribute power from the central government to the lower levels, which encourages and maintains greater participation by local people in decision-making. The major objective of decentralization is to empower local people by granting them the rights to make decision about issues that affect them directly. One advantage of decentralization is that management decisions made locally can benefit from local knowledge. Furthermore, locally made decisions are likely to address the local needs, thus receiving more support in their implementation. With local buy-in, effective enforcement of the decisions is more likely. Lastly, decentralization protects ethnic minorities by granting them some level of autonomy in local decision-making. The expected outcome of decentralization is expanded democracy, as well as social and economic improvement (Blomquist, Dinar, & Kemper, 2010; Seemann, 2004).

Despite the noble intentions of decentralization and land reform, cases studies have discovered some disappointing results. With their newly-vested power, some local government officials are reluctant to engage other local people (Ribot, 2009). Local politicians lack the incentives to carry out decentralization tasks, and some have even made decisions that impede decentralized forest activities. Such weak local institutional support for decentralization has been a barrier to realizing the expected outcomes. Sometimes the central governments are responsible for the unsatisfactory outcomes because they do not provide sufficient financial and personnel support for carrying out the delegated tasks (Andersson, 2003; Andersson, Gibson, & Lehoucq, 2006; Andersson & van Laerhoven, 2007). In some cases, corruption has led to elite control of most decentralized decisions, and the elite capture of many of the benefits. In other cases, central and local governments' conflicting agendas create confusion and impasse in decision-making (Seemann, 2004). As in other public policy reform initiatives, the effectiveness

and the outcomes of decentralization vary based on many contextual factors (Blomquist et al., 2010; Pacheco, 2012). Next, I discuss the Bolivian case in particular and explain why it is a good focus for this study.

3.4.1 Why Bolivia?

Among the many developing nations that have participated in decentralization reform, Bolivia presents one of the most comprehensive cases, with an extensive history and an aggressive model (Pacheco, 2012). Before the 1960s, Bolivian lowland forest areas were largely marginalized from the political center in La Paz, the capital city where most of the decisions were made. The expansions of natural gas extraction, agriculture, and logging changed the dynamic between La Paz and the lowland region in the early 1960s. A class of regional elites formed in the resource-rich areas, especially in the Santa Cruz department (a department in Bolivia is similar to a state in the United States). During the 1980s, the Bolivian economy experienced hyperinflation, huge external debt burdens, high interest rates, a concentration of land ownership, and wide income disparity. These fiscal issues, combined with ineffective government and a lack of employment opportunities, created social unrest. The regional elites demanded that the central government grant them more autonomy and greater control of their financial interests. Meanwhile, the World Bank and the International Monetary Fund were in a position to guide the Bolivian government out of the financial crisis. Under the auspices of the Structural Adjustment Programs advocated by the two organizations, the Bolivian government launched a series of decentralization policies in 1986. This set of policies aimed not only to reduce the country's fiscal imbalance, but also to present a new paradigm for public and private sector cooperation (Leon, Uberhuaga, Benavides, & Andersson, 2012; Pacheco, 2012; Seemann,

2004). Some of these policies were more notable than others, and have affected the governance of natural resources.

The Popular Participation Law (1994) was signed by President Gonzalo Sánchez de Lozada to engage marginalized populations in political dialog and economic development. The objectives are to create a more democratic and accountable local government structure, and to improve the quality and effectiveness of delivering services at the municipal level. Under this law, groups or communities can form civic committees called Organizaciones Territoriales de Base (OTBs). OTBs could include, for example, local farmer organizations, indigenous groups, and neighborhood committees. The OTBs represent their corresponding groups in making decisions about municipal planning, administrative activities, and public spending.

In addition, 311 municipalities covering the entire territory were created under the law. All municipalities can elect their town councilmen and mayors. Local residents can run for seats in the Municipal Council, although the national political parties still back candidates that align with their agendas. The elected officials, working with the OTBs, are required to create a five-year development plan as well as an annual operations plan for their municipality. Local issues such as schools, road maintenance, and water and health systems are under the municipalities' jurisdiction.

The law also called for a more equal distribution of financial resources from the central government to the municipal level. The percentage of national tax revenue transferred to the municipal governments was raised from 10% to 20%. On top of that, 40% of the tax revenue goes to the nine departmental governments. In other words, 60% of the national tax income is allocated to the local levels. Since the passage of the law, the OTBs have been getting more recognition in policymaking, including in the governance of forest resources. They are also

sharing a bigger portion of forest revenues, and they have the freedom to use the revenue for regional development projects.

The last change from the law allows local groups to form a watchdog committee called Comité de Vigilancia in each municipality. Each watchdog committee oversees the activities of the OTBs and of its municipal government. If the committee observes any mismanagement of funds at the local level, it can notify the central government to cease the tax distribution.

In addition to the Popular Participation Law, two more relevant laws were passed in 1996. The Agrarian Reform Law aimed to define "the legal basis to develop a system of titling and land regularization, and redefining the conditions to access and maintain access to rural property" (Pacheco, 2012, p. 9). Indigenous claims to ancestral land, which is mostly located in the forest-covered lowland area, were considered under the section of the law labeled "community lands of origin." The Bolivian government also ratified the Indigenous and Tribal Peoples Convention (1989), which requires the signatory countries to recognize the common property rights of indigenous forest land that had been managed previously as public land or with open access. As a result of these two legislative moves, indigenous groups are granted common property rights on their indigenous territories once the titling process is completed. The property rights are bundled, and include rights of access, withdraw, exclusion, and some level of management, but not alienation; therefore, assigned land cannot be sold or used as collateral for a loan. Non-commercial uses of forest resources by the indigenous groups are not regulated, but commercial forestry activities are governed under the new Forestry Law.

The new Forestry Law redefined the conditions for obtaining forest rights and for protecting those rights. The Forestry Law also specifies regulations of forest use with the objective that the appropriate forest management practices will lead to sustainable forestry. A

new system that monitors forest management activities, enforces forest rules, and sanctions illegal logging was established. Forestry market regulations, restrictions on extraction techniques, and a tax to discourage unsustainable forestry operation were also introduced. Under this law, forests supply the raw materials for a well-organized enterprise; many public forests and communally-owned forests became eligible for concessions.

To participate in commercial logging, communities develop their own Forest Management Plan, which specifies the scale of the operation, the technology used for extraction, the development of infrastructure to aid logging, and the sustainable practices that address environmental concerns. The Forestry Superintendence (SF), with assistance from the municipal government, is in charge of granting forest concessions, authorizing logging permits, monitoring forest products transportation, and confiscating illegal timber. The SF also approves the communities' Forest Management Plans and oversees forest management tasks.

Bolivian land reforms under decentralization have given forest communities more extensive user rights to govern their forest resource. Local people can claim land title to their forest, and can participate in making decisions that address the long-term interest of the resource. Decisions made with locals' interests and needs in mind have shown to improve the efficacy of monitoring and the enforcement of forest rules. Additionally, granting local people the rights to manage forest resources gives them an opportunity to capture economic benefits of logging. As a result, the distribution of benefits from forestry can be made in a more equitable manner (Pacheco, 2012).

Nevertheless, the full effect of Bolivian decentralization and land reforms on the people and the forests is not yet apparent. For the first time, residents representing local communities were elected to local office; however, some cases show that the dominating local elites are

gaining more power and political influence at the local level. Under the laws, municipalities have obtained more power, both politically and financially, in governing their natural resources. However, they are still under the control of the central government. The recognition of indigenous land rights was a big step forward, and, among all Latin American countries, Bolivia ranks at the top in recognizing indigenous territorial rights (Leon et al., 2012). However, land rights disputes are common and the land titling process has been moving very slowly. Despite the recognition of indigenous rights, indigenous knowledge of forest management was widely ignored or undermined in many forest policies. In an effort to uphold the forest rules, the SF increased monitoring activities, and the local people also have more incentive to monitor their territories. Nevertheless, decentralizing monitoring power was not shown to be able to reduce forest crime (Pacheco, 2012).

In conclusion, decentralization and land reforms in Bolivia provide the opportunity for local people to make important decisions about their natural resources; Bolivian forest communities can obtain legal title of their land, and craft Forest Management Plans to earn revenue from forestry. Most importantly, forest communities are granted the rights to access and use their forests in a non-commercial manner, to exclude illegitimate users from exploiting their property, and to collaborate with the government in managing their forests. Community members can decide how to share and manage the forest among themselves. This condition is necessary for me to investigate forest users' preference in forest governance and to test the factors that affect their decisions; this makes Bolivia an ideal context for my research. Among the many forest communities in Bolivia, communities that are part of an international network were selected because these communities present conditions that are advantageous to my study.

3.4.2 International Forestry Resources and Institutions Network

International Forestry Resources and Institutions (IFRI) is an international research program that examines the relationships among forest users, governance, and resource outcomes. Through an understanding of how governance arrangements affect forests and the users who depend on the resources, IFRI researchers can provide evidence-based findings to inform policy-making (The Ostrom Workshop, 2008). IFRI applies an interdisciplinary approach to studying human-natural relationships; it uses 10 research methods and instruments (see Appendix 2 for a summary) to collect information from forest users and to obtain biological data from the forests. All data are entered into a Microsoft Access database for analysis and sharing among IFRI researchers and affiliates (IFRI, 2008).

The primary unit of analysis for an IFRI study is a research site. A site must contain a forest at least 0.5 hectares in size, and must have at least three households using the forest. Each set of the 10 instruments addresses one aspect of the forest, the forest users, or the relationships between the two. The research techniques used to collect social data from forest users include participant observation, focus group discussion, structured and semi-structured interviews, and process tracing. Data on hundreds of variables are collected, and eight of the 10 instruments are used to capture the social data.

To collect the biological data on the forests, IFRI applies a random plot sampling technique. At least 30 plots should be sampled at each research site. For each plot, data collection in the first 1-meter radius circle captures the occurrence of the woody seedlings and herbaceous groundcover. In the second 3-meter radius circle, researchers collect data on the identity, count, diameter at breast height (DBH), and height of shrubs, saplings, and woody and herbaceous climbers with stems between 2.5 and 10 centimeters in diameter. In the third 10-

meter radius circle, researchers collect the same information as in the 3-meter radius circle, but only for stems that are greater to or equal to 10 centimeters in DBH. A forester's appraisal of the overall forest condition is also included. This biological information is used to complete the remaining two of the 10 research instruments.

In order to carry out such extensive social and biological data collection, IFRI trains and works with local institutions called Collaborating Research Centers (CRCs), which are interested in learning and knowledge sharing. Twenty-two CRCs are part of the IFRI worldwide network. Bolivia's CRC is called the Centro de Estudios de la Realidad Económica y Social (CERES). CERES is a Cochabamba-based non-profit research institute with over 55 years of experience (CERES, 2013). CERES works with foresters, social scientists, and economists in researching issues related to indigenous rights, natural resource governance, community well-being, rural livelihoods, and development. In the past 16 years, CERES' researchers have been key collaborators with Professor Krister Andersson in many Bolivian forestry studies. As of December 2012, CERES had studied 23 forest communities in Bolivia, and all of these studies were carried out according to the IFRI protocol.

One key advantage of selecting communities from the IFRI network for my research is the ease of getting access to the communities. Members of CERES have maintained close relationships with the communities they visited and have gained the trust of many of the local people. Findings from previous studies have been shared with the communities, and CERES researchers brought back and shared the research results from the latest visit with members of the communities during the fall of 2013 (Andersson & Benavides, personal communication). CERES' connections with the communities and their knowledge of the forests and rural livelihoods make it an ideal collaborator for my research. Furthermore, existing data from these

communities have been collected during previous IFRI visits, so revisiting the same communities makes longitudinal analyses possible. Lastly, by combining my investigation with an IFRI re-visit, funding and other resources can be pooled together to achieve more effective outcomes.

Data from five of the 23 research sites are used for this study. All five communities were visited during the 2006-2008 timeframe for a project called SANREM. Details of the SANREM project are discussed in chapter 4. Two of these five communities were chosen for my own research. These two communities were selected because the local people have been willing to work with us during the specific research timeframe, and it was logistically possible to visit them under our budgetary constraints.

3.5 2012 site visits

I spent three months (May to August) in Bolivia and worked with members of CERES. I visited Caracara and Oropendola, two indigenous communities in the Bolivian lowland forest region. Focusing on indigenous communities for this project has an added benefit because communal land rights have been a customary land management practice. This traditional arrangement creates a bias in favor of common property rights, so any finding signaling resistance to common property rights would indicate that there are significant factors that can even overpower cultural norms. During each visit, we carried out the IFRI data collection. We also conducted a household survey (see Appendix 3 for the actual survey used in Spanish). The household survey included questions about demographic, livelihood strategies, land and asset ownership, forest usage and management activities, and interpersonal relationship. It also contains questions related to my own research such as property rights, risk, and coping strategy options.

At each site, we started with a community meeting to report findings from the last visit and to explain the purpose of the current visit. A CERES field worker and community representatives scheduled these community meetings in advance. Everyone from the community was invited to attend. The meetings were scheduled at a time when high attendance was expected. After the meeting, we met with the community representative(s) independently and collected the names of each household head. For the next several days, the research team attempted to contact all households in order to conduct the household survey. The households that were available and willing to participate were included in the survey. In other words, no random sampling of households was done on either community; rather, a census was performed. In Caracara, 26 of the 51 households were surveyed; one household headed by a young woman who is under the age of 15 was not interviewed. The remaining 24 households either no longer lived in the community or declined to be surveyed. In Oropendola, 19 surveys were conducted out of the 36 households. The 17 missing households were either not reachable or could not communicate effectively in Spanish.

For the community-level IFRI data, we organized several community meetings and small group gatherings to collect information about the local peoples' interactions with their forests. The community meetings openly discussed a wide range of topics in order to build trust between the researchers and the community members. At least 30% of the residents attended the community meetings in Caracara, while almost the whole community attended the meetings in Oropendola. The meetings typically lasted for 1 to 1.5 hours. Small group gatherings were organized to collect more specific information. For instance, some small group gatherings involved only women, who discussed household activities and the use of NTFP. Other small group gatherings involved members of loosely-formed organizations that use particular forest

products for subsistence or to earn cash income. Food was usually served during the community meetings and the small group gatherings to encourage attendance. The IFRI protocol was followed to collect the biological forest data.

3.6 Conclusion

This research design is grounded in the existing literature that links rural livelihoods, risk, property rights, and forest outcomes. As discussed in chapter 2, the importance of forest resources to rural livelihoods has prompted studies of the impacts of community-level risk on forest users' well-being, and the role of property rights in protecting forest users' rights to access and use the resources they rely on. Since risk has a direct effect on forest users' livelihoods, it will affect how they use the forest resource. Subsequently, risk may influence forest users' preferences for certain property rights arrangements in their forests. This study is designed to expand on the research in this area.

A conceptual model was built to connect relevant concepts, and the next four chapters test their interrelationships. Chapter 4 uses quantitative analysis to investigate the relationships among household characteristics, household-level risk, coping strategy options, and forest condition. Chapter 5 applies the SES framework (Ostrom, 2009) to qualitatively analyze factors that facilitate or hinder forest users' collective action in risk management activities. Chapter 6 focuses on changes in the communities, forest conditions, risk, and coping strategy options over time. Also, the PRM technique is applied to perform a comparative analysis of the two communities' risk exposures. Chapter 7 investigates how risk affects the forest users' preferences for different levels of common property rights arrangements.

Findings from this study strengthen our understanding about how rural forest users deal with risk and the role of common property rights in risk management. Results from chapter 4

add to the growing body of evidence that suggests that risk and coping strategy options directly affect rural livelihoods and forest users' dependency on forests. Therefore, identifying ways to assist rural households in dealing with risk could lessen their hardship and reduce the undesirable impacts on the forests. Analysis from chapter 5 provides a window into the process of collective decision-making and actions of forest communities, and deepens our knowledge of forest governance by communities in developing countries. Chapter 6 documents how two rural forest communities evolve over time and the changes that occur in their forests. In addition, this chapter compares and contrasts risk exposure and the coping strategy options used by members of the two communities. These results provide a better understanding of the contextual factors that affect household risk exposure and risk management responses.

McKean (2000) suggests that using common property rights to manage CPR has various advantages. In particular, common property rights are beneficial for forest users when dealing with risk. Chapter 7 tests this argument quantitatively, and the results support McKean's suggestion. This finding indicates that a common property rights arrangement can benefit individual forest users by reducing the costs associated with risk, and it can also lead to improvement of the community and the forests in the long run. Many, if not all, forest users face risk. The knowledge that we gain from studying the Bolivian forest communities' risk management practices can deepen our understanding of their coping strategy options. Coping strategy options that are transferable to other settings can be incorporated into risk management policies and programs that assist other Bolivian forest communities or forest communities worldwide.

Chapter 4

How Does Risk Affect Forest Users? And How Do They Cope?

4.1 Introduction

This chapter presents an analysis of the relationships between risk and forest users. I investigate these relationships at the household level using quantitative analyses. Recall from Chapter 2 that vulnerable households rely more on forests and forest products for daily consumption. Furthermore, they also depend on forests as safety nets in times of adversity, because they have fewer ways to deal with community-level risk than their better-off counterparts do. These households are usually poorer, are headed by women, elderly or less educated people, and have more dependents. Scholars have raised the concern that these peoples' heavy reliance on forests will drive them to consume more, especially as a way to cope with risks. The increased consumption of forest products could worsen the forest condition. As forests keep degrading, the supply of forest products could be reduced while environmental risk could be heightened. Eventually, these people will fall into a vicious cycle – the poverty trap – of vulnerability and impoverishment that is hard to escape.

Yet, the relationship between household-level risk exposure and household characteristics is unclear: Are these vulnerable households more likely to be exposed to household-level risk than their better-off counterparts? Although several case studies have documented that

household characteristics are linked to risk exposure levels (M. R. Carter et al., 2007; Fisher & Shively, 2005; Gentle & Maraseni, 2012; Rayhan, 2010), they investigated mostly economic and environmental risks that affect a wide range of households. The lack of research on the nuances of household-level risks and household characteristics prompts me to address this issue.

Specifically, I examine the relationships between household characteristics and household-level risk using survey data from five indigenous communities. I focus on household characteristics that are associated with a higher dependency on forests – being headed by women or elderly, having more children, or being poorer – but I eliminated the test on education level because the education data are not reliable. Furthermore, I investigate households' responses to household-level risk, and test the relationships between household characteristics and coping strategy options. This test will tell us how successful rural forest households are in dealing with the household-level risks.

I also explore the relationships among risk, coping strategy options, and forest condition. I test how the forest condition reported by forest user is related to the level of risk she encounters and to the coping strategy options she has. Do forest users who face higher levels of risk or have fewer coping strategy options report poorer forest conditions? Understanding these relationships will shed light on how these indigenous forest users use forest resources to deal with risk, and which policies can be implemented to prevent forest users from falling into the poverty trap.

Four Poisson and two logit models are developed to test these relationships. Results from these analyses suggest that the "vulnerable" and the "less vulnerable" households are exposed to different household-level risks. Since risks are vast and diverse, rural households with different characteristics are likely affected by different types of risks. Findings indicate that women-headed households are more vulnerable to personal health risks and risk of crop failure, while

wealthier households or households with more children are likely to be victims of theft or robbery. These results suggest that rural household characteristics are not effective indicators of the likelihood of risk exposure.

Furthermore, the affected households are not helpless in dealing with risk; households facing different types of risk are equally likely to come up with coping strategy options. Findings show that women-headed households and wealthier households will employ self-help strategies and seek assistance from outside sources to cope.

Lastly, the reported forest condition is not related to the level of risk a forest user experiences, rather the number of coping strategy options available to her. Forest users who have more coping strategy options are more likely to report better forest conditions. One way to explain this outcome is that the forest users who have more coping strategy options are less dependent on forest products. Since they are not putting additional stress on the forests, better forest conditions are observed. Another explanation is that forest users who rely on the forest for a safety net tend to better manage the forest during normal times so that the forest can care for them during hardship. This reciprocal relationship between the forest and its users may lead to better forest conditions.

Findings from this chapter improve our understanding of the relationships among household-level risks, coping strategy options, household characteristics, and forest condition in the Bolivian context. The results suggest that risk management programs that focus primarily on the "vulnerable" population are limited. Instead, a broader approach that assists households of various characteristics is preferable. In addition, risk management programs should not only promote risk prevention, but should also advocate coping mechanisms to deal with risk. We could infer that women-headed and wealthier households have more coping strategy options

because they are experiencing more risks and are forced to develop multiple ways to cope. This dynamic presents an opportunity for assistance programs to help the rural forest communities identify and implement non-forest-based coping strategy options. Policies that focus on improving forest users' coping capacity can help them recover more quickly, build resilience against future risks, and develop better forest use and management practices.

4.2 Household characteristics and risks

This chapter focuses on risks that affect only certain households, such as illness, death, theft, robbery, or crop failure. Community-level risks, such as flood, fire or drought, are likely to affect many or all members. Hence, those risks do not contribute to our understanding of the relationships between risks and specific household characteristics

Three research questions guide my analysis of these relationships. First, how does risk exposure differ among households in rural Bolivian forest communities? Empirical findings worldwide support the idea that vulnerable households depend more on forests, especially as safety nets. Also, some studies show that risks such as climate change and economic shocks affect vulnerable households more than the better-off ones. Households that are headed by women or elderly people, have more children, or are poorer are considered to be vulnerable households in general.

For many subsistence families, physical labor is a primary means of obtaining food or money. Given that women and elderly are generally less suited to physical labor than men, they are less likely than men to perform the same type of intensive work (or as much physical work). This shortage of human capital, in turn, reduces the likelihood that women- or elderly-headed families can capture the same level of material capital as families headed by adult men. The lack of sufficient material capital, such as food, fuel, fodder, and clothing, is likely to affect the health

of the household members and their animals. Furthermore, most women and elderly are less likely than men to be able to defend their property. As a result, women- or elderly-headed families are more likely to be exposed to risks like sickness, death or robbery.

The same argument can be applied to families with more children. The need for material capital rises when the number of children increases. A family with more kids likely has a more difficult time finding sufficient material resources than a family with fewer kids and the same number of adult members. Hence, the risks of falling ill or dying may increase. Although some families with more kids may manage to increase their material capital holdings, children are less capable of safeguarding their belongings. Since children in developing countries are always given the responsibility to guard and care for small livestock, they can become easy targets for intruders who want to steal or rob. Therefore, the risk of robbery is likely to rise for families with more kids.

Poorer households may encounter more risks simply because they consistently fall short in obtaining a sufficient amount of material capital to sustain their livelihoods. These poorer families have fewer household belongings, so they are less likely to be robbed; however, a shortage of basic materials can leave them vulnerable to frequent illness or even death. These threats that arise due to a lack of material capital prompt my second research question: How do coping strategy options differ among these households? Empirical studies have discovered that vulnerable households are less able to cope with risks, which suggests that the availability of coping strategy options is related to household characteristics. For instance, loans are not available to women or the poor in Uganda (Debela et al., 2012). The relationship between household characteristics and availability of coping strategy options can be explained as follows: Risk and coping strategies act as two forces pulling a household in different directions. On one

hand, risk – or to be more specific, the harmful effects from realized risks – pushes the household toward a higher level of vulnerability. On the other hand, coping strategies, which help to mitigate the harmful effects of risks, pull the household back to the original state, or at least closer to the original state. So the more coping strategy options a family has to cope with risks, the less likely that the family is to remain in a compromised state. If higher risk exposure is linked to the lack of material capital that is associated with specific household characteristics, the availability of coping strategy options may also be related to these same household characteristics. In other words, households that are headed by women or elderly, have more children, or are poorer may have fewer coping strategy options available to them.

The third research question is: How do risk exposure and availability of coping strategy options influence forest condition? On one hand, it is possible that a higher level of risk and/or a lack of coping strategy options drive forest users to exploit the forest resources and degrade the forest condition. On the other hand, a high dependency on the forest for sustaining livelihoods and as safety nets may encourage forest users to take better care of the forest, leading to better forest conditions. The last part of this chapter will explore these two competing scenarios.

4.3 Approach

The dataset used to analyze the relationships between risk and household characteristics was obtained through a project under the Sustainable Agriculture and Natural Resources Management Collaborative Research Support Program (SANREM)[2]. One of the main purposes of this SANREM project was to analyze the effects of decentralization and land tenure reforms

[2] *Funding for the Sustainable Agriculture and Natural Resources Management Collaborative Research Support Program (SANREM) was provided by the United States Agency for International Development (USAID) under terms of Cooperative Agreement Award number EPP-A-00-04-00013-00 to the Office of International Research and Development at Virginia Polytechnic Institute and State University.*

on indigenous communities and their forests. The SANREM project selected five communities in Bolivia (Figure 4.1) from the IFRI database for analysis. Communities from the IFRI database are ideal candidates because the local forest users are familiar with the researchers from CERES, our Bolivian research partner, and are more receptive to answering survey questions.

These five communities were selected from the IFRI Bolivian sites because they are indigenous communities. Also, they are all located in the lowland forest region, so ecological differences affecting forest resource availability and usages are minimized. Finally, revisits to these communities were planned to collect longitudinal data for comparative analyses for IFRI. By combining the SANREM project with the IFRI revisits, our colleagues in Bolivia could better utilize their time and resources. With one single visit to each of the five communities, our colleagues not only collected the community-level data and the forest mensuration data, as per the IFRI protocol, but also the household-level data for performing the SANREM analyses.

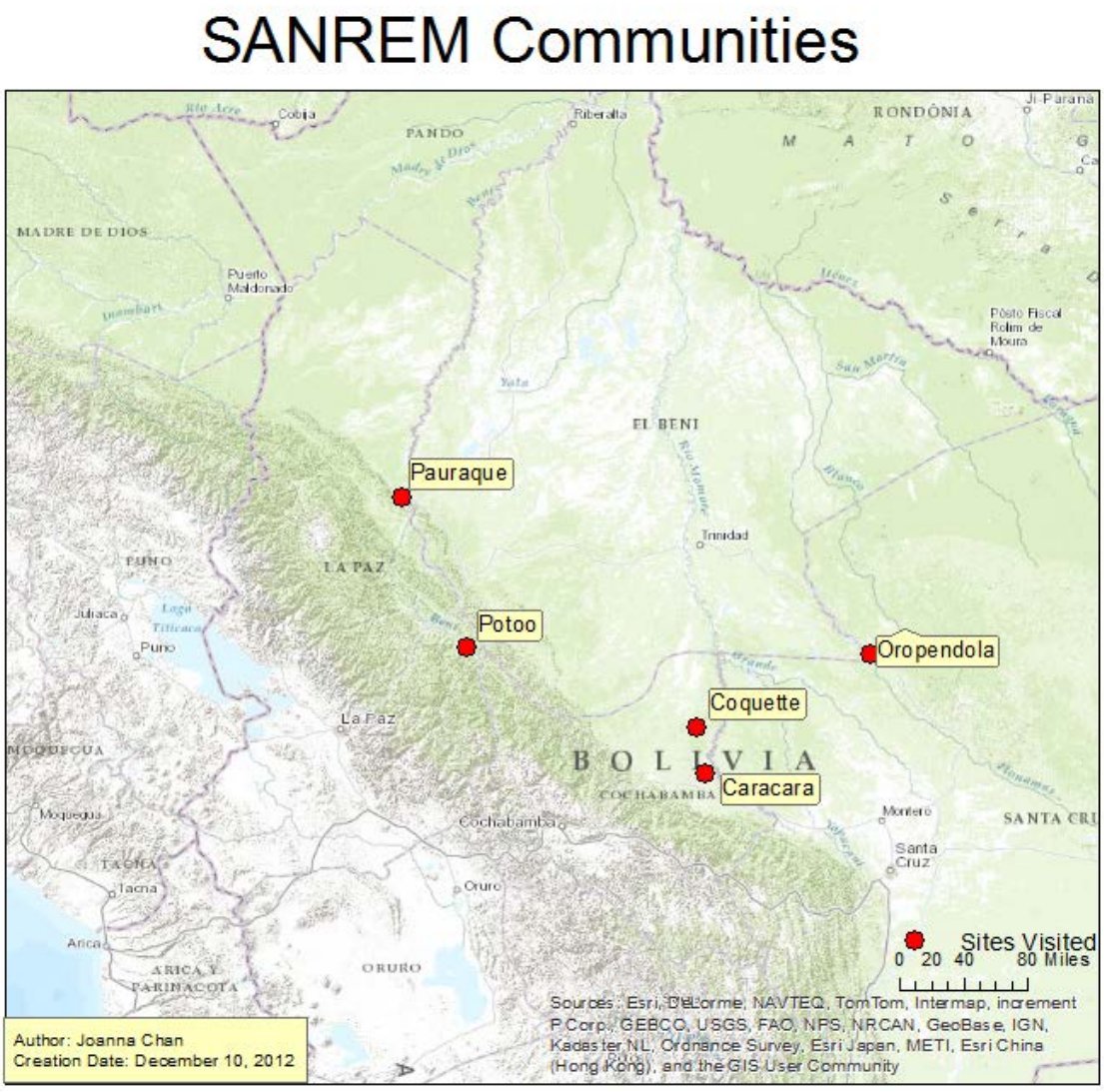

Figure 4.1 Map of the SANREM project indigenous communities

My analysis uses the household-level data from the SANREM dataset. These data were collected through a household survey (Appendix 1) done between 2006 and 2008. This survey covers a range of topics – from household well-being to livelihood strategies to forest governance. During their visits, the CERES researchers made a list of all of the households in each community, and attempted to survey all households. They completed a total of 126 household surveys. This number represents all households in the five communities that were available and willing to do a survey. The survey results I focus on include demographic data, the

respondents' responses to crisis in the past 12 months, and all of the coping strategy options they used.

4.3.1 Overview of the communities

Subsistence farming is the primary livelihood strategy for the majority of people in these five indigenous communities. Sixty-two percent of respondents ranked agricultural activities as the most important sources of subsistence and cash income. Seven percent cited forest products as the most important source of subsistence and cash income, and 5% of respondents ranked wages and income from trade as their most important income sources.

Logging was encountered in all five communities. "Outsiders" or early settlers who moved into the areas conduct most of the logging activities, and clashes and conflicts were frequently reported. As of 2008, four of the five communities had formed their own forest management committees, seeking to obtain recognition of their collective property rights to the forests; Pauraque was the only community that did not report the formation of a forest management committee. Indigenous peoples' collective property rights over their ancestral lands were recognized by a state land law under the category of "community land of origin." This law grants access, use, and exclusion rights to the recognized indigenous communities. In addition, indigenous communities are given certain management rights.

All five indigenous forest communities practice mixed property rights arrangements that assign individual lots – lot sizes vary among communities – to members of the community, while managing the remaining forest as common property. The individual lots are used primarily for agricultural purposes, though some small-scale logging activities were reported. The communal part of the forest is accessible to all members of that community. Members use the communal forest mainly for hunting, and also for collecting fuelwood, building materials, and non-timber

forest products (NTFP). In some cases, the forest management committee of the community permits logging and commercial timber trading in the communal forest. Usually, cash income from logging is used for community improvement activities. Table 4.1 presents some key descriptive statistics of the five communities collected from the 2006/2008 visits.

Community	*Population*	*Number of households*	*Ethnicity*	*Surveys conducted*
Oropendola	174	25	Guarayo	22
Pauraque	89	16	Quechua	16
Potoo	120	23	Mosetén-Trinitaria	23
Caracara	184	36	Yuracaré	29
Coquette	253	53	Yuracaré	36

Table 4.1 Descriptive statistics of the SANREM communities

All five forests are lowland tropical forests; they vary in species and sizes, but the residents use similar products from these forests. The most common products used are chocolate, timber, and firewood. A list of all identifiable species is shown in Appendix 4. Table 4.2 presents some key descriptive statistics of the five forests. Forest mensuration data were obtained through forest plot surveys conducted in accordance with IFRI protocol; the number of plots surveyed appears in the third column of Table 4.2. The 'Stem count', 'Species count' and 'Median and Mean Diameter at Breast Height (DBH)' were obtained by analyzing the forest mensuration data. 'Tree density' is 'Stem count' divided by the size of the forest area surveyed; recall that each IFRI plot has a 10-meter radius, so the size per plot is approximately 314 square meters. 'Tree diversity' was calculated using a species count sampling technique (Wills et al., 2006) that calls for determining a sample size, randomly selecting samples from the population, and counting the number of different species in that sample. Multiple rounds of sampling are required to normalize the result. The 'Tree diversity' index was calculated by averaging the number of different species counted in all the rounds. For my analysis, I used a sample size of

100. For each community, I selected 100 stems randomly and count the number of different species within that sample. One thousand rounds of sampling are done for each community, and the averages are then calculated.

Community Name	*Forest Size (ha)*	*Plots Surveyed*	*Stem Count*	*Species Count*	*Median DBH (cm)*	*Mean DBH (cm)*	*Variance (cm)*	*Tree density (per ha)*	*Tree diversity*
Oropendola	691	38	607	98	13	16	271	508	34
Pauraque	242	41	687	129	15	20	432	533	46
Potoo	504	42	653	143	15	21	376	495	48
Caracara	1523	95	2211	291	13	17	277	741	52
Coquette	15222*	213	2387	172	14	21	1899	357	49

*Missing 2006/2008 data, 1995 data used

Table 4.2 Descriptive statistics of the SANREM forests

Of the five communities, Pauraque is the smallest, with the fewest households and the smallest forest. Coquette is the largest, with almost three times the population and 63 times the forest size of Pauraque. Coquette is much larger than the others because it consists of six smaller settlements where local people use their forests in a cooperative manner.

All five forests have mean DBH larger than median DBH; this indicates that all forests have a higher number of smaller trees than big trees. Both Oropendola and Caracara have smaller trees than the other three communities, but their trees have less variance in size. Coquette has the most variations in stem sizes among the five communities; its trees are the least dense but very diverse.

4.3.2 Analysis and results

In the household surveys, forest users in the five communities identify seven types of risks: (1) Crop failure, (2) Illness, (3) Death, (4) Loss of land, (5) Loss of livestock, (6) Loss of

major asset, and (7) Other. This list of risks is compiled from the survey questions asking the respondents to describe crises they had encountered in the past 12 months. The risks encountered and the exposure levels to risk vary among communities. Table 4.3 shows the breakdown of each risk by community; the percentages are calculated by dividing the individual risk counts by the number of responses.

Risk	*Community*					*Total*
	Oropendola	*Pauraque*	*Potoo*	*Caracara*	*Coquette*	
Crop failure	11 (50%)	12 (75%)	10 (43%)	17 (59%)	36 (100%)	86
Illness	12 (55%)	13 (81%)	14 (61%)	12 (41%)	9 (25%)	60
Loss of major asset	4 (18%)	2 (13%)	1 (4%)	2 (7%)	4 (11%)	13
Loss of livestock	1 (5%)	3 (19%)	2 (9%)	6 (21%)	0	12
Loss of land	1 (5%)	2 (13%)	1 (4%)	3 (10%)	1 (3%)	8
Death	1 (5%)	1 (6%)	3 (13%)	0	1 (3%)	6
Other	10 (45%)	3 (19%)	6 (26%)	8 (28%)	3 (9%)	30
N	22	16	23	29	36	

Table 4.3 Risk exposure by community matrix

Crop failure is the most common risk, and it has affected all of the households of Coquette. Illness is the second most reported risk; it affects over 80% of the households in Pauraque. On the other end of the spectrum, death is the least reported risk with only six instances recorded.

Respondents also reported which coping strategy options they used to deal with each risk. Identifying coping strategy options is a follow-up question, so if a respondent had not experienced any risk, no coping strategy options were recorded. The survey results indicate that

forest users employ 12 strategy options: (1) Harvest more forest products, (2) Harvest more wild foods not found in the forest, (3) Harvest more farm products, (4) Spend cash savings, (5) Sell assets (land, livestock, etc.), (6) Do extra casual labor, (7) Help from friends or relatives, (8) Help from NGO, community organization, religious organization, etc., (9) Get loan from money lender, credit association, etc., (10) Reduce household spending, (11) Did nothing in particular, and (12) Other. Coping strategy options, like risks, also vary among communities. Table 4.4 shows the breakdown of each coping strategy option by community; the percentages are calculated by dividing the coping strategy option counts by the number of risk responses.

Coping strategy option	*Community*					*Total*
	Oropendola	*Pauraque*	*Potoo*	*Caracara*	*Coquette*	
Did nothing	13 (33%)	15 (42%)	12 (32%)	28 (58%)	11 (20%)	79
Spend cash savings	7 (18%)	12 (33%)	11 (30%)	7 (15%)	3 (6%)	40
Harvest more forest products	8 (20%)	0	4 (11%)	3 (6%)	25 (46%)	40
Help from friends or relatives	1 (3%)	1 (3%)	5 (14%)	0	6 (11%)	13
Get loan	0	2 (6%)	0	2 (4%)	6 (11%)	10
Do extra casual labor	1 (3%)	0	3 (8%)	3 (6%)	1 (2%)	8
Harvest more farm products	7 (18%)	0	0	0	0	7
Other	3 (8%)	0	1 (3%)	2 (4%)	1 (2%)	7
Reduce household spending	0	2 (6%)	1 (3%)	2 (4%)	1 (2%)	6
Sell assets	0	3 (8%)	0	0	0	3
Harvest more wild foods	0	0	0	1 (2%)	0	1
Help from NGO, etc.	0	1 (3%)	0	0	0	1

Table 4.4 Coping strategy options by community matrix

According to the survey results, the most common response to deal with the harm from risk is to do nothing. Since 'Did nothing' cannot be considered a coping strategy, these responses are removed from the valid strategy count in the later analyses. Among the valid coping strategy options, harvesting more forest products and spending cash saving are the most popular responses. The least used coping strategy options are harvesting more wild foods and getting help from NGOs, community organizations, religious organizations, etc.

In order to compare how well each community deals with risks, I calculate the 'copability index' by dividing the number of valid strategy options by the total risk count. A community with a higher copability index has members who are more capable of coping with risks than a community with a lower index. Based on this calculation, the people of Coquette are the most capable of coping with risks, while the people of Caracara are least capable. Table 4.5 shows the results of each community.

Community	*Risks count*	*Valid strategy options count**	*Copability index*
Oropendola	40	27	0.68
Pauraque	36	21	0.58
Potoo	37	25	0.68
Caracara	48	20	0.42
Coquette	54	43	0.80

* 'Did nothing' is not counted as a valid strategy

Table 4.5 Table of risks and strategy counts, and copability index

To understand risk exposure and availability of coping strategy options at the household level, four hypotheses are developed. They test the relationships between (1) household characteristics and risk exposure level, (2) household characteristics and availability of coping strategy, (3) risk exposure level and forest condition, and (4) availability of coping strategy options and forest condition. The unit of analysis for this section is the household. The hypotheses are stated as follows:

H1: Households that are more vulnerable to community-level risk are likely to experience more household-level risk
H2: Households that are less vulnerable to community-level risk are likely to have more valid coping strategy options to deal with household-level risk
H3: Households that are exposed to more risk are likely to report poor forest condition
H4: Households that lack coping strategy options are likely to report poor forest condition

For H1, the dependent variable (DV) is the number of risks reported by the household. This is a count variable, and it is calculated by summing all the risks a respondent reported. The independent variable (IV) is household vulnerability to community-level risk. Four proxy measures are used to measure vulnerability: The first proxy is the age of the household head. The second is the gender of the household head. The third is the ratio of the number of children under 15 to the number of adults in the household (a higher ratio means that the household has more children than adults and, therefore, a higher level of vulnerability). The fourth proxy is the household income. However, since income data were not captured in the survey, the size of a household's cropland functions as a proxy for income. Recall that 62% of respondents reported that agricultural activities are the most important source of income; therefore, I infer that the more cropland a household owns, the more income that household is likely to capture.

For H2, the DV is the number of valid coping strategy options used by the household. This is also a count variable, and it is calculated by summing all the valid coping strategy options a respondent said she used to deal with risks. Valid coping strategy options are the 12 strategy options mentioned above, excluding 'Did nothing.' The IV of this hypothesis is also household vulnerability; hence, the same four proxy measures as in H1 are used.

H3 tests if a higher level of risk exposure will lead to a higher consumption on forest products to cope, thus affecting the forest condition negatively. The DV for H3 is the household's report of the forest's condition. This is a binary variable and is collected by asking each survey respondent her opinion of the forest condition. If the respondent indicated that the

forest is dense or very dense, a positive value is recorded in the good forest condition indicator. Otherwise, a negative value is recorded in the good forest condition indicator. "Dense" reflects the perception of the respondents as they compare their forest to other forests nearby or the changes of the forest condition over time. The IV is the number of risks reported by the household; this IV is the same count variable that is used as the DV in H1.

H4 tests if fewer valid coping strategy options will lead to a higher consumption of forest products to cope, thus affecting the forest condition negatively. The DV for H4 is the same binary variable used in H3, i.e. the variable indicating the household's report of a good forest condition. The IV is the number of valid coping strategy options used by the household; this IV is the same count variable that is used as the DV in H2. Table 4.6 presents a summary of the hypotheses and variables.

Hypothesis (simplified)	*DV*	*IV/proxy measures*
H1: ↑ vulnerability to community-level risk → ↑ risks exposure to household-level risk	Count of risks encountered	1. Age of household head 2. Gender of household head 3. Child to adult ratio 4. Size of cropland
H2: ↓ vulnerability to community-level risk → ↑ coping strategy options availability to deal with household-level risk	Count of valid coping strategy options	1. Age of household head 2. Gender of household head 3. Child to adult ratio 4. Size of cropland
H3: ↑ risks exposure → poor forest condition	Good forest indicator	Count of risks encountered
H4: ↓ coping strategy options → poor forest condition	Good forest indicator	Count of valid coping strategy options

Table 4.6 Summary of hypotheses and variables for testing risks at the household level

Table 4.7 shows the summary statistics that allow us to compare household characteristics across the five communities; the table presents data for age and gender of the household head, child to adult ratio, cropland size, and the perception of the forest. Caracara has the highest percentage of women-headed households (14%), while Pauraque has none. The

highest average age of a household head is 43; this average age is the same in Pauraque, Potoo and Coquette. Caracara has the lowest average age. By far, Oropendola has the largest number of children under 15. Potoo households, on the other hand, have the fewest children under 15. The average cropland size in Pauraque (6.91 hectares) is over five times larger than the average 1.32 hectares owned by Caracara residents.

Community	*Number of women-headed households*	*Average age of household head*	*Average number of children under 15 per household*	*Average cropland size (hectares)*	*Number of household reported forest as good*
Oropendola	3 (14%)	39	4.68	6.3	9 (41%)
Pauraque	0	43	2.5	6.91	7 (78%)
Potoo	1 (4%)	43	2.04	3.43	10 (77%)
Caracara	4 (14%)	36	3.21	1.32	7 (28%)
Coquette	3 (8%)	43	2.44	3.03	12 (38%)
Combined	11/126 (9%)	41	2.94	3.87	45/101 (45%)

Table 4.7 Summary statistics of household characteristics

Local users have very different perceptions of their forests. Pauraque's residents have the most positive perception of their forest, with 78% of respondents ranking their forest's condition as good. Residents of Caracara are the most pessimistic about their forest; just 28% of people considered the forest to be in good condition. Recall from Table 4.2, which presents IFRI plot data, that Caracara has the most diverse forests and the highest density, but only 28% of Caracara's residents rate their forest as good.

Across all the survey responses, 9% of households are headed by women, and the average age of the household head is 41. On average, each household has 2.94 children under the age of 15. The average cropland size is 3.87 hectares for each household. Finally, 45% of residents consider their forests to be in good condition.

Poisson regressions are used to test H1 and H2, Poisson is appropriate for testing these two hypotheses because the DVs are count variables. Four Poisson models are developed to test H1. The first model (Model 1) looks at all the seven risks. Due to the likely correlation between cropland size and land-related risks, Model 2 is built to consider only the risks that are not related to land size. In other words, 'Crop failure' and 'Loss of land' are not counted in the DV of Model 2. Furthermore, I am interested in testing risks that are likely to be caused by the actions of other people, and therefore could affect the level of trust among community members. Model 3 measures all the risks that resulted in loss of household belongings. Specifically, only 'Loss of land,' 'Loss of livestock,' and 'Loss of major assets' are included in the DV in this model. Finally, I build a model for testing H2, i.e. the availability of valid coping strategy options and household vulnerability. Regression results from all four models are shown in Table 4.8.

	Risks			*Have valid coping strategy options*
	Model 1: All risks	*Model 2: Non-land risk*	*Model 3: Loss of belongings*	
Women household head	1.347* (0.240)	1.586* (0.407)	0.710 (0.701)	1.458** (0.238)
Age of household head	1.002 (0.004)	0.998 (0.005)	1.006 (0.013)	0.995 (0.004)
Child to adult ratio	1.049 (0.044)	1.045 (0.068)	1.399** (0.223)	0.994 (0.058)
Size of cropland (hectares)	1.022** (0.006)	1.034** (0.008)	1.050** (0.022)	1.025** (0.011)
N	121	121	120	114

Notes: Coefficients are displayed as incidence rate ratios (IRR). Standard errors are in parentheses[3]

* significant at 10% ** significant at 5%

Table 4.8 Poisson regression models for testing risks at household level

[3] *All four models pass the goodness-of-fit Chi2 test, which indicates that these Poisson models are fit for testing the corresponding data.*

Model 1 shows that women-headed households and cropland size have a significant correlation to all kinds of risk exposure. According to the incidence rate ratio (IRR), a women-headed household is 1.347 times (an increase of 34.7%) more likely to experience any one of the seven risks than a male-headed household. In addition, the likelihood of experiencing a risk is 2.2% higher with each additional hectare of cropland. Model 2 produces similar findings; a women-headed household has a 58.6% higher exposure to all the non-land-related risks than a male-headed household. For each additional hectare of cropland, the likelihood of realizing a non-land-related risk is 3.4% higher. As for risks that are related to loss of belongings (Model 3), a unit increase in the child-to-adult ratio raises the risk exposure by 39.9%. For each additional hectare of cropland, the likelihood of experiencing a risk that results in loss of belongings is 5% higher.

A women-headed household is 45.8% more likely to have coping strategy options than a male-headed household. Furthermore, the likelihood of finding valid coping strategy options increases by 2.5% with each additional hectare of cropland. To further understand which coping strategy options are used by the two different groups – the women-headed households and the wealthier households – correlations between household characteristics and their likelihoods of using one of the 11 strategy options are analyzed. Results suggest that wealthier households are more likely to harvest more farm products, sell assets, and get help from external organizations. The significant correlations are 0.35, 0.32 and 0.23, respectively. The women-headed households are more inclined to spend cash savings and get help from friends or relatives. The significant correlations are 0.26 and 0.19, respectively. No correlation is found between harvesting more forest products and household characteristics. In other words, data from the

study area show that better-off households are as likely as the "vulnerable" ones to use forest products to cope.

To test H3 and H4, a logit regression model is used, and the results are displayed in Table 4.9. This model shows that the number of risks encountered by a respondent does not significantly affect her report of the forest condition. However, the number of valid coping strategy options she has to deal with risks does significantly affect her report of the forest condition. For each additional valid coping strategy available to her, the odds of her rating the forest condition as good increase by 2.137 times.

	Reported good forest condition
Number of risks encountered	0.733 (0.199)
Number of coping strategy options to deal with risks	2.137** (0.715)

Notes: Coefficients are displayed as odds ratios. Standard errors are in parentheses
* significant at 10% ** significant at 5% n=101

Table 4.9 Logit regression model for testing perspective of forest condition

To predict how the availability of coping strategy options affects forest condition, I translated the log odds from the logit model into predicted probability, based on the number of valid coping strategy options reported by the respondents (Table 4.10). The calculations show that a forest user who experiences some risks but has no coping strategy option has only a 26% chance of reporting the forest condition as good, when holding the number of risks encountered at mean. When a forest user has one coping strategy option to deal with risks, there is a 43% chance that she reports the forest condition as good, also holding the number of risks encountered at mean. This difference between having one strategy versus no strategy is a 17-point change towards a positive report of forest condition. With the highest number of reported coping strategy options available to her, i.e. five coping strategy options, the chance that she reports the forest condition as good is almost 94%, again holding the number of risks

encountered at mean. These results show that the availability of coping strategy options is highly significant, and that it influences the forest's condition as reported by the forest users.

	Predicted probability of reporting forest condition as good
Does not have any coping strategy option	0.2592 (0.0992, 0.4193)
Has one (1) coping strategy option	0.4279 (0.3274, 0.5285)
Has two (2) coping strategy options	0.6152 (0.4471, 0.7833)
Has three (3) coping strategy options	0.7736 (0.5452, 1.0020)
Has five (5) coping strategy options	0.9398 (0.7936, 1.0860)
Notes: 95% confidence intervals are in parentheses	

Table 4.10 Predicted probabilities of coping strategy on forest condition

Further analysis shows that the types of strategy options used by the respondents have no correlation with the forest condition reported. Whether or not a forest user harvests more forest products to cope has no influence on her report of the forest condition. This dataset does not offer support for the possibility that a forest user's reliance on forest products to cope affects her view of the forest condition.

4.4 Discussion

The SANREM dataset provides a window into these five indigenous forest communities in Bolivia. These communities vary in size, population rates, forest conditions, and household composition. However, they all have experienced land disputes with outsiders, and the residents are exposed to similar risks that affect their well-being and livelihoods. In addition, most of these forest users lack valid coping strategy options for dealing with risks, so they often do nothing when they realize harm from risks. When they do respond, most of them rely on harvesting more forest products in order to cope. Despite their dependence on forests and forest products, forest conditions reported by these respondents vary widely.

My first research question examines how household characteristics and household-level risks are related. Findings indicate that wealthier households with more cropland have experienced more risk than households with fewer hectares. Furthermore, wealthier households, particularly those with more children, are the preferred targets of thieves and robbers, so they are more vulnerable to risks that result in a loss of belongings. Women-headed households have experienced more risks related to health issues and crop failure, but they are less likely to become victims of theft or robbery. This outcome is consistent with the locals' belief that a household without a productive adult male is considered "poor." This perception of a "poor" family may drive away thieves or robbers because such a family may have fewer items to steal, or because people believe that it should not be further victimized by any individual's actions. Finally, the age of the household head does not affect the exposure to household risks. Due to the different natures of various types of risks, households with certain member compositions are more vulnerable to certain risks. The hypothesis that households with characteristics that make them more vulnerable to community-level risk will also make them more vulnerable to household-level risk is not fully supported by findings form this dataset.

The second research question focused on the relationship between household characteristics and coping strategy options, results show that when there is a need to find coping strategies to deal with risks, women household heads and wealthier households are more likely to be successful. The fact that women-headed households have more coping strategy options is consistent with a previous finding that women are able to identify more livelihood diversification strategies (Debela et al., 2012). Although the wealthier households are exposed to more risk, they are not necessarily more vulnerable because these households can find ways to cope, and their economic condition may help them smooth out the harmful impact of adverse events that

are likely to happen more easily. The choices of coping strategy options differ between the two groups, but both groups have used self-help alternatives and sought assistance from outside sources.

One plausible explanation for the high number of coping strategy options observed in these two groups is that they have been encountering more risks. It is likely that higher risk exposure drives them to identify more coping strategy options. As a result, these two groups are likely to report higher availabilities of valid coping strategy options. This finding supports a previous finding (Debela et al., 2012) showing that households that had experienced above-average losses tended to come up with more diverse sources of income. Based on this result, I argue that households that face more risk are more motivated to find valid coping strategy options, and they are capable of doing so regardless of their household characteristics.

The third research question asked how forest conditions are influenced by users' exposure to risk and by the number of valid coping strategy options they have. The findings suggest that reports of good forest conditions are highly affected by the availability of valid coping strategy options, but not by the level of risk exposure. If a forest user has more valid coping strategy options to deal with risk, she is more likely to report the forest condition favorably, regardless of how much risk she encounters. This is possible that if forest users do not rely too heavily on forest products to deal with realized harm, the forest is better preserved. It is also possible that users who depend on forests as safety nets take better care of the forests during normal times so they can safely rely on the forest during hardship. Both scenarios can lead users to report better forest conditions.

The results from this analysis suggest that risk management programs should broaden their coverage to assist households with diverse characteristics. Aid programs should also help

identify, implement, and promote non-forest-based coping strategy options. My policy recommendations, outlined in more detail in chapter 8, suggest that rural risk management should aim to help forest users recover more quickly from setbacks, build their resilience against future risks, and foster conditions for better forest outcomes.

Chapter 5

What Drives Forest Users To Act Collectively In Dealing With Risk?

5.1 Introduction

This chapter explores the conditions that motivate forest users to self-organize and act collectively in dealing with community-level risks. My analysis compares data from two indigenous forest communities – Caracara and Oropendola – using a qualitative approach. Members of multiple households may sometimes work collectively to manage risk. For instance, they may develop monitoring routines to jointly guard their forests, or they may share food in a reciprocal manner during hard times (Axelrod & Fuerch, 2006; Banks, 2003). Recall that community-level risks refer to risks that affect many (or all) of the households of a community; therefore, the household-level characteristics discussed in chapter 4 play a lesser role in influencing the likelihood of risk exposure. When faced with similar levels of exposure and similar resulting harm, members of a community who act collectively to manage community-level risk can yield better outcomes for the entire group. This suggests that collective risk management can benefit all the individuals involved and should be preferred by community members. Nonetheless, there are barriers that discourage individuals from self-organizing and acting collectively. Applying the Social-Ecological System (SES) Framework (Ostrom, 2009), I used data collected from my field visit to analyze the collective risk management activities

performed by the two forest communities. This analysis focuses on the communities' collective actions, their outcomes, and the barriers to acting collectively.

Both Caracara and Oropendola have experienced natural disasters such as flooding and drought. Both communities also experience intrusions from outsiders who illegally harvest their trees and occupy their land, market pressures to extract more timber from their communal forests, and pressure from population growth. Members of both communities have to struggle with certain levels of elite capture. In order to deal with some of these risks, and to benefit from forestry activities, both communities have obtained their legal land rights and developed Forest Management Plans. Nevertheless, the outcomes in the two communities are quite different due to the variations in social and environmental conditions.

By examining the relationships among members of the two communities and between forest users and their environment, I discover that market exposure has dramatically changed the dynamic between the residents of Caracara and their forest. Access to markets increases demand for timber extraction, offers different mechanisms to deal with risk, makes the forest more accessible to intrusion through the improved road systems, and reduces the importance of forests for sustaining users' livelihoods. Furthermore, the influx of outsiders dilutes the indigenous identity of the people of Caracara and weakens their desire to retain their traditions and norms of forest management. More importantly, Caracara is located in the region where coca production is blooming, and the financial incentive from coca trading has motivated many locals to convert forests into coca farms. All of these changes reduce the likelihood that forest users will act collectively to manage risk or to protect their forest. This finding aligns with other case studies' findings: market access increases timber extraction (Mamo et al., 2007); market intervention

reduces the likelihood of successful collective action (Acharya, 2005); and proximity to roads weakens the community's desire to engage in collective forest management (Tucker et al., 2007).

Another key factor that hinders collective action in Caracara is past failure in achieving the expected results when acting collectively. Although Caracara has established community rules to distribute forestry revenue evenly among members and to appropriate funds towards community improvement projects, these rules have not been enforced. Violations are usually committed by a group of local elites who are so powerful and influential that other community members tend not to openly raise any objections to their decisions and activities. Thus, the lack of transparency in decision-making and the failure to capture any benefits from past collective actions definitely discourage many members from trying.

In Oropendola, community members report a much lower level of elite capture, and the community is able to enforce the rules that are established collectively. Also, past collective activities have improved living conditions in Oropendola, and have allowed community members to share the financial benefits from forestry and to develop a long-term plan to ensure the sustainability of their forest. Furthermore, the competent leadership of the Oropendola Chief, a relatively egalitarian relationship among community members, a strong cultural identity, and an ongoing reliance on the forest contribute to community members' shared goal of being forest stewards. Since the people in Oropendola have acted collectively in the past and have yielded positive results, it is likely that they will continue to engage in future collective actions. Comparing the conditions and collective risk management activities of these two communities deepens our understanding of the conditions that favor collective action.

5.2 The Social-Ecological System (SES) framework

A framework is a tool that helps identify the different variables relevant to the analysis, categorize them into logical groups, and connect the groups according to their relationships. By analyzing the relationships among the variables or the groups, we can evaluate the underlying theories that explain the relationships, and generate hypotheses for testing them (Ostrom, 2005). The Social-Ecological System (SES) framework is commonly used to analyze collective action on CPR (Figure 5.1). The SES framework was developed by Ostrom (2009) and has been enhanced by scholars from The Vincent and Elinor Ostrom Workshop in Political Theory and Policy Analysis at Indiana University. I use the version presented by McGinnis (2010), which summarizes the changes over the years.

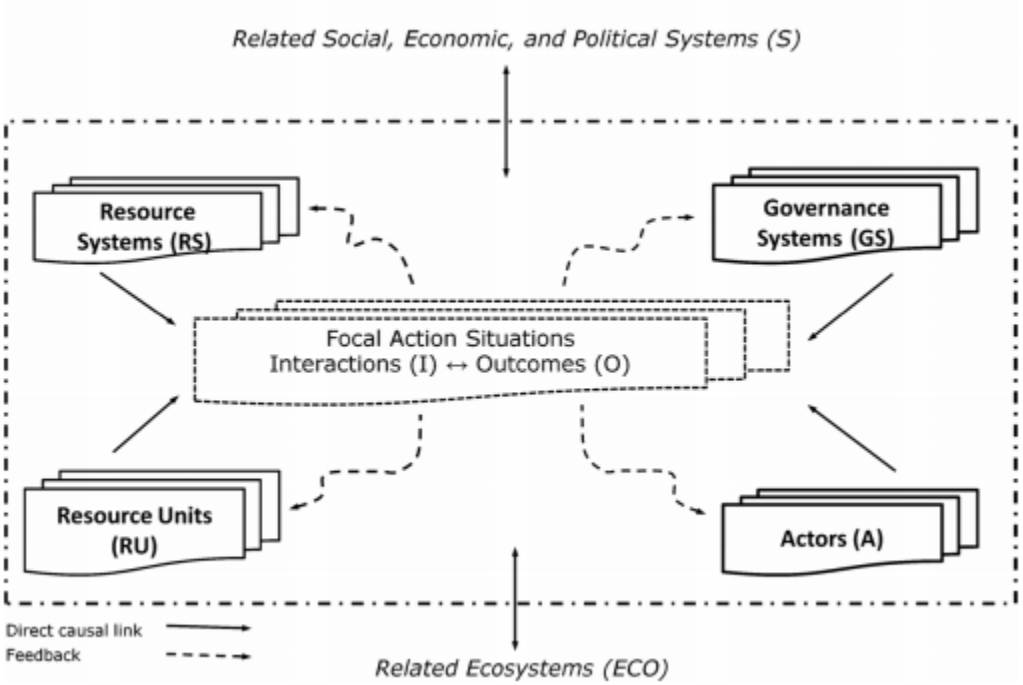

Figure 5.1 Revised SES framework. Source: Cox (2011)

SES "is an ecological system intricately linked with and affected by one or more social systems" (Anderies, Janssen, & Ostrom, 2004). In a SES, both the social and the ecological systems contain units that interact independently. Additionally, both systems may contain

interactive subsystems with interdependent relationships. The SES framework is intended to identify relevant variables, map their linkages, and organize the relationships of a SES. The SES framework consists of four subsystems, also known as first-tier components. The first subsystem is the Resource System, which refers to the overall physical entity of a resource such as a coastal fishery, a protected wildlife park, or a forest. The second subsystem is the Resource Units, which are the elements that made up the resource system. Examples of resource units are lobsters (in a coastal fishery), animals (in a protected wildlife park), and trees (in a forest). The third subsystem is the Governance System, which refers to organizations and rules that govern the use of the resource system and the extraction of the resource units. A governance system can be as grand as a multinational treaty like the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), or as limited as the informal rules specified by a village chief. The fourth subsystem is the Actors who have access to the resource system. All four subsystems are interrelated, so changes to any one of them will affect the others. These interrelationships are presented as Interactions & Outcomes in Figure 5.1. For example, a group of actors who decides to cut more firewood reduces the number of trees available in the communal forest. The decrease in tree stock prompts the village chief to limit the amount of firewood allowed for each family in order to reduce overconsumption. In this example, the interaction is the excessive harvesting by the users, which reduces the number of available trees; the outcome is the establishment of the informal rule by the village chief to remedy the situation.

Broader Social, Economic, and Political Settings—demographic trends, the developmental stage of the place where the resource system is located, and the political climate for enforcing the established rules and regulations—also influence the SES. Furthermore, the

Related Ecosystems in which the SES is embedded also affect the outcomes. Examples of related ecosystems are climate patterns and pollution patterns.

Underneath each of the four subsystems, there are second- or even third-tier variables. These variables help unpack the attributes of the subsystems (Figure 5.2). Ostrom (2009) identified 10 second-tier variables (a selected few among the variables shown in Figure 5.2) that commonly affect the likelihood of success in self-organized activities. In Resource Systems, the key variables are: (1) the size of the resource system, (2) the productivity of the system, and (3) the predictability of the system dynamics. In Resource Units, (4) the mobility of the resource is the key variable. In Governance Systems, (5) collective-choice rules can affect the outcome of self-organization. In Actors, the five key variables are: (6) number of users, (7) leadership/entrepreneurship, (8) norms/social capital, (9) knowledge of SES/mental model, and (10) importance of the resource. In a later section, I apply the SES framework and analyze how these variables affect the self-organization activities in risk management of the two forest communities.

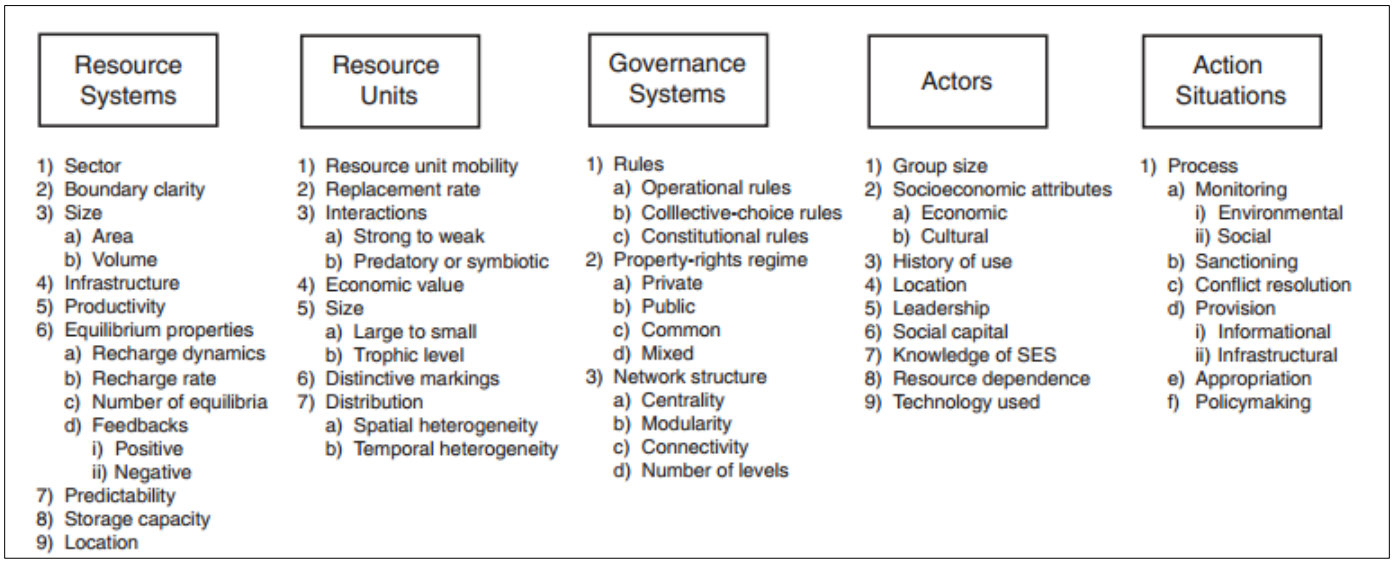

Figure 5.2 SES framework with multi-tier variables. Source: Ostrom and Cox (2010)

5.3 Bolivian forests at a glance

Bolivia is one of the poorest countries in South America, with a poverty level above 51% and a gross national income per capita at just US$2,000 in 2011 (World Bank, 2011). However, Bolivia has rich natural resources and is one of the most biodiverse countries in the world (Canavire-Bacarreza & Hanauer, 2012). Over 48% (approximately 534,000 square kilometers) of Bolivia is forest, and 85% of Bolivian forest is located in lowland areas that are less than 500 meters above sea level. This Bolivian lowland forest region is mainly comprised of areas east and northeast of the Andes. In this region, humid evergreen forests are located primarily in the north, while the dry deciduous forests are in the south. Tree species are abundant in the southern deciduous forests, and this area has been targeted by logging companies for decades (Pacheco, 2012).

As part of the land reforms, indigenous groups are entitled to claim their ancestral land. Over 22 million hectares have been claimed and recognized since the 1990s. Among them, 540,000 hectares of indigenous forests are covered under Forest Management Plans, which allow the groups to harvest timber commercially in a sustainable manner. The area I visited is in this lowland forest region. Both indigenous communities have obtained recognitions of their land rights and have developed Forest Management Plans to benefit from the sale of timber. At the community level, both are experiencing intrusions from outsiders who illegally harvest their trees and occupy their land. Furthermore, both communities are dealing with threats from natural disasters, struggling with certain levels of elite capture, experiencing market pressure to increase timber production, and facing population pressure to extract more forest products. Both communities experience similar community-level risks, and this chapter investigates how each community has responded and which outcomes were achieved.

5.3.1 Community Caracara

The people of Caracara belong to an indigenous group called Yuracaré, one of the 32 indigenous groups in Bolivia (Leon et al., 2012). The Yuracaré settled in the Chapare Region, the northeastern part of the Department of Cochabamba, more than 400 years ago. Prior to colonial influence, the Yuracaré's lifestyle was totally dependent on forests (Becker & Leon, 2000). Today, about 3,000 Yuracaré live in the Chapare Region, and they represent 18 different communities in the area (Leon et al., 2012).

For decades, the Yuracaré have struggled in land disputes with other indigenous groups and settlers from nearby populated regions. They were able to obtain legal recognition of part of their traditional territories under laws that were passed as part of the land reforms. Currently, the Yuracaré's control approximately 250,000 hectares, which is just a small portion of what they occupied historically. In 1992, the Yuracaré decided to participate in timber trading, so they have worked with several NGOs to formulate the Forest Management Plan required by the government.

Three social levels exist in the traditional Yuracaré system. A clan refers to an extended family that consists of 10 to 20 nuclear families of husband, wife and children. A *corregimiento* (this word originally refers to a Spanish magistrate and is used here to indicate a spatially defined unit of governance) consists of multiple clans. The territory is comprised of all the *corregimientos.* Each clan selects its own representatives, and these representatives elect a *cacique* (Chief) to lead the tribe. The election of the Chief occurs through consensus. Each *corregimiento* also selects representatives to participate in the tribal council. The tribal council uses the one-person-one-vote system and the majority-rule system in decision-making.

The Yuracaré's teaching is to "use the trees and animals in the forest without depletion." Their traditional social norms call for caring for the forest by protecting, planting and transplanting fruit trees, practicing selective harvesting, and establishing no-hunting seasons. These informal rules are in place in order to maintain a dense forest so that animals will remain plentiful for their consumption. The Yuracaré also believe that valuable tree species in the forest act as a savings account and should be used sporadically, e.g. by converting timber into cash for emergencies. In case of rule violation, sanctioning is conducted in the forms of social reprimand and ostracism.

According to their custom, all Yuracaré have *de facto* rights to hunt and collect natural resources from their clan's areas and the tribal territory. Members of a *corregimiento* jointly create and manage their family forest garden like private property. These gardens are used to cultivate yucca, banana, chocolate, coffee, palms and other native fruit trees. Moreover, members share information about good hunting areas and locations of fruit-bearing trees. They also monitor each other's usage of resources within their *corregimiento*. When it is strategically sound, clans move within the area controlled by the *corregimiento*. Sometimes a *corregimiento* moves within the territory to create a new family forest garden in an area where resources are available. This practice aims to reduce intensive use of a particular area and allow the residents to adjust for the seasonal variation of availability of different forest products. The traditional lifestyle of the Yuracaré reduces the need for private property rights, and encourages all members to maintain control and care for the entire territory.

Nevertheless, land reforms incentivize timber production, and some Yuracaré have benefited financially more than others through excessive logging in areas where valuable trees species are abundant. The relatively mild forms of social sanctioning against excessive logging

proved to be ineffective, so a new approach has divided ownership of valuable trees species, such as mahogany and Spanish cedar, among *corregimiento*s. Each *corregimiento* then forms a forest association to organize logging activities. The forest associations are responsible for ensuring equitable distribution of timber revenue among members of the *corregimiento*, controlling methods of extraction, and resolving conflicts among members. This is a significant change to the relationship between the Yuracaré and their forest. Before the reforms, individuals or families harvested timber over a vast area. Trees were cut for household or community use, and traded locally for cash, only for emergency purposes. Since the reforms, families have negotiated the amount of timber to be harvested with the forest association, conducted the logging activities in a commercial manner, and traded the products globally. The mobile tradition of the Yuracaré is seldom practiced today because people now favor permanent settlement in areas where ownership of the trees is established.

One of these permanent settlements is Caracara, located along the Caracara River in the southeastern part of the Chapare Region (Figure 5.3). The nearest market of Caracara is the Town of Caracara (Figure 5.4 to Figure 5.6), which lies along a highway connecting two of Bolivia's biggest cities – Cochabamba and Santa Cruz. The Town of Caracara is about 150 kilometers from Cochabamba. The town is a transportation hub with a bus terminal and several markets; it also has schools and several hostels. Around the market, local people, who mainly commute via motorcycle or bicycle, bring produce and homemade goods to be traded. Besides these small-scale commercial activities, the Town of Caracara is also a main departure point of timber and coca (the raw materials of cocaine). Coca has important cultural and religious significance in Bolivia, and chewing dry coca leaves is an Andean tradition because of their medical benefits in overcoming fatigue, hunger, thirst and altitude sickness. The Chapare

Region is a fertile ground for coca production, and many residents are knowledgeable about growing and processing their own coca. At least one coca co-op is located in the Town of Caracara, and dry coca leaves are commonly available in the stores.

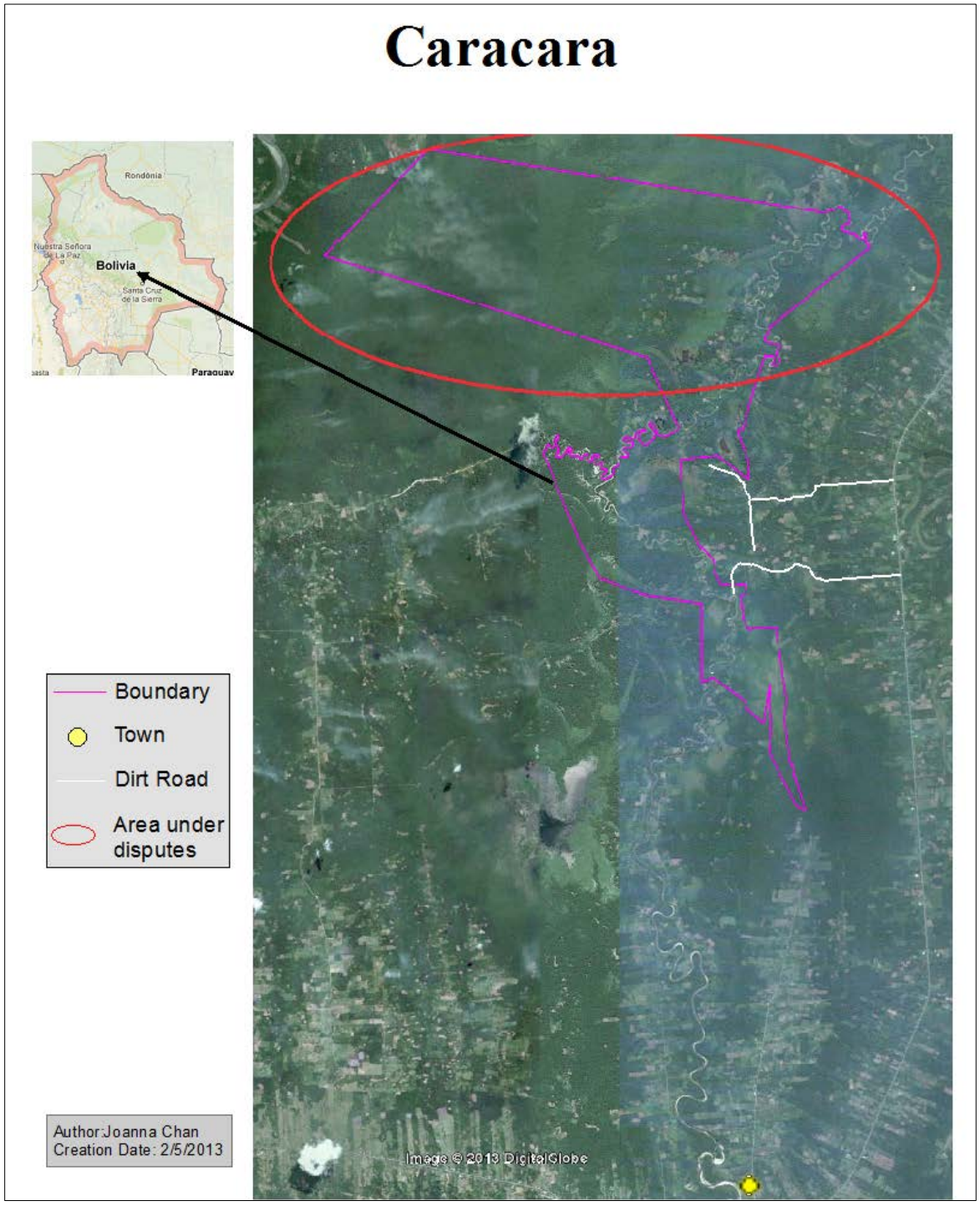

Figure 5.3 Map of Caracara

Figure 5.4 The main road of the Town of Caracara

Figure 5.5 A side road in the Town of Caracara

Figure 5.6 A storefront in the Town of Caracara

The direct distance between the Town of Caracara (marked as the yellow dot in Figure 5.3) and the area where Caracara's residents have their original dwellings, where the lower dirt road (the white line in Figure 5.3) intersects with the community boundary (the purple line in Figure 5.3), is about 15 kilometers. There are two routes to Caracara from the town. One route is via the Caracara River using dugout canoes and paddling upstream for 34 kilometers. An easier route is to drive on a paved road east of the Town of Caracara for about 20 minutes to reach one of the dirt roads. The 4-kilometer drive on the dirt road usually takes less than an hour in good conditions. The total travel distance via this road route is approximately 20 kilometers. However, both dirt roads are often flooded, so passage is prohibited due to the poor road conditions.

The Caracara River basin is part of the larger Amazon basin and contains some unexplored forest. Caracara has a territory of 6,485 hectares, and a portion of it is in a flood zone where the east-west running Mariposas River joins the Caracara River. The forest is classified as a lowland tropical moist forest with relatively homogeneous species. Three hundred and fifty-five plants were counted in 1.1 hectares of forest. Sixty-three different species were recorded, but 24 of them only have local names; the remaining 39 known species come from 25 different families. The average DBH of the plants is 14.6 centimeters. The most common species is *Socratea exorrhiza*, a tropical palm. A similar eco-zone in the region, the Manu River protected area, has 283 different tree species from 45 families in a 1-hectare area, and the average DBH is 22.6 centimeters (Becker & Leon, 2000).

Access to the inner forest area of Caracara is mainly on footpaths or motorcycle paths. Most residents of Caracara have houses along a small stretch of the river less than 3 kilometers long (Figure 5.7). In the early 1990s, the Vargas[4] families, one of the oldest family lines inhabiting the community, led 10 other families in forming a community and requesting land under the "community lands of origin" provision of the land reform laws. Their land claim triggered many challenges from settlers nearby. Despite the fact that the conflict was "resolved" through agreement between

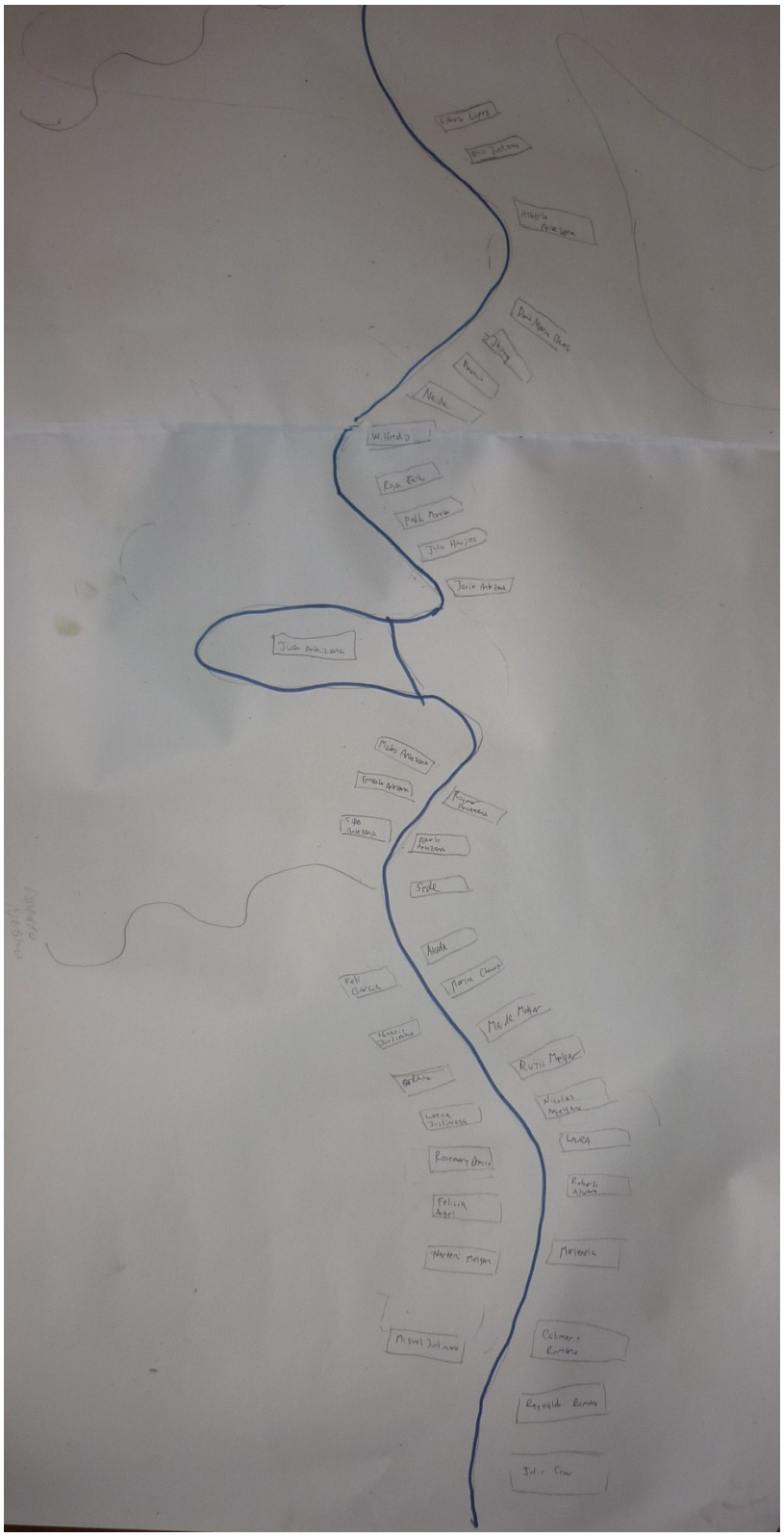

Figure 5.7 Community map of Caracara (drawn by local residents)

[4] *A fictitious name is used to seal the identities of the research subjects*

the leaders of Caracara and the other communities, land disputes still occur today. Regardless of the success of their ancestral land claim, the residents of Caracara face continuous land invasions in the disputed territory (marked by the red circle in Figure 5.3).

The forest of Caracara is managed as a communal property. All members have *de facto* rights and can hunt, fish, and gather NTFP in their territory. They also obtain construction materials for building dwellings from the forest. In addition, the locals clear land near their residences for individual farming plots (called *chacos*). A *chaco* is typically 100 square meters in size and is located 200 to 300 meters from the river shore. They cultivate subsistence crops like rice, corn, cassava, chocolate, banana, and coca in the *chacos*. Since 2007, four of the original 10 families moved out of Caracara. As of 2012, 51 households, about 300 people, are recorded as residents of Caracara and 20 of them are from the extended Vargas family. The average family size is 6 people per household, and 2.8 of them are children. The average time of residence is 11.5 years.

The community is managed by a Board, which consists of the *Cacique Mayor* (the Head Chief), a *Segundo Cacique* (the Second Chief), and nine secretaries in a linear order. At the Head Chief's level, two advisors are positioned above the rest of the board members. The Board is responsible for community matters related to education, school, health, infrastructure development, land disputes, and finances. Seven of the 13 board members are from the extended Vargas family.

Since 1987, people from Caracara started moving away from the forest to live closer to the Town of Caracara in order to engage in wage labor and trade. They settle in the outskirts of the Town of Caracara, in an area called *Barrio 8 de Agosto*. The distance between this new settlement and the town is just a 10-minute walk. Only two families continue to live in the

forest. Access to markets has rapidly changed the livelihood strategies of the people of Caracara, though the living conditions still vary widely in the new settlement (Figure 5.8 to Figure 5.10). Some houses were built with bricks and have electricity, running water, and modern appliances like televisions and refrigerators. Others are just wooden shacks with holes around the structures. Some houses lack complete roofs or walls, and are just covered with sheets of plastic or cloth. Fruit trees, such as oranges and papaya, were planted outside some houses. Some residents live with small livestock--ducks, chickens, and pigs--inside their houses. Other houses have better upkeep and tidier appearances.

Figure 5.8 Road through the new settlement

Figure 5.9 The house of a poorer resident

Figure 5.10 The house of a wealthier resident

Market activities have made a big impact on locals' income. The average income is 9000 Bolivianos per year (US$1,300), in a range from 990 to 26,800 Bolivianos. Some adults engage in all sorts of commercial activities, including timber and coca trading, and transportation, while others still sustain their livelihoods in the more traditional way – farming at the *chacos* – with supplementary wages. On average, only 0.93 hectare of the *chacos* is cultivated, and farming and collecting forest products contribute to less than 20% of food consumed.

The connection to markets also triggers a change in the community's ethnic composition. Respondents indicated that people from the "highland" married natives of Caracara, and the ethnic identity of Yuracaré has been diluted over time. The native Yuracaré language is no longer spoken, and some people reported their ethnicity as Quechua, one of the two most prominent indigenous groups in Bolivia, rather than Yuracaré. These changes in livelihood strategies and social fabric not only alter the people's relationship with the forest, but also the risks they encounter.

Selective logging that abided by the customary use rules had been commonly practiced in the territory before land reforms. Some trees were cut for community use while others were sold in the nearby market for cash in case of emergency. Land reforms that promote commercial timber trading have challenged the traditional forest management system of the Yuracaré.

Approximately 10 families, mostly the Vargas, participate in extraction and exploitation of timber. The Vargas family is also the key contact with timber companies, coordinating the logging activities in their territory. According to a community rule, members who sell timber should contribute 10% of the income to a community fund. Nonetheless, violations of this rule have been reported, but no action has been taken to remedy the situation. Furthermore, the Forest Management Plan, which outlines the timber revenue sharing scheme and job opportunities, is supposed to dictate the distribution of financial benefits among members. One major benefit from the plan for many people is that it offers forest work that pays 100 Bolivianos per day, approximately US$14. However, many residents we spoke with do not understand the plan or the laws associated with the plan, and have received very minimal or no financial benefits from the plan at all. Several families harbor frustrations against those who violate the community rules without punishment. They are also angry about the extractions of timber from "their forest" when they do not receive their share of the benefit. Some claimed that the Forest Management Plan mainly benefits the powerful Vargas family and is not working for the entire community. Unfair distribution of wealth due to elite capture by the Vargas family is obvious.

Demand for cocaine has given a boost to coca production in the region. Although an official reply from the community leader has indicated that no coca leaves from Caracara have been traded illegally for the production of the narcotic, several residents of Caracara acknowledged that some other locals have engaged in such activities and are displaying their financial windfalls around town. As shown in Figure 5.9 and Figure 5.10, income disparity is wide in the new settlement. Several respondents said that more forest has been cleared for coca cultivation, and money from coca production has financed the new houses, cars and vans, and other luxury items.

Besides the accused illegal activities, legal coca production has been an ongoing activity, and Caracara has been affiliated with a coca union since 2007. The higher demand for coca leaves also instigates more arguments over land use practices between the community members who favor more coca production and those who oppose it. These arguments mainly happen in the lower area of the territory. Some respondents indicated that the people who favor increased coca production are "not their own." They are primarily migrants from the "highland" who settled in the Caracara territory through marriage or befriending a native. An anecdote supports this theory: when the CERES researchers and I walked around the settlement area, we saw several households drying coca leaves in their front yards. We asked a man for directions to his neighbor's house, and the man indicated that he is not from the area and knew no one from the community.

Coca production also leads to another big problem – outside intrusion. Before the coca bloom, outsiders came to their territory to hunt extensively, fish using dynamite, and cut down timber illegally for cash. Nowadays, outsiders deforest vast areas to make room for coca cultivation. Respondents said that intrusion occurred primarily in the area marked by the red circle in Figure 5.3, but the CERES forester, who conducted the forest survey in June 2012, reported remnants of illegal logging south of the disputed area. The forester noted that a chainsaw was used and that the timber was shipped down the river in canoes.

In Caracara, monitoring was hardly sufficient due to the large forest area and a small number of residents. Conflicts that escalated to violence, mainly in the disputed area, have been frequently reported. Gangs that are connected to the drug cartels carry out some of the illegal activities. Due to the danger, the locals of Caracara have refrained from entering the disputed area and confronting the intruders. Most of the monitoring is now performed in the area that is

regulated under the Forest Management Plan, and is carried out by the government designated forestry professionals rather than the local residents.

Population pressure is another risk facing the people of Caracara. The number of people who claimed to be residents of Caracara jumped at least 60% between 2007 and 2012. The increase in the number of families and in family size requires more forest materials for housing and products for subsistence. Some locals have indicated that others have been expanding their *chacos* (the family farming plots in the forest) near their residences by cutting down more trees. The expanded *chacos* are needed to accommodate more subsistence crop cultivation.

Since part of Caracara's territory is located in a flood zone, flooding is a common risk. When the CERES researchers and I visited the site in early June 2012, the dirt roads to the forest were partly flooded on the first day we arrived. Within the next two days, torrential rain covered the roads and flooded areas along the river. Later reports indicated that water up to one meter high had covered part of the territory. Flooding has changed the landscape around the river, and has created challenges for the locals in accessing the forest or farming in their *chacos*.

In general, people believe that the forest has deteriorated, and that it is harder for them to find animals now. They raised concerns about forest degradation and deforestation, particularly about losing the valuable timber species. Some people mentioned that none of the forest rules established by the community had been followed. As a result, they are losing both trees and land, and feeling poorer. Even when violations were reported to the Board, sanction seldom followed. One respondent suggested privatizing the entire territory because the Forest Management Plan is just not working. Interestingly, all of these issues were raised during individual interviews, but no one openly mentioned any threat to their forest or conflicts within the community in the community meetings.

The last issue reported by the respondents was that the traditional Yuracaré conflict resolution system no longer works with the changing environment. Taking time to discuss the matter in the communal assembly and to strive for consensus on a course of action does not interest the locals anymore, and is not appropriate for resolving conflicts with the non-Yuracaré. Instead, the State judicial system is used, but this move has marginalized the locals who have little or no education or knowledge of how to navigate the system.

To conclude, the people of Caracara constantly have to deal with floods, and deforestation caused by market incentives for timber extraction and coca cultivation is another common risk. Deforestation not only reduces the number of trees, but also affects the abundance of animals available for hunting. The CERES forester who performed the forest survey also raised concerns about fragmentation due to selective extraction of valuable species in the study area. Market incentives also fuel the risk of outside intrusion, which threatens locals' property rights as well as their personal safety. Increased connectivity to the market also dilutes the indigenous Yuracaré identity of Caracara's residents, and creates population pressure. Within the community, elite capture is apparently high. Members of Caracara acted collectively to set up a system to secure their rights, distribute financial benefits fairly, and protect their forest. Nonetheless, the continued failure to honor and enforce the established community rules has destroyed trust among community members; some members said that they no longer trust the system and had lost interest in working together to solve problems. Instead, many of them embrace the market system and try to capture monetary rewards based on individual actions. A group of nine Caracara's residents initiated the only collective activity since 2007, by joining a regional distribution network for chocolate producers.

5.3.2 Community Oropendola

Oropendola is located in the northern area of the Department of Santa Cruz; the nearest town to Oropendola is called Urubichá. Reaching Oropendola is a long and winding journey. From Santa Cruz, a bus ride takes about 5 hours to reach a bigger town called the Town of Guarayo. From the Town of Guarayo, another two-hour bus ride reaches Urubichá. There are timber companies along the route between Town of Guarayo and Urubichá. At least nine of them are located in a stretch of just 5 kilometers near the Town of Guarayo. From Urubichá, the transportation options to get close to Oropendola are motorcycle or private vehicle. The direct distance is about 12 kilometers, but the trip can take over two hours, assuming the road is not flooded. The last section of the journey requires crossing a river using dugout canoes. The distance from the Town of Guarayo to Oropendola is 75 kilometers, but it usually takes one full travel day.

Oropendola was founded in 1992 by 14 families, in an area that is formally a Franciscan mission (Figure 5.11). The mission was destroyed during an invasion by the *Choris* (the wild people), and was abandoned. The community founders picked the name "Oropendola," which means toad in their native language. One of oldest women in the village said that the fully fed giant toads sing beautifully at night around the river, and the toads represent the area; that was why they call their village Oropendola. One motivation for the families to form a community was to educate their children; there were 48 of them at the time. Before having their own school, children of Oropendola had to travel 20 kilometers to a nearby village to attend school. Some of the founders, including the tribal Chief, decided to build their own community with a primary school in it. They sought government funding for the construction and asked to have teachers sent from the municipality, and the school was built by the municipal government and four state-

employed teachers have been coming to the village to teach. The school offers elementary level classes in both Spanish and their native language to all Oropendola children between ages six and fourteen. Some of the graduates moved out of the village to attend secondary school and even college in Santa Cruz.

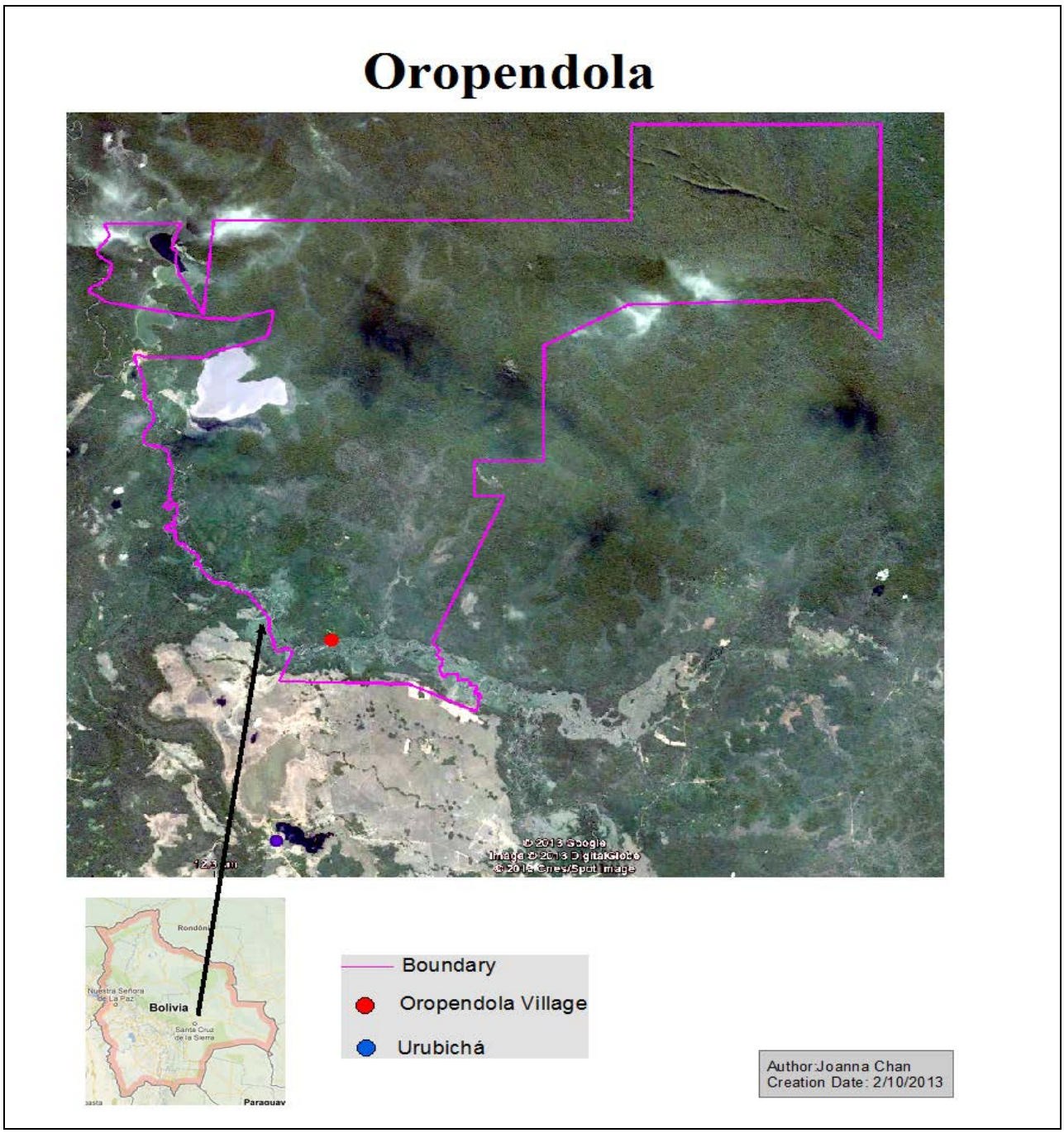

Figure 5.11 Map of Oropendola

The people of Oropendola belong to an indigenous group called Guarayo, who came to Bolivia from Guaraní (a part of today's Paraguay) and settled in the region in the 15th century. The people of Oropendola, even children, speak the native Guarayo language in addition to Spanish. They pride themselves as good stewards of the forest. The Chief once said: "We Guarayos care for the trees and the animals that live here. The trees do not ask for food, they do not ask for clothing and they should not be killed insensibly. Otherwise, the world will end." A *motosierrista* (local tree cutter) also said this: "God and the Virgin Mary gave us the trees. They [the trees] are alive and they can feel. This is why we only cut just what we need." Their culture demonstrates that sustainable tree management is not a foreign concept, but a tradition.

In 1996, the Guarayos Indigenous Organization, representing at least seven communities, was formed to claim an area of 1.3 million hectares of their ancestral land (Cronkleton et al., 2012). The people of Oropendola own a territory of 56,140 hectares. They also submitted a Forest Management Plan for 26,420 hectares so that they could engage in commercial logging in that area; the plan was approved by the Bolivian government in 1999.

Despite the huge territory, all the residents of Oropendola live near the White River, in an area less than 10 hectares (Figure 5.12). As of 2012, 36 households, about 240 people, are recorded as residents of Oropendola. The average time of residency is 19.8 years. The village has a small plaza, a school, a community meeting hall, a water tower, a public toilet, and 36 houses (Figure 5.13 to Figure 5.15). A small church with the statue of Santa Teresita, the patron saint of Oropendola, sits at one end of the plaza. The community also owns a gasoline engine, which supplies electricity at times.

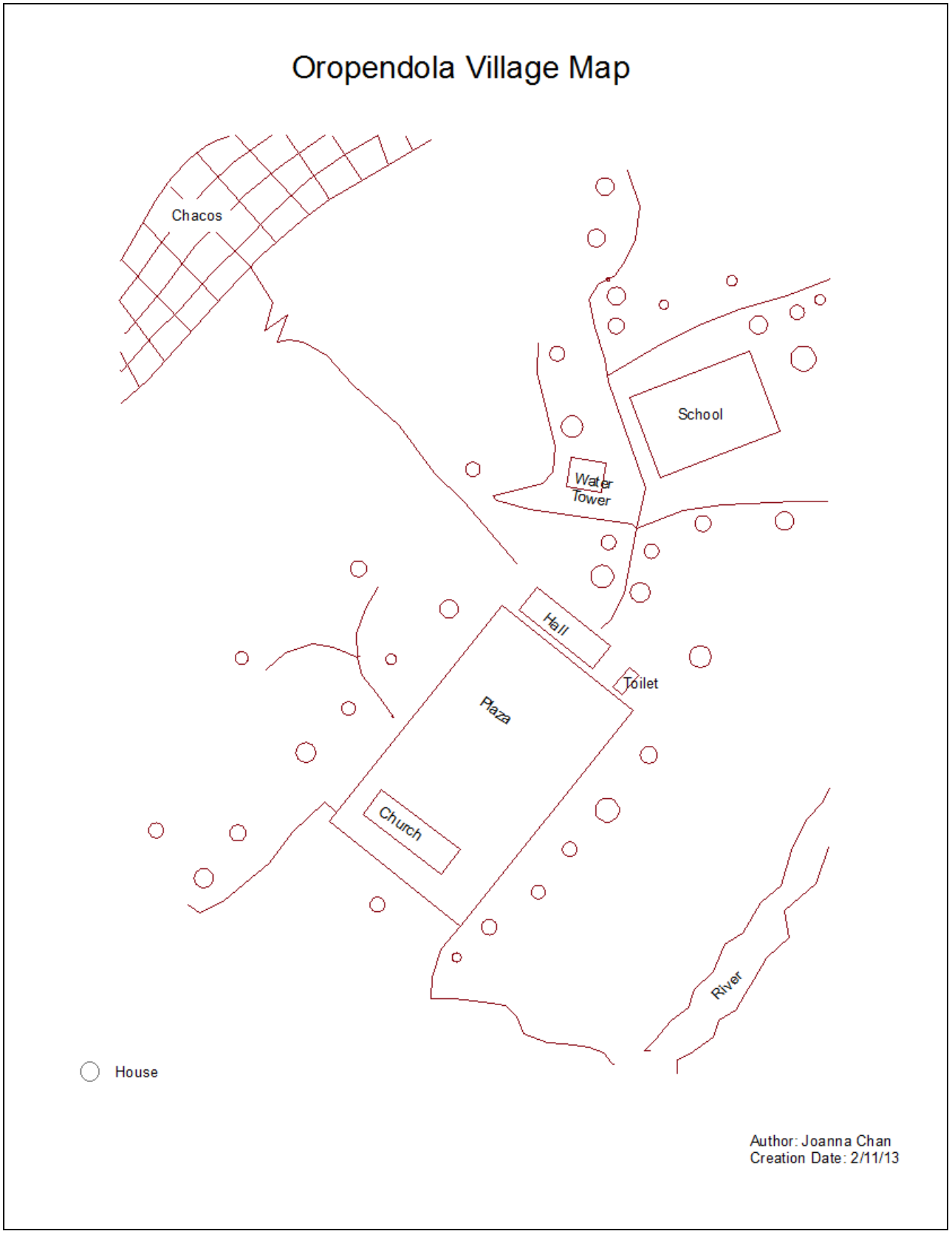

Figure 5.12 Oropendola village map

Figure 5.13 Typical houses

Figure 5.14 The plaza and the church (the rightmost structure)

Figure 5.15 The school

All houses in Oropendola are built with similar materials following a traditional design. The structures are secured by wooden poles collected from the forest. The locals use wood, brick, straw, or mud for construction. All the houses have thatched roofs made from palm leaves collected along the river, and they all have dirt floors. The kitchens are located outside, and many families use stone ovens for cooking. The locals also built shelters for animals and shacks for shading. No electricity or running water is available in the village. Some families have wells, but the main water source is the White River located south of the village. The locals use the river water for cooking, drinking, cleaning, and bathing. They also get fish from the river; the most common species is the *Piranha*, a flesh-eating fish that is considered a delicacy in their culture. Many families own similar household items such as radios, bicycles, motorcycles, and some basic furniture; sharing of household items among families is very common. Fruit trees were planted around some houses.

Similar to the families of Caracara, each family in Oropendola has a *chaco* (a family farming plot) of 50 hectares in the communal forest. All families use only part of the plot, and they cultivate rice, corn, cassava, banana, plantain, and other native fruit trees. On average, 3.28 hectares of the *chacos* are farmed; farming and collecting forest products contribute to 83% of food consumed. Mostly men work at the *chaco*, but women do so when no adult man in her family is able to work at the *chaco*. They commute between their houses and the *chacos* by foot or on motorcycles on dirt paths. Many families also raise small livestock such as pigs, ducks, and chickens; most of the livestock are for the family's own consumption, but two families sell theirs in the market. They purchase other necessities such as sugar, gasoline, salt, oil, or flour from Urubichá. In Oropendola, the average income is 2,300 Bolivianos per year (US$330), and that ranges from 200 to 6,000 Bolivianos. The rest of the forest is managed communally and can

be accessed and used by all members for hunting, fishing, and collecting NTFP, firewood, and materials for constructing houses.

The forest is semi-mature to mature, and is classified as a lowland tropical moist forest. Six hundred and two plants were counted in 1.2 hectares of the forest. Sixty-four different species were recorded, but 27 of them only have local names; the remaining 37 known species come from 28 different families. The average DBH is 17.2 centimeters. The most common species is *Smilax flavicauli*, a climbing flower plant. Logging and grazing activities were ongoing during our visit. The CERES forester who performed the forest survey reported erosion in some areas due to extensive logging. He also saw new roads into areas that were marked for timber extraction in 2012, according to the Forest Management Plan.

Many people, especially men, are very knowledgeable about the flora and fauna of their territory, but they hold different views regarding the condition of the forest. Some indicated that the forest is deteriorating and many valuable tree species are disappearing. Some respondents also signaled a decline in animals and fish. This group hinted that the benefits from the Forest Management Plan are exaggerated, and the misguided incentive is the cause of the degraded forest. On the other hand, others reported no concern about forest sustainability, given their huge territory, the small population, and the good forest management practices outlined in the Forest Management Plan. This group mostly consists of *motosierrista* who usually work for the timber companies or the Forest Management Plan to inventory trees for selective extraction. In sum, there is no consensus on the overall condition of the forest.

Oropendola has a modern organizational structure for managing community matters. The community assembly is the highest decision-making body, and is a forum for monthly meetings to address issues. Decisions are made according to the simple majority rule. Every adult in the

community has the right to vote in the community assembly. They are also eligible to share the financial benefits from business transactions conducted by the community. In exchange, all adult members have the responsibility to attend community meetings, contribute to community improvement projects, patrol the territory, and enroll school-age children in the community school.

In order to manage daily operations, the people of Oropendola elect a president, a vice-president, a secretary, and a treasurer to form the village council. The elected council members have a two-year term limit, and they represent the community in external matters. They are also in charge of sanctioning. Sentences are determined according to the severity of the violations. Minor violations, like refusing to help during an emergency, carry a fine up to 20 Bolivianos (approximately US$3) or one day of communal work. For serious misconduct that results in damages to the community, or illegal activities, the lightest punishment is a fine up to 300 Bolivianos, approximately US$43, while the harshest is expulsion from the community.

Outside the administrative structure, the tribal Chief acts as the highest spiritual leader and oversees cultural issues in the community. Oropendola also has a women's council, a school board, and an association that governs timber production and is responsible for the Forest Stewardship Council (FSC) certification compliance. All members of Oropendola belong to the timber association, which holds monthly meetings to discuss commercial logging activities.

As mentioned above, education has been a high priority for the people of Oropendola. Some families used to sustain their livelihoods using products from their *chacos* or from the forest, while others had members working for the timber company. However, the pay was poor, and some locals realized that education would provide a better path to improve their quality of life. Therefore, the community sent some children to secondary schools outside the community.

Some of the students returned to the village with ideas for improvements. One of the graduates rejected a job offer in Santa Cruz, and is now in charge of the Forest Management Plan. He has been working with international NGOs, like the USAID and The Nature Conservancy, to study germination rates of different tree species in order to conserve the stock and catalog the different species in their territory.

Locals also took the initiative to obtain FSC certification, which endorses sustainable timber production in their territory. They recalled a discussion about how the FSC certificate would help them find certified timber companies for selling their certified wood at a better price; this could improve their livelihoods while protecting the natural resource they care about deeply. In 2006, the application process was completed, and the certification made Oropendola one of the first Bolivian communities to obtain the FSC credential. The certification requires them to harvest at most 1/20 of their territory every year, and cut only 80% of the trees that are at least 50 centimeters in diameter. According to the Chief, they received 15,000 Bolivianos (US$2140) from certified timber transactions in 2006. After paying for the logging machinery and equipment, the community's consensus was to spend the money on improving the 36 dwellings. In other years, the profit has been shared among the families, and each of them has received 200 to 800 Bolivianos (US$ 30 to 110).

Many of the men now work for the Forest Management Plan, which offers a daily wage between 80 and 100 Bolivianos (US$11.5 to 15). Some men participate in timber trading, while others help with the forest census on a part-time, full-time, permanent, or temporary basis. These jobs are highly preferred by the locals because they do not have to travel outside the community to work. Many local men invest their time and money in the job; some of them acquired chainsaws and GPS units to aid forest work, and many purchase protective gear like

boots, helmets, and gloves. All the *motosierristas* we talked with enjoy their work and feel optimistic about their forest and their future. Women also benefit from the provisions of the Forest Management Plan; they are usually hired as cooks during the forest census, and they receive wages as men do. Women are paid slightly less, 50 to 60 Bolivianos per day (US$ 7 to 8.5) because of the different nature of the work they perform.

Families in Oropendola are relatively large; on average, there are 7.2 people per household, and 3.6 of them are children. Population pressure is an ongoing concern in Oropendola. Between 1992 and 2012, a 257% growth was recorded. Most of this growth is organic, as young adults start their own families. As the Chief indicated, more families mean more demand for forest land to be cleared for *chacos*. In addition, more forest materials are needed for constructing dwellings. Furthermore, timber revenues and job opportunities from the Forest Management Plan have to be spread more widely among more people.

Several NGOs and the municipal government had started development projects in Oropendola, but many of the projects have been abandoned without reaching the intended results. For example, a clean water system, which is supposed to provide running water to the homes of the villagers, is not functioning. The water pipes were laid, and some houses have outdoor water taps, but the water tower remains empty. Two flush toilets, built to accommodate the teachers, stopped functioning within a month. A project operated by a religious organization that aims to provide early childhood education for children under five halted without achieving any significant outcome. On the brighter side, some of the successful projects include teaching the locals best practices in animal husbandry, agricultural improvement through donated seeds, and simple leadership training for young people.

During our discussion with the locals, they kept emphasizing the importance of education and training. They asked CERES for training programs to teach their youth modern forestry techniques, and for financial support so that some of the brightest students could attend college and bring knowledge back to the community. The locals indicated that the whole community benefits if the native sons and daughters from Oropendola fill the government positions that are responsible for managing their forest.

Overall, there is definitely a sense of community in Oropendola. People share the same native language; they follow the lead of the Chief; they discuss issues and find consensus in their community meetings; they all enjoy a share of the economic benefit from the forest; and they consider themselves proud Guarayos – the ones who tame the forest.

However, underneath a rather harmonious cover, conflicts do exist in Oropendola. Even though many people feel positively about the Forest Management Plan, some have disagreements over how the plan should be executed, and the minority feels undermined by the majority. Some respondents feel that certain information is not shared with the whole group. As a result, they are being left out and are not fully benefiting from the plan. There are also tensions among the job seekers who want to benefit from the lucrative, but limited, forest management jobs. Since there is not enough work for everyone in the community, accusations of nepotism and cronyism by the person in charge of staffing were reported. Although everyone from Oropendola belongs to the organization in charge of conducting forestry activities, and can participate in decision-making about timber extraction, the final decisions are usually made by only a few families. So other locals feel that the process lacks transparency and is unjust. Some respondents indicated that a group of decision-making families, including the head of the Forest Management Plan, takes more benefits than others.

Several individuals suggested that the forest management laws imposed by the government are not as flexible as their customary laws. Before the reforms, local people could sell timber in exchange for cash in cases of emergency. Under the current Forest Management Plan, this small-scale transaction is no longer permitted.

Outside influences have had some impact on the rather simplistic way of living in Oropendola. During our visit, one man requested more financial benefit from participating in projects that collect personal information and details about their forest, like those conducted by CERES. He asked to be paid for answering the household survey and suggested that his fellow villagers should also receive payments. Another man echoed the first man's request and said that the researcher who visited their community previously made money from the information they provided and then forgot all about the community afterwards. Some respondents worry that the Forest Management Plan will shift their tradition of self-sufficiency to a reliance on markets and the government. Some older residents suggested that forgetting how to cultivate one's *chaco* is a step toward losing the Guarayo heritage.

The risk of natural disasters, especially floods, also shapes the lives of the people of Oropendola. Floods sometimes block the road between Urubichá and Oropendola for weeks, so teachers cannot reach the village, and the locals cannot commute to the market. In addition to flooding, respondents also list drought and pests that lead to crop failure among common natural threats.

Oropendola's rich neighbor, a private landowner who has about 5,000 hectares of land, poses another risk to the community. This landowner offered to build Oropendola a new community building in exchange for 1,500 hectares of land. Although some locals favored the idea, the community eventually rejected the offer. Nonetheless, the discussion about this offer

was tense, and some people worry that the neighbor will use their land anyway, since they do not have enough manpower to monitor and secure the whole territory.

Since the 1980s, the forestry sector has been well developed in the Guarayo's territory. Several small- and medium-scale sawmills still operate outside the realm of the Forest Management Plan. These operators illegally cut trees from the area, turn them into plywood, and sell it to a network of urban buyers. The people of Oropendola acknowledge that timber extractions by outsiders do occur. They also feel constant pressure from outsiders who want to extend their landholdings within Oropendola's territory. Some of them recalled incidents when corrupt leaders of the Guarayos Indigenous Organization forged land titles, which resulted in land ownership being granted to outsiders. In other cases, some of Oropendola's land title owners were misinformed and sold their properties to outsiders.

To conclude, the people from Oropendola face many risks: natural disasters like flooding and drought, outside intrusions, land disputes, population pressure, and some level of elite capture within the community. Several collective actions – for example, obtaining FSC certification –have increased community benefits from the timber market while protecting the forest. Every family in Oropendola shares the financial benefits from the Forest Management Plan, although the distribution of income is not as even as some residents would prefer. The desire for education is quite unique in Oropendola; the locals acted collectively to seek resources for the community school, and, during our visit, many of them kept demanding technical training for the youth. However, this collective action breaks down in efforts to monitor the territory. Generally, though, Oropendola's administrative structure is very well suited for handling community matters; community meetings to discuss issues are held periodically, and most decisions are reached democratically through majority consensus.

5.4 Discussion

Caracara and Oropendola present two different pictures of an indigenous forest community in Bolivia. Although both communities experience land disputes, invasions of their common forest property, population pressure, natural disasters, and certain level of elite capture, they handle these risks quite differently, and unique outcomes are observed. In this section, I analyze the variables in the SES framework that are found to be influential in affecting the likelihood of success in self-organized collective activities in the study area.

5.4.1 Resources Systems & Resources Units

Location: One major factor underlying the risk that Caracara's residents face is its prime location for coca production and ease of transporting the product to market. Because of these attributes, Caracara has attracted illegal drug gangs that occupy the northern area of the territory and threaten the personal safety of local residents who intervene with the gangs' operation. Due to this threat, the cost of enforcing property rights rises dramatically, and even acting collectively in defending the territory will not be rewarding.

Also, the locations of the two communities create a major difference in their connections with the market. People in Caracara participate more in the cash economy, while people of Oropendola still survive mainly through subsistence. Market penetration changes the livelihood strategies of the people in Caracara, and allows them to manage risk using the market system rather than the traditional mechanisms. For the people of Caracara, having individual risk management alternatives through market mechanisms reduces the urge to act collectively in forest protection.

Infrastructure: The remoteness of Oropendola creates a buffer between the community and the outside world. This buffer prevents the influx of outsiders into the community and

allows the community to retain its indigenous identity. Also, the distance between Oropendola and a road network hinders outside access to their forest. Other Guarayo communities that are closer to the highways are less fortunate; they have to deal with constant land disputes and encroachment by outsiders (Cronkleton et al., 2012). In Caracara, road access to the forest is much shorter and better developed than in Oropendola. Also, the distance between a market and Caracara's forest is much shorter. As a result, the ease of access may encourage more intrusions into Caracara's property.

Productivity & predictability: Coca production creates a totally different dynamic around land use practices for the people of Caracara. Unfortunately, demand for cocaine is likely to increase, and so will the demand for coca. However, eradication and anti-drug-trafficking programs can hamper the ease of finding buyers or lower the potential financial gain. The unstable market condition and hazy outlook for such a controversial product make it hard for the residents of Caracara to predict the most beneficial use of their forest land in the long-run, thus reducing the locals' motivation to come up with a long-term plan. In Oropendola, the revenue residents can obtain from their forest is highly predictable. Furthermore, all of them have been enjoying the economic benefits from forestry for years. These conditions provide stimulus for the people of Oropendola to act collectively in securing their long-term benefits.

Economic value: In Caracara, the potential economic gain from coca production increases the tension over land use preferences among the locals and draws outsiders into their territory. The people of Caracara were not able to reach any consensus on how the communal forest should be used – for coca production or for traditional subsistence. As a result, some people in Caracara started their own venture according to their personal inclination and deforested some common areas for coca cultivation. In Oropendola, the forest is still performing the same

functions as before – providing products for subsistence and timber for cash. Fewer conflicting interests arise, and reaching agreements on how the forest should be managed is possible.

5.4.2 Governance Systems

Collective-choice rules: Oropendola has a more elaborate administrative structure than Caracara, and rule enforcement is more effective in Oropendola than in Caracara. Although Caracara has established the rule that requires locals who trade timber to contribute to the community fund, the rule is not honored or enforced. Even worse, violators, when caught, are not punished. As a result, people lose trust in the system and feel betrayed by their fellow community members. These conditions are not likely to motivate future collective action toward a common goal.

Both communities indicated that finding consensus is the preferred way to make decisions. However, respondents also reported a dominant force in decision-making, mainly in decisions that are related to financial activities. The lack of transparency in decision-making and the lack of a clear mechanism to address differences in opinion may discourage people from acting collectively.

5.4.3 Actors

Group size: Both Caracara and Oropendola are small communities, with 51 and 36 households respectively. Such small sizes should be a positive factor in initiating collective actions, as Agrawal (2000) suggests. Nonetheless, the sizes of their territories make collective monitoring activities infeasible. In Caracara, the internal tension and distrust among community members hinder other collective activities.

The small number of households in Oropendola does help the community reach decisions, as in the construction of the school and the FSC certification. It also allows members to share a relatively substantial financial benefit, as much as 35% of average income, from managing the communal forest collectively. These individual benefits are likely to motive the people from Oropendola to continue their collective forest management practice.

Leadership: The Oropendola Chief is clearly a respected leader of the community. When he called for assembly during our visit, almost everyone attended and listened patiently and respectfully. Although there were some disagreements between the Chief and the president of the village council, the majority still followed the Chief's direction. Since the Chief's position is life-long, and not a two-year appointment like the president's, the Chief possesses an authority and influence that no one else has in the community. The Chief teaches familiar Guarayo traditions, and he has the track record of bringing benefits to the community, so the people of Oropendola are willing to follow his leadership and act collectively when he advises them to do so.

On the contrary, Caracara does not have a leader who can excite the people and generate momentum toward any collective initiative. The dominance of the Vargas family on the Board creates a dynamic of elite control and has discouraged other families from participating in community matters. As a result, collective activity is less likely to occur.

Social capital: The people of Oropendola still retain their strong cultural identity and traditions, and they still speak their native language primarily. Few outsiders move to their community, so Oropendola maintains an ethnically homogenous population. Their land management practices are still guided by the norms that many people share, so acting collectively in forest protection becomes an easier endeavor. On the other hand, the influx of

outsiders to Caracara, especially through marriage, has threatened the community's indigenous identity, culture, and traditions. The people of Caracara no longer have the same strong ethnic identity. Furthermore, elite capture and uneven distribution of benefits have damaged the trust among community members and created many conflicts among them as well. This situation in Caracara can make collective action much more difficult to carry out.

The length of residency varies greatly between the two communities – 12 years in Caracara versus 20 years in Oropendola. In Oropendola, the long-term relationships among community members build bonds and trust, making it easier to organize collective actions. Moreover, the deep connection built over the years between the people of Oropendola and their forest also motivates locals to protect the resources.

Knowledge of SES/mental models: Based on a shared knowledge of how different forest products are produced and used, the people of Oropendola understand how they should manage the forest to maximize its productivity. This shared knowledge builds an understanding that certain practices are preferred, and creates consensus about how to act collectively. On the contrary, the people of Caracara expect different products – coca vs. timber vs. subsistence crops – from their forest and have incentives to manage the forest differently. This fundamental disagreement is a barrier toward any collective action.

Moreover, although both communities have developed Forest Management Plans, more people in Caracara indicated that they do not understand the plan and have not participated in the decision-making. This group of Caracara residents keeps a distance from most of the community activities, so engaging them in collective action can be difficult.

Resource dependence: The forest is still a basis for subsistence living in Oropendola, whereas in Caracara, the forest has become a source for cash income. Although both Caracara

and Oropendola feel the pressure from the timber market, and though selective logging has fragmented both forests, the people in Oropendola follow the FSC guidelines in order to achieve a sustainable forest. Also, since a booming population in Oropendola is still relying heavily on the forest for subsistence, the people are more inclined to protect the resource so that every resident can share a sufficient supply.

In Caracara, the market, rather than the forest, has become the key livelihood source. The pressure of timber extraction, combined with the incentive to clear forest for coca cultivation, has altered the role of the forest. For some people in Caracara, the forest is a source of cash income rather than subsistence. The differences in forest use preferences make it difficult for the people of Caracara to collectively organize forest protection activities.

Furthermore, the people of Oropendola live near their forest, so managing the resource is easier. In Caracara, most people moved away from the forest to live in the peri-urban area. The increased distance between their residences and the forest makes it harder for the people of Caracara to manage their forest or to feel a need to care deeply about the resource.

History: In Oropendola, past collective actions were successful in building the community school, obtaining the FSC certification, and sharing the forestry revenue. These successes are definitely good motivators for encouraging the locals to continue their collective activities. In Caracara, however, past activities have not brought a fair distribution of revenue to the whole community. The rules established by the community were not honored or enforced. Some powerful families capture most of the financial gains and parade their fortunes around town. These outcomes are highly likely to discourage any further collective activities.

Furthermore, land disputes have occurred since the creation of the community of Caracara. Nothing seems to be able to resolve the conflicts with neighbors. Instead, conflicts

have escalated into violence and have threatened the safety of the locals. Failures of the past are major obstacles to any future engagement in collective actions when dealing with outside intrusion.

5.4.4 Summary

To conclude, Oropendola is a more peaceful community than Caracara, in terms of the political, social, and environmental conditions. Although a low level of elite capture is reported in Oropendola, community rules are mostly enforced, all members get a fair share of the financial benefits from their forest, and they are living in a more egalitarian fashion. The Chief of Oropendola has been a strong leader, and he has led initiatives that have brought improvements to the community. Most people from Oropendola are long-time residents. They have a strong cultural identity and hold deep beliefs in their norms and heritage. Most of them consider the forest a vital part of their subsistence, and they have implemented plans to ensure its sustainability. Subsistence living also drives the people of Oropendola to remain close in order to support each other. For instance, people share food and household items when necessary. All of these factors have driven the people in Oropendola to act collectively in the past, and they are likely to engage in future collective actions. Nevertheless, no respondents suggested collective actions to improve monitoring in their territory or to control floods.

In Caracara, elite capture is high, and it has destroyed the trust among community members. The failures to enforce established community rules and to share revenue evenly with all community members have ruined the locals' expectations of collective action and weakened incentives to act collectively in the future. Weak local institutions have made it difficult to achieve the goals that benefit the entire community. Market exposure is one key factor that has changed Caracara. The demand for coca has strengthened the incentive to convert forest into

coca farms; the influx of outsiders has diluted the cultural identity and undermined tradition; and the proximity to highways has provided easier access for intruders. Most importantly, market access has changed the livelihoods and coping strategy options of the people of Caracara. The forest is no longer the source of subsistence, rather the source of cash income. Moreover, markets provide other ways to insure against risk, so the importance of the forest as natural insurance is diminished. No one in Caracara mentioned collective actions to confront the Vargas family, to control the flood, to address the land invasion problem, or to improve the implementation of the Forest Management Plan. Finally, in contrast to Oropendola, education is less highly valued in Caracara. Although the new settlement is very close to the Town of Caracara, where schools are accessible, not all children attend school. During the weekdays we spent in the community, many of the children (approximately five to eleven years of age) assisted with household chores and played in the street.

My findings give a new spin to Becker's and Leon's assessment stating that "[i]t is extremely clear that timber marketing is changing forest structure along the Chapare River" (Becker & Leon, 2000, p. 186). In their analysis (2000), they concluded that market incentives favored unsustainable harvest of timber species and had led to loss of biomass and diversity. They noted the influence of market pressure on the number of commercial trees remaining. More than ten years after their study, market pressure on timber products has decreased, but incentives to convert forest for coca cultivation have skyrocketed. Regardless of whether they support timber or coca, market incentives have played a significant role in changing the forest conditions in the region.

Scholars have discussed the heterogeneity of communities, and have suggested that researchers consider unique contextual factors in their analyses (Adhikari et al., 2004; Agrawal

& Gibson, 1999; Andersson & Agrawal, 2011). My analysis shows that two indigenous forest communities in the Bolivian lowland region face similar risks, but they behave quite differently in managing that risk and in engaging in collective action. Furthermore, these communities are evolving along with the risks they face and the options they have to deal with those risks. This in-depth community-level qualitative analysis reveals drivers that promote and hinder collective actions. The results add to a growing body of literature that documents the challenges of collective action. Through understanding these barriers and motivators, policy makers can better manage resistance to policies that promote collective actions.

Chapter 6

How Do Risks Differ Spatially And Temporally?

6.1 Introduction

As the case studies discussed in chapter 2 show, not only is the nature of risks diverse, but households' and communities' likelihood of risk exposure also varies. Furthermore, the availability of certain coping strategy options also differs due to many contextual factors, including household characteristics. In chapter 5, I presented the cases of two communities – Caracara and Oropendola – and discussed qualitatively how differences in social, political, and environmental settings make certain risks more prominent, while creating challenges in community-level risk management.

In this chapter, I analyze these two communities at the household-level, with a quantitative approach. The first section of this chapter uses data from the 2012 visit to compare and contrasts the different risks that members of these two communities encounter, and the perceived severity of each risk. I apply the Participatory Risk Mapping (PRM) technique and generate indices and risk maps to aid the analysis. The objective is to understand how the perceptions of risk differ among members of these two communities, and how the types of risk differ between the communities.

Even though the respondents were free to name any number of risks, results show that they only cited a small number – six in Caracara and seven in Oropendola. For both communities, the highest number of risks cited by one respondent was three. Also, both communities had respondents who indicated that they experienced no risk at all. The common risks identified by both communities were flood, animal deaths, illness, and wind. Residents of Caracara also experienced harm from pests and from animals being stolen, while residents of Oropendola reported fire, drought, and a drop in crop price. The majority of these risks, although severe as perceived by the respondents, only affected a handful of people. The risks that generated harmful impact to many residents were flooding in Caracara and drought in Oropendola. One surprising finding is that none of the respondents indicated outside intrusion, deforestation, or uneven distribution of forestry benefits as risks. These risks were mentioned during other parts of the interviews, but were not identified in the PRM listing activity. One possible explanation is that when respondents are asked to list risks, they focus on the risks that directly affect their daily operations and ignore those that exist outside of their personal space.

Since both the communities and their environments are evolving, the types of risk they face are very likely to change over time. The second section of this chapter explores changes in the two communities and their forests between 2006 and 2012. It also investigates how risk and coping strategy options changed during that time period. I perform this longitudinal analysis by analyzing the data from the SANREM project with the information collected from the 2012 household survey. The objective is to understand the changes that occurred in these two communities and their forests from 2006 to 2012, and how these changes affected the risks the members of these communities faced and the coping strategy options they used.

Results show that population pressure exists in both communities, but it did not create a higher demand for cropland because improvements that reduce crop failure have produced higher yields. Furthermore, no respondents mentioned land loss, even with the larger population. This suggests that both communities have large enough territories to accommodate newcomers' demand for land. Biological data show that the forest of Caracara has degraded more since 2006; the current forest has fewer, smaller, and less diverse trees. This result is consistent with the impressions of many of Caracara's residents. Interestingly, the condition of Oropendola's forest remains basically the same over the same time period, but the locals gave more positive and optimistic ratings of its condition. More importantly, the role of the forest has shifted. Although the forest is still considered to be an important source for subsistence and cash income, people of Caracara and Oropendola on longer rely on their forests as safety nets because natural disasters, like flooding and drought, made forest resources less accessible and reliable. Instead, the locals are relying more on loans, cash savings, aid from the government, and income from labor to cope during times of hardship. Finally, even though natural disasters like flood, wind, and drought have been very harmful to the two communities, most of the respondents did nothing to deal with those risks, and neither community has any risk management plan. These outcomes suggest that risk management policies – like offering affordable loans, crafting community natural disaster management plans, or offering development paths for the locals to migrate out of forest-based subsistence livelihoods – are beneficial for the people and their forests.

6.2 Participatory Risk Mapping (PRM)

As discussed in chapter 4 and chapter 5, various risks challenge rural households, and the level of risk exposure differs among households as well as among communities. In order to

systematically analyze and compare variations of risk across different subject populations, Smith et al. (2000) proposed the Participatory Risk Mapping (PRM) technique. PRM is used to classify and order sources of risk, and to distinguish between the incidence and severity of each identified risk. This method is a simple and inexpensive tool to capture the variable nature of risk and the heterogeneous impacts perceived by the affected individuals. It also generates informative outputs that can easily communicate results with the research subjects, policymakers and other researchers (Smith et al., 2000).

PRM uses a two-stage approach to obtain ordinal rankings of risk. It starts by asking respondents to identify all risks that they can recall. The official PRM does not specify a time period, but my study asked the respondents to list risks that they encountered in the last 12 months, in order to be consistent with the SANREM questioning. This open-ended format allows the respondents to freely name the risk(s) they recall instead of answering a yes or no from a list of risks identified by the researchers. It also gives the respondents an opportunity to name as many or as few risks as they prefer in an order they like. Once the listing is completed, the respondents are asked to rank each risk based on the harm it caused them and their households. The most dreadful risk receives a rank of "1^{st}," while the least harmful is ranked "n^{th}" where n is the number of risks identified; equally severe risks are assigned the same ranking.

For each identified risk, three indices are calculated. The first one is the incidence index, which is used to gauge how widely the risk is identified by the respondents. In other words, the incidence index for a given risk is the proportion of respondents who identify that risk. If all respondents identify the same risk, that risk gets an incidence index of "1." If only one person identifies a risk, that risk gets an incidence index of $1/m$, where m is the number of respondents

surveyed. An incidence index ranges from 0 to 1, where 0 is the least commonly identified risk and 1 is the most commonly identified.

The second index is the severity index, which is used to compare how severe a risk is relative to other risks. Since the numbers of risks identified and the rankings vary among respondents, it is challenging to compare the severity of a particular risk across responses. To address this problem, I adopted the approach outlined by Braid et al (2009). This approach "employ[s] uniform intervals between ranked concerns for a given respondent" (T. D. Baird et al., 2009). For each respondent, individual severity indices for each risk identified are calculated first. Mathematically, the individual severity indices are calculated using Formula 6.1:

$$R_{ij} = 1 - \frac{(r_{ij} - 1)}{n_i} \qquad \text{[Formula 6.1]}$$

R_{ij} = the severity index of the risk *j* identified by respondent *i*
r_{ij} = the rank of risk *j* identified by respondent *i*
n_i = the number of risks identified by respondent *i*

For example, Respondent A identifies three risks and ranks them: illness, having an animal stolen, and flood. The individual severity index of illness is 1–[(1-1)/3], and the result is 1. The individual severity index of having an animal stolen is 1– [(2-1)/3], and the result is 0.67. The individual severity index of flood is 1–[(3-1)/3], and the result is 0.33. If Respondent B identifies only two risks – flood and having an animal stolen, in order of severity – the individual severity index of the flood is 1–[(1-1)/2], and the result is 1. The individual severity index of having an animal stolen is 1–[(2-1)/2], and the result is 0.5. The remaining risk – illness – that is identified by Respondent A but not by Respondent B gets a value of 0 in Respondent B's individual severity index. Based on Formula 6.1, the risk that is ranked first, i.e. the most severe one, always gets a severity index of 1, while the risk that is ranked least severe gets a severity index of 1/*n*, where *n* is the number of risks identified by the respondent.

Once all of the individual severity indices are calculated, the aggregated severity index for the group is calculated using Formula 6.2:

$$S_j = \frac{\sum_{i=1}^{N_j} R_{ij}}{N_j} \qquad \text{[Formula 6.2]}$$

S_j = the aggregated severity index of the risk *j*
R_{ij} = the severity index of the risk *j* identified by respondent *i*
N_j = the number of respondents who identified risk *j*

Formula 6.2 basically calculates the aggregated severity index for the group as the mean of the individual severity indices of that given risk. Similar to the incident index, the severity index also ranges from 0 to 1, where 0 is the least severe risk and 1 is the most severe.

The third index is the risk index, which is used to indicate the overall harmfulness of a given risk by combining information from the two indices obtained previously. The risk index is calculated by multiplying the incidence index by the severity index. The risk index also ranges from 0 to 1, where 0 is the least harmful risk and 1 is the most harmful risk perceived by the group. Using the three indices, comparisons of risk perception can be performed according to a number of strata, including demographic and economic attributes within the same population (Smith et al., 2000).

In addition to the three indices, PRM also generates a risk map (Figure 6.1). A risk map is a graphical presentation of all the risks reported. It shows each risk on two dimensions – incidence on the x-axis and severity on the y-axis. The risk map has four quadrants; each one represents a combination of incidence and severity (T. D. Baird et al., 2009).

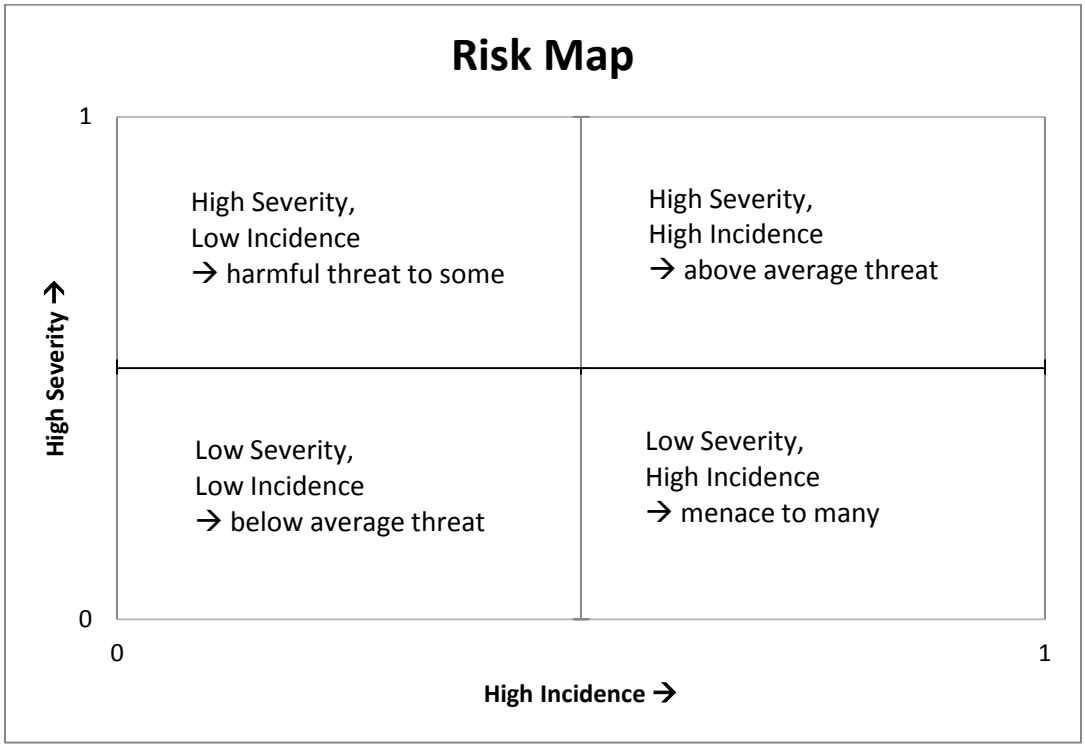

Figure 6.1 Risk map template

I conducted the PRM questioning as part of the household survey during the 2012 visit. Due to the likelihood that respondents may have difficulty understanding the nuance between risk, problems, and uncertainty, the survey questions asked them to identify events that had negatively affect their household welfare in the past 12 months; the identified events are considered to be risks because it is assumed that harmful events happened in the past have the perceived probability among respondents that they may happen again. Additional questions asked them to indicate if the same event had reoccurred in the last 5 years and if they anticipate that the same event will occur again.

In the next two sections, I apply the technique to analyze the risks reported by the residents of Caracara and Oropendola. Since risk exposure and the resulting harm are heterogeneous among members of the same community, this bottom-up approach captures the variations. Then, by combining the risks and rankings reported by individual households, I

obtain a better picture of all of the risks each community experiences, along with information about the resulting impacts. Finally, by calculating the indices, I am able to compare risks and impacts across the communities.

6.2.1 Perceptions of risk in Caracara

In Caracara, respondents identified six risks; Table 6.1 shows the distribution and the PRM indices. Of the 26 respondents, two reported three risks, 13 reported two, 10 reported one, and one respondent said no risk had been encountered.

Risks	*Ranked as 1st*	*Ranked as 2nd*	*Ranked as 3rd*	*Incidence index*	*Severity index*	*Risk index*
Flood	20	4	0	0.923	0.924	0.853
Illness	4	4	1	0.346	0.703	0.243
Pests	1	2	0	0.115	0.723	0.083
Animal stolen	0	2	1	0.115	0.443	0.051
Wind	0	2	0	0.077	0.500	0.038
Animal died	0	1	0	0.038	0.500	0.019

Table 6.1 PRM indices of Caracara

Overwhelmingly, flooding was perceived as the most harmful risk, and it was reported by 92% of the respondents. This is not a surprising finding since flooding made it difficult for us to reach Caracara's forest, and delayed the forest survey for three months. Flooding is a relatively predictable event because it occurs almost yearly. However, the impact of flooding has grown because residents have been cutting more and more trees along the riverbank. According to many residents, flood waters move closer to their homes now that the trees that used to intercept the rain are gone and the soil was washed out. Illness came in second and was cited by 35% of the respondents. The least harmful risk was death of an animal, which was cited by only one respondent.

The risk map for Caracara (Figure 6.2) displays all six risks according to their incidence and severity indices. Flood is no doubt the most harmful risk; it is the only risk in the "High severity, High incidence" quadrant. The other risks fall into or close to the "High severity, Low incidence" quadrant. Only a few respondents reported these other five risks, but they are perceived to be severe by those who are affected.

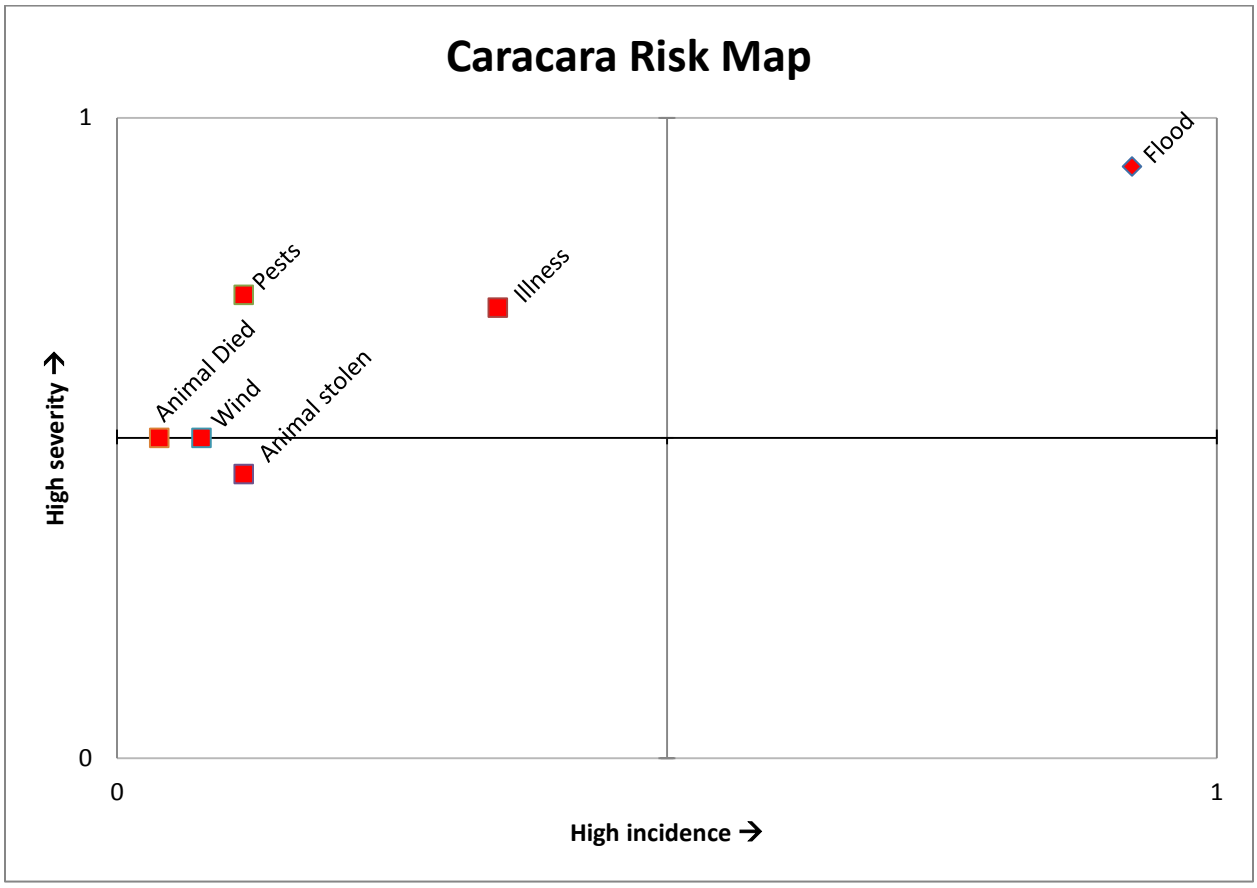

Figure 6.2 Risk map of Caracara (n=26)

Table 6.2 presents the breakdown of 5-year recurrences and respondents' predictions about future recurrence of the six risks. Results show that the reported risks have been problems in the past and are perceived to recur in the near future.

Risk	*Has occurred in the past 12 months*	*Has occurred in the 5 years prior to the last 12 month*	*Will occur again soon*
Flood	24	24	24
Illness	9	8	7
Pests	3	3	3
Animal stolen	3	3	3
Wind	2	2	2
Animal died	1	1	1

Table 6.2 Past and future risk analysis of Caracara

6.2.2 Perceptions of risk in Oropendola

In Oropendola, seven risks were cited by 19 respondents. Six respondents reported three risks, five reported two, and five reported one. The remaining three reported no risk at all. Table 6.3 displays the risk distributions and the PRM indices.

Risks	*Ranked as 1st*	*Ranked as 2nd*	*Ranked as 3rd*	*Incidence index*	*Severity index*	*Risk index*
Drought	8	2	1	0.579	0.848	0.491
Illness	4	3	2	0.474	0.703	0.333
Flood	3	3	0	0.316	0.807	0.255
Fire	2	0	2	0.211	0.665	0.140
Crop price fall	1	0	0	0.053	1.000	0.053
Animal died	0	1	0	0.053	0.670	0.035
Wind	0	1	0	0.053	0.670	0.035

Table 6.3 PRM indices of Oropendola

The majority of respondents, 58%, indicated that drought is the most harmful risk. Illness is the second most harmful risk, cited by 47% of respondents. A drop in crop price, death of an animal, and wind are the least significant risks, with only one incidence count for each. Figure 6.3 shows the risk map of Oropendola.

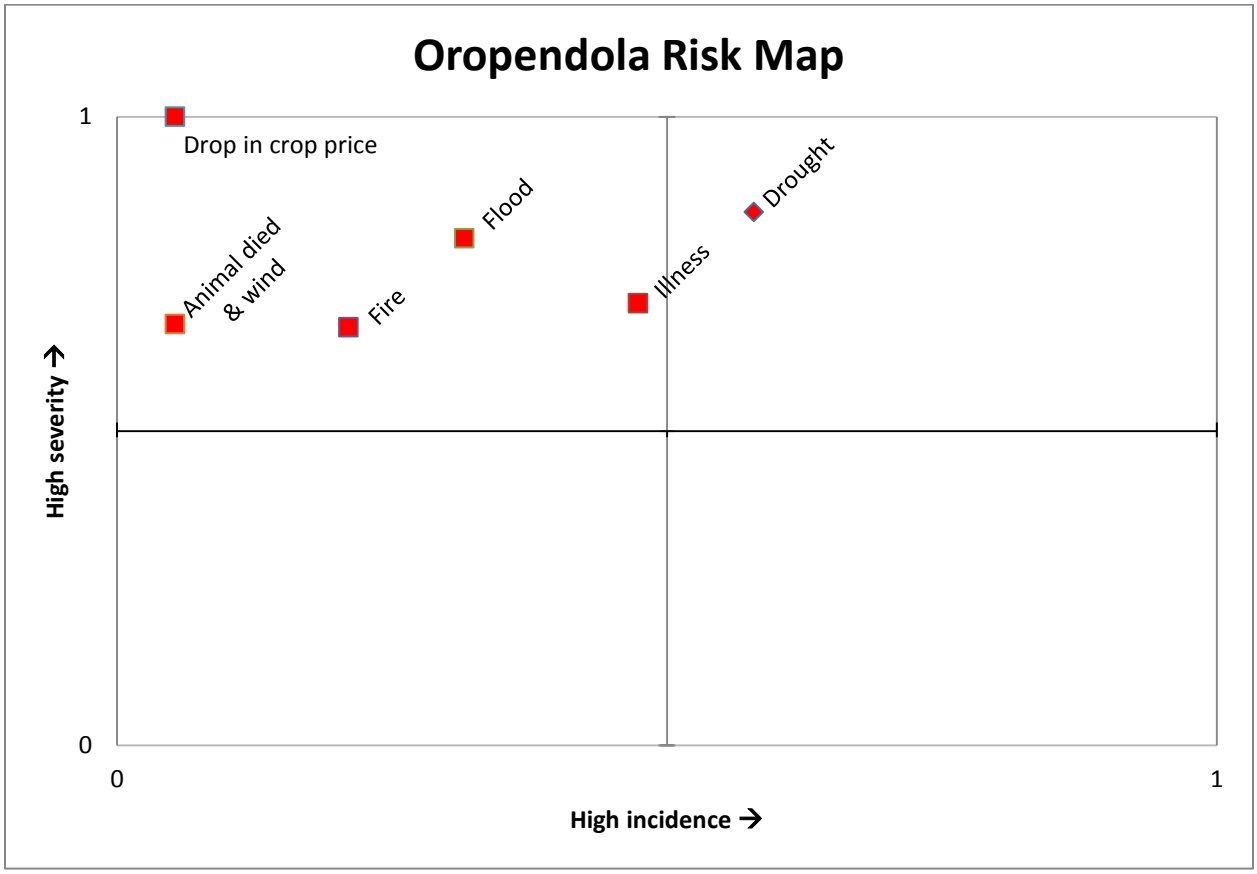

Figure 6.3 Risk map of Oropendola (n=19)

In Oropendola, drought is the most harmful risk, falling into the "High severity, High incidence" quadrant. All other risks lie within the "High severity, Low incidence" quadrant. These risks have affected only a few respondents, but the impact on the affected households was quite hurtful. The most interesting observation from Figure 6.3 is the risk of a drop in crop price. Only one respondent cited that risk, but it is the most harmful risk perceived by that respondent.

Table 6.4 presents the breakdown of 5-year recurrences and respondents' predictions of future recurrence of the seven risks. It shows that all of the reported risks, except crop price fall, have been problems in the past. Also, at least 50% of the respondents perceive that many of the reported risks (except crop price fall and animal died) are likely to occur in the near future.

Risk	*Has occurred in the past 12 months*	*Has occurred in the 5 years prior to the last 12 month*	*Will occur again soon*
Drought	11	10	7
Illness	9	8	5
Flood	6	8	4
Fire	4	4	2
Crop price fall	1	0	0
Animal died	1	1	0
Wind	1	1	1

Table 6.4 Past and future risk analysis of Oropendola

6.2.3 Discussion

Residents of both Caracara and Oropendola face similar risks. The first set of risks, from natural disasters, includes floods, drought, and wind. Among these three natural disaster risks, only floods and drought were cited by more than half of the respondents in each community. Illness is another common risk, and it was the second most-cited risk in both communities. Loss of animals (through death or robbery) and crop failure are another set of risks that reduce household assets; these risks affected only a handful of respondents in both communities. Fire was reported only by a few residents of Oropendola, and a drop in crop price was cited only once in Oropendola.

Among the nine combined risks reported, four risks – floods, illness, wind, and death of an animal – are cited by members of both communities. As shown by the corresponding risk indices, floods definitely are perceived to be more harmful by the residents of Caracara than by the residents of Oropendola. One reason flooding has such high incident and a severity rating is that there was a flood when we visited Caracara; the recall effect was very strong among the respondents. Illness, on the other hand, has affected more Oropendola residents than Caracara residents (47% versus 35%). The remoteness of Oropendola could explain this outcome. Since Caracara is located closer to a market where many services are available, seeking preventative

medical care is easier for the people of Caracara than for the people of Oropendola. When we were in Caracara, we encountered medical workers giving vaccinations to Caracara's residents. During our visit to Oropendola, one respondent showed us a broken arm covered by cloth bandages. He told us that he fell off of his motorcycle while driving to Urubichá. Instead of seeking professional medical attention, he has used medicinal plants from the forest to help ease the pain. Another respondent, along with several members of his family, fell ill with a stomach virus, but they did not seek any medical care. These anecdotes show that illness could be more prevalent in Oropendola, and more harmful to the people, due to their lack of access to medical care. Finally, wind and the death of an animal affected at most two respondents and are two of the least harmful risks in both communities.

As discussed in chapter 4, household characteristics can affect which types of risk a household may be exposed to. In order to understand how different household characteristics influence households' perception of risk, I compare the indices of the top two risks from each community between households headed by men vs. households headed by women (Table 6.5 and Table 6.6).

Caracara						
	Male		*Female*		*Change in incidence index*	*Change in severity index*
	Incidence index	*Severity index*	*Incidence index*	*Severity index*		
Flood	0.88	0.96	1.00	0.87	-13%	10%
Illness	0.25	0.75	0.50	0.67	-25%	8%

Table 6.5 PRM comparison of men- vs. women-headed household of Caracara

Oropendola						
	Male		*Female*		*Change in incidence index*	*Change in severity index*
	Incidence index	*Severity index*	*Incidence index*	*Severity index*		
Drought	0.53	0.81	1.00	1.00	-47%	-19%
Illness	0.47	0.75	0.50	0.33	-3%	42%

Table 6.6 PRM comparison of men- vs. women-headed household of Oropendola

Table 6.5 shows that all women household heads in Caracara reported flood risk but only 88% of men household heads reported floods. However, men-headed households consider flooding a more severe risk than women-headed households do. Women-headed households reported more incidents of illness than men-headed households do, but women perceive illness to be a less severe risk.

In Oropendola (Table 6.6), all women household heads reported drought risk, but only 53% of men household heads reported drought. Women-headed households also perceive drought as a more severe risk. Women also reported slightly more incidents of illness, but they perceive illness as a less severe risk than men do.

Next, I compare how the number of kids affects households' perception of the top two risks. I classify a household as a fewer-kids-household if its kid-to-adult ratio is less than or equal to one; if a household has at least the same number of adults as kids, that household is considered a fewer-kids-household. Otherwise, households with more kids than adults are classified as a more-kids-household. Table 6.7 shows the comparison of Caracara and Table 6.8 shows the comparison of Oropendola.

Caracara						
	Fewer kids		*More kids*		*Change in incidence index*	*Change in severity index*
	Incidence index	*Severity index*	*Incidence index*	*Severity index*		
Flood	0.93	0.92	0.88	0.88	5%	4%
Illness	0.50	0.71	0.25	0.67	25%	5%

Table 6.7 PRM comparison of households of Caracara with different kid-adult ratios

Oropendola						
	Fewer kids		*More kids*		*Change in incidence index*	*Change in severity index*
	Incidence index	*Severity index*	*Incidence index*	*Severity index*		
Drought	0.60	1.00	0.56	0.67	4%	33%
Illness	0.70	0.62	0.22	1.00	48%	-38%

Table 6.8 PRM comparison of households of Oropendola with different kid-adult ratios

Table 6.7 shows that households with fewer kids in Caracara reported slightly more incidents of flood risk and perceived that as slightly more severe. Interestingly, households with fewer kids also reported more incidents of illness and perceived that as slightly more severe as well; most of these household heads are older people with adult kids.

Table 6.8 shows that Oropendola households with fewer kids reported slightly more incidents of drought risk and perceived that as more severe. Also, households with fewer kids reported more incidents of illness but perceived that as less severe.

One puzzling finding from the Caracara PRM analysis is the lack of reporting on risks such as land use disputes among members, outside intrusion, and the uneven distribution of forestry revenue. Recall from chapter 5 that timber extraction and coca production have led to an increase in illegal logging in Caracara's territory by community members and outsiders. Furthermore, elites of Caracara have captured most of the financial benefits from forestry activities and have ignored the community rules requiring investment of some revenue in improvement projects. These concerns were raised during interviews with the respondents or

when they were answering other survey questions. Surprisingly, when the respondents were asked to list the risks under the PRM protocol, they only listed the six shown in Table 6.1.

Similarly in Oropendola, the respondents did not mention the risks of illegal logging, land conflicts, or elite control of forest-based activities. Although some residents have raised concerns about the loss of valuable tree species and the increased difficulty of hunting animals due to deforestation, none of them listed forest degradation as a risk. Furthermore, the people who disagreed with the implementation of the Forest Management Plan and the distribution of forestry-related jobs did not mention those perceived unfair activities as risks.

Lastly, no respondents listed population growth as a risk, although the population has grown almost threefold in twenty years. I argue that population growth is a risk even though both communities have small numbers of residents and big territories. During the interviews, some respondents discussed the increased demand for forest materials to support the growing population; they mentioned that more trees were cut to build houses and shelters for animals. Another signal of this risk is more applicable to Oropendola: as the number of households increases, each household is likely to get a smaller share of the forestry revenue. This direct impact to the financial benefit received may trigger some residents to advocate expanding timber trade or cause other tensions.

One possible explanation for these discrepancies is that respondents focused on the risks that affect their daily operations. For instance, they are concerned about floods or illnesses that prevent them from going to the *chacos* to farm, or crop failure and animal loss that reduce the value of their personal assets. Deforestation and outside intrusion do not affect the respondents' personal space directly, so they worry less about those risks. Furthermore, if a respondent has never received financial benefit from forestry activities, as in Caracara, continuous elite capture

is not a risk to her at all. Another explanation is that the respondents have accepted outside intrusion, population growth, and elite capture as a normal part of life. In Caracara, where the residents had tried but failed to remedy these situations, respondents no longer consider these occurrences as risks because the uncertainty is gone. All of these explanations are plausible. Comparing the PRM analyses with findings from chapter 5 shows how the different dimensions of risk are perceived and how they influence the daily lives of forest users.

6.3 Comparison of changes over time

The following analyses compare changes in Caracara and Oropendola between two time periods – 2006 and 2012. Within these six years, many events changed the forests and peoples' livelihoods in Caracara and Oropendola, and those events are discussed in chapter 5. This section analyzes these changes quantitatively, and explores the effects on the risks that members of both communities encountered and the coping strategy options they used.

6.3.1 Changes in the communities

Many political and social changes occurred in Caracara and Oropendola between 2006 and 2012. Some of these changes have affected the relationships between the forest users and their forest, and others have altered the relationships among community members. In the 2012 household survey, the respondents were asked how they use the forest, their views on the forest conditions, and their opinions about forest management activities. In addition, demographic and livelihood information was collected. The new data are paired with the data from the SANREM project for comparison. Table 6.9 presents statistics on some key changes from that time period.

	Caracara			*Oropendola*		
	2006	*2012*	*Change*	*2006*	*2012*	*Change*
Population	184	300*	63%	174	240*	38%
Number of households	36	51	42%	25	36	44%
Average family size	5.1	5.9	15%	7.0	6.7	-4%
Average # of kids under 15 per household	3.2	2.8	-13%	4.7	3.3	-30%
Women-headed household	14%	38%	176%	14%	11%	-21%
Average age of household head	36	43	19%	39	44	13%
Average size of cropland owned (ha)	1.3	0.9	-28%	6.3	3.3	-48%
Average size of total land owned (ha)	6.5	5.3	-19%	42.4	47	11%
Average food grown	41%	18%	-56%	73%	83%	14%
Rate common forest as important for subsistence	91%	95%	4%	91%	100%	10%
Rate common forest as important for cash income	80%	90%	13%	100%	100%	0%
Report good forest condition	28%	23%	-18%	41%	95%	132%
Rate forest rules as fair	42%	35%	-17%	53%	69%	30%
Rate penalty as fair	27%	24%	-11%	63%	75%	19%
Participate in forest management activities	69%	48%	-30%	95%	82%	-14%
Receive money from forest activities	0%	0%	0%	91%	100%	10%
Overall satisfaction with forest management activities and benefits	71%	32%	-55%	43%	80%	86%
N	29	26		22	19	

* Estimated number

Table 6.9 Comparison of social changes in Caracara and Oropendola

Both Caracara and Oropendola are experiencing population growth, 63% and 38% respectively. This growth is the result of an increase in the number of family members and/or number of households. In Caracara, the growth mainly comes from the increasing number of "outsiders" who move into the community. In Oropendola, the formation of families by adult children is the main driver of population growth; some Oropendola natives marry people from nearby villages or towns and start a new family. In other cases, adult children move back to the community with their families.

Meanwhile, both communities are aging; the average ages of household heads in both communities increased, while the numbers of kids under 15 dropped. In 2006, women headed 14% of households in both communities. This number had almost tripled in Caracara by 2012, but dropped by 21% in Oropendola.

Residents of both communities are reducing the size of land they farm. In Caracara, the sizes of croplands and total land owned both dropped. This is not a surprising trend because the percentage of self-grown food declined by more than half. As discussed in chapter 5, proximity to market has changed the livelihood strategies of the people of Caracara. These farming data support the argument that more residents are engaging in wage labor for cash income and purchasing food from the market, rather than growing their own food. In Oropendola, however, the percentage of self-grown food increased slightly, but the size of cropland dropped by almost 50%. One explanation is that people in Oropendola farm more efficiently and obtain higher yields on less land. This explanation is plausible because one NGO has implemented an agricultural improvement project in Oropendola. Furthermore, by participating in the FSC certification process and the Forest Management Plan, residents of Oropendola have been exposed to newer technologies that may increase their yields.

Members of both communities consider their forest important for subsistence as well as for cash. However, the people of Caracara lowered their rating of the forest; only 23% of residents reported the forest condition as good in 2012, compared to 28% in 2006. In Oropendola, however, the number of people who reported their forest condition as good has more than doubled. This positive rating supports many residents' claim that the FSC certification and the Forest Management Plan have helped improve their forest.

The people of Caracara have very negative feelings about forest management activities and forest rule implementation. The number of people who think the forest rules and penalties are fair dropped by 17% and 11%, respectively. In addition, participation in forest management activities dropped by 30%. On the other hand, the number of Oropendola residents who think the forest rules and penalties are fair increased by 30% and 19% respectively. Nonetheless, participation in forest management activities also dropped by 14% in Oropendola. The most polarized number is the percentage of residents who receive financial benefit from forest-related activities; 0% in Caracara and 100% in Oropendola. Recall from chapter 5 that local elites in Caracara have controlled forestry activities and have captured most of the benefits. This explains why none of the respondents reported forest income sharing in Caracara. Lastly, in Caracara, the overall level of satisfaction with forest management activities decreased by 55%, while the same number jumps 86% in Oropendola.

The results from this analysis are consistent with the findings from chapter 5. The perceived forest condition and the interpersonal relationships among community members in Caracara are deteriorating. Residents indicated that trees and animals are disappearing due to forestry activities, but they are not receiving any financial benefits from timber extraction. Their displeasure with the situation is clearly reflected in the statistics presented here. On the contrary, forest management activities have generated positive outcomes in Oropendola. The local people consider their forestry operation sustainable, and all residents are receiving financial benefits from the operation. The optimistic outlook on the forest and their livelihoods likely induces the positive ratings in Oropendola.

6.3.2 Changes in the forests

The territories of Caracara and Oropendola are 6,845 and 56,140 hectares, respectively, and only parts of these vast areas are classified as IFRI forests, where the IFRI forest surveys are performed. In Caracara, the IFRI forest is 1,523 hectares, while in Oropendola it is 691 hectares. The agreements to define the IFRI forest and to conduct longitudinal studies in the same forest area were reached by the local people and the Bolivian CRC.

The forester determines which and how many plots to survey in an IFRI forest. For the first studies done in 2006, the forester selected the plots randomly. In Caracara, only the "safe" undisputed lower area, i.e. the area outside the red circle in Figure 5.3, was used as the sampling frame. In Oropendola, the whole IFRI forest area was the sampling frame. For the 2012 studies, the forester attempted to survey the 2006 plots. In Oropendola, all 38 plots surveyed in 2006 were revisited in 2012. In Caracara, flooding has blocked access to certain areas of the IFRI forest, so only 35 plots were chosen randomly based on accessibility.

Table 6.10 presents the analysis of the two forests using the IFRI forest data. Appendix 5 shows all of the identifiable species. Since the number of plots surveyed in Caracara decreased by over 60%, the following comparisons are done using normalized statistics – DBHs, Tree density, and Tree diversity. Recall from chapter 4 that 'Tree density' is 'Stem count' divided by the size of the forest area surveyed. 'Tree diversity' is calculated using a species count sampling technique (Wills et al., 2006).

	Caracara			*Oropendola*		
	2006	*2012*	*% change*	*2006*	*2012*	*% change*
Plots surveyed	95	35		38	38	
Stem count	2211	355		607	602	
Species count	291	63		98	64	
Median DBH (cm)	13	13	<1%	13	15	15%
Mean DBH (cm)	17	15	-14%	16	17	4%
Variance (cm)	277	116	-58%	271	154	-43%
Tree density (per ha)	741	323	-56%	508	504	<-1%
Tree diversity	52	39	-24%	34	34	<-1%

Table 6.10 Comparison of forest change in Caracara and Oropendola

The overall condition of Caracara's forest is deteriorating. The average size of trees is 14% smaller, and this is likely caused by the harvesting of larger trees. The greatest change is the 56% drop in plant density; this indicates that more than half of the trees that existed in 2006 were no longer there in 2012. Plant diversity also decreases by 24%, so a more homogenous forest was observed in 2012. It is possible that when more older trees were cut, the remaining trees are likely to be similar in size and age. This could lead to reductions in plant diversity if some plant species are dependent on older trees. In sum, Caracara's forest is getting thinner (fewer trees), with smaller trees and less diverse tree species.

Overall, trees are getting bigger in Oropendola. The median DBH increases by 15% while the mean DBH increases by 4%. The minor drops in the tree density and diversity indices suggest that the forest has not experienced major changes. Similar to the 2006 forest results, the mean DBH of both communities is larger than the median DBH; this signals that there are still more smaller trees than bigger trees. Also, variances drop in both communities over the last six years. This suggests that tree sizes are becoming more even over time.

6.3.3 Changes in risks and coping strategy options

For both Caracara and Oropendola, the types of risk encountered and the corresponding frequencies have changed between the 2006 and 2012 period. In the 2006 survey, the respondents were asked to answer yes or no to a list of identified risks, while in 2012 the PRM technique was used. The difference in asking the risk-related questions presents some challenges in comparing the responses directly. Therefore, I consolidate some related risks and classify them into five groups. Then, I calculate the percentages by dividing the count of each risk cited by the number of surveys done. Table 6.11 shows the groupings and the comparisons. Figure 6.4 shows the graphical presentation.

	Caracara		Oropendola	
	% cited in 2006	*% cited in 2012*	*% cited in 2006*	*% cited in 2012*
Farming issues				
Crop failure/pests	59	12	50	0
Health issues				
Illness	41	35	55	47
Death	0	0	5	0
Theft issues				
Loss of livestock*	21	15	5	5
Loss of land	10	0	5	0
Loss of major asset	7	0	18	0
Natural disasters				
Flood	0	92	0	32
Wind	0	8	0	5
Drought	0	0	0	58
Miscellaneous				
Fire	0	0	0	21
Crop price fall	0	0	0	5
Other	28	0	45	0

* Refers to animals that died or were stolen

Table 6.11 Comparison of changes in risk in Caracara and Oropendola

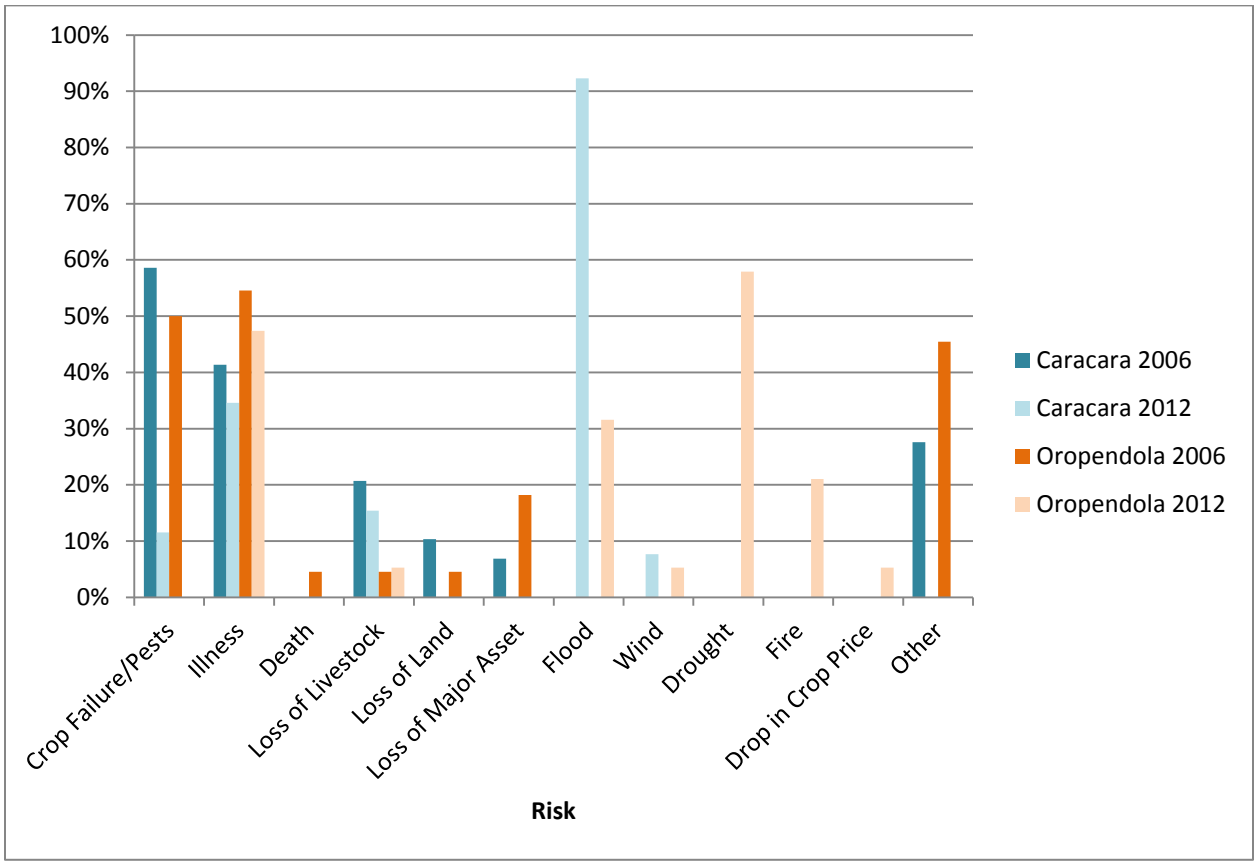

Figure 6.4 Frequency of risks cited

In Caracara, the risk of crop failure dropped almost four times, while health related risks decreased by 6%. Risks related to theft have occurred less frequently. Loss of livestock still occurs, but the frequency dropped by 6%. Losses of land or other major assets were not cited at all in 2012. Flooding was the most harmful risk in 2012, but it was not reported in 2006. Comparing Caracara's risk data between the two periods suggests that living conditions have improved. The residents are more likely to obtain the expected yield from crops, they are slightly healthier, and they are living with less exposure to theft. However, natural disasters like flooding and wind have become major threats to the residents.

In Oropendola, crop failure affected 50% of the respondents in 2006, but was not cited at all in 2012. No deaths were recorded in 2012, and the frequency of illness dropped by 8%. Risk

of animal theft remained minor, and respondents no longer cited losses of land or other major assets as risks. However, natural disasters have become significant threats to the people of Oropendola. Flood, wind, and drought, which were not recorded in 2006, showed up in 2012. Respondents cited other minor risks, such as fire and a drop in crop price, in 2012 only.

In addition to identifying risk, respondents in both the 2006 and 2012 household surveys were asked to report the coping strategy options they used to deal with each risk. The respondents could discuss any strategy they used, and the responses were grouped into one of the 12 identified strategy options by the SANREM project (see section 4.3.2). Results show that only 10 of the 12 strategy options were used. Table 6.12 lists the coping strategy options used and their distributions. I calculate the percentages by dividing the count of each coping strategy option used by the number of risks cited. A graphical presentation is shown in Figure 6.5.

Coping strategy options	*Caracara*		*Oropendola*	
	% cited in 2006	*% cited in 2012*	*% cited in 2006*	*% cited in 2012*
Harvest more forest products	6	0	20	0
Harvest more wild foods	2	0	0	0
Harvest more farm products	0	0	18	0
Spend cash savings	15	7	18	21
Do extra casual labor	6	2	3	12
Help from friends or relatives	0	0	3	0
Get loan	4	12	0	12
Reduce household spending	4	2	0	0
Did nothing	58	69	33	45
Other*	4	2	8	21

* For Oropendola, assistance from government is commonly mentioned

Table 6.12 Comparison of changes in coping strategy options in Caracara and Oropendola

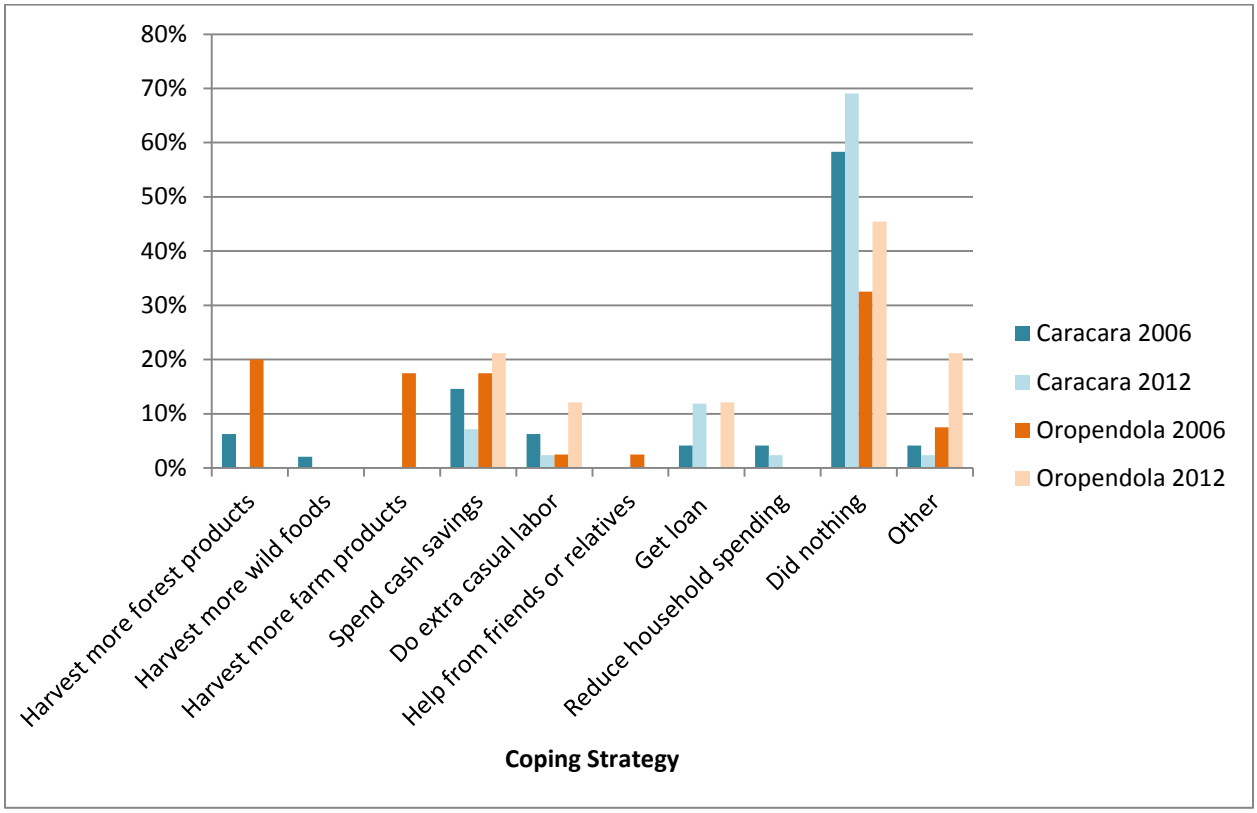

Figure 6.5 Frequency of coping strategy options used to manage identified risks

In both communities, reliance on forest and farm products as a way to cope with risk has decreased. Instead, getting a loan has become a popular option in both communities; use of this coping strategy option increased by 8% in Caracara and by 12% in Oropendola. The people of Caracara are less likely to spend cash savings, do extra casual labor, or reduce household spending; the use of these strategy options declined by 8%, 4%, and 2% respectively. For the residents of Oropendola, spending cash savings and doing extra casual labor are still viable options; the percentage of respondents who use these two coping strategy options increased by 3% and 9%, respectively. Furthermore, Oropendola's residents no longer rely on help from friends or relatives, but they do accept more assistance from others (a jump of 13 %), and the most commonly mentioned source of help is the government. Assistance from the government is an option for the residents of Oropendola but not for the people in Caracara because Oropendola

maintains good relationships its local government officials. In both communities, "did nothing" is still the most common response to risk. The increases in this response were 11% in Caracara and 12% in Oropendola.

Multiple reasons can drive the respondents to answer "did nothing." The respondent may feel helpless in dealing with risk because she has no strategy option. As a result, she has no incentive to do anything or even try to cope. Or, the respondent may have tried but still cannot find any valid strategy, so the end result is still "did nothing." The respondent may feel no need to deal with the risk because the impact is likely to be minimal. For instance, a household with dozens of livestock may decide to do nothing if one or two died. For the first two cases, the respondents decided to do nothing involuntarily, while the respondents of the third case chose "did nothing" voluntarily.

From my observation in the field, many of the respondents who answered "did nothing" fell into the first two cases; these are households that have less material or physical capital to find valid strategy options. To validate this assumption, I analyzed the income levels of the respondents based on the frequency of their "did nothing" replies. For the group that has only one "did nothing" reply, the average income is 9994 Bolivianos. For the group that has two "did nothing" replies, the average income is 6769 Bolivianos. For the group that has three "did nothing" replies, the average income is only 700 Bolivianos. These differences in income among the three groups strengthen the assumption that households that responded "did nothing" more frequently lack financial buffers that could shield them from the harmful impact of risk. Instead, these households are more likely to feel helplessness in finding valid coping strategy options.

Further analysis found that there are only two significances in the relationships among coping strategy options used and household characteristics. The first is a 0.43 correlation

between women-headed households and the "spend cash savings" strategy in the 2006 data. The second is a 0.26 correlation between women-headed households and the "get loan" strategy in the 2012 data. Both correlations are below the 0.01 significance levels. These findings suggest that women-headed households have a higher reliance on emergency cash to cope with hardship.

To compare the two communities' abilities to deal with risk, I calculate the copability index as explained in chapter 4. Recall that the "copability index" is calculated by dividing the number of valid strategy options by the total risk count; a high index means a higher ability to cope. Valid strategy options are listed in Table 6.12 (except "did nothing"). Table 6.13 presents the comparison of the two communities in 2006 and in 2012. This analysis shows that people in Caracara were less able to cope with risks in 2012 than in 2006, while Oropendola residents' ability to deal with risk remained stable.

	Caracara		*Oropendola*	
	2006	*2012*	*2006*	*2012*
Risks count	48	42	40	33
Valid strategy options count	20	11	27	22
Copability index	0.42	0.26	0.68	0.67

Table 6.13 Comparison of changes in copability index in Caracara and Oropendola

6.3.4 Discussion

Several observations from this comparative analysis are worth discussing. First, despite the population growth, the average size of cropland fell. In Caracara, this can be explained partly by the increased consumption of purchased food, but this condition is not observed in Oropendola. Therefore, I hypothesize that farming conditions have improved, so residents obtain a better yield with less land. The "Crop failure/pests" risk data support this hypothesis. In both Caracara and Oropendola, the risk of crop failure dropped to 12% and 0%, respectively.

This reduction in crop failure risk likely has allowed the locals to produce enough food even while farming a smaller piece of land.

Second, population pressure does not increase the risk of land loss. I raised the concern about the lack of reporting on land conflicts with outsiders in section 6.2.3, and suggested that the respondents were only citing risks that affect them directly in their personal space. Under this assumption, the drop in the "Loss of land" risk indicates that land security in the residents' personal territory has improved in both communities. Furthermore, there is enough land to support newcomers, so no internal land conflict was cited.

Third, the biological forest data echo Caracara's residents' reports of their forest. The majority of the residents indicated that timber extraction and coca cultivation were degrading their forest, and the deteriorating conditions observed in the biological data confirm their claims. In Oropendola, a few people suggested that the forest condition was deteriorating, but more residents indicated that their forest was improving. Although the forest data show slight decreases in all three indicators, the changes are so minor that they are not likely to be detected by the residents. It is possible that the people of Oropendola consider their forest condition to be improving because their forest is in better condition compared to other forests nearby. Given their successful implementation of the Forest Management Plan and the FSC certification, the people of Oropendola are able to practice sustainable forestry that has improved their living conditions and the condition of the forest. These beneficial outcomes may lead them to respond positively to the question about changes in forest conditions.

Fourth, the reliance on the forest as a safety net has definitely shifted between 2006 and 2012; more dramatic changes are shown in Oropendola. Although the forest is still highly regarded as an important source for subsistence and cash income, residents of the two

communities did not seek out forest resources to cope when they experienced hardship. One plausible explanation is that the most harmful risks encountered by Caracara and Oropendola were flooding and drought, and these natural disasters could affect the accessibility and availability of forest products. Therefore, the forest's role as a safety net has been limited in 2012. It is also possible that access to loans has partially replaced the need to use more forest products during times of adversity. In Caracara, market penetration likely provides channels for residents to seek loans. In Oropendola, emergency loans mainly come from the government or the community. In both cases, residents may not have to rely on forest resources to cope. Also, jobs from the Forest Management Plan and the forestry sector have provided opportunities to earn and save cash for emergencies. This may lead to less reliance on natural resources as a safety net by residents of Oropendola.

Fifth, government assistance plays an important role in helping Oropendola's residents deal with risk. Oropendola has been able to get help from the government because of its good relationship with the government officials and the positive outcomes that local officials can show to the central government, e.g. the community school. This relationship is definitely beneficial to Oropendola, but it can undermine the more urgent needs of other communities. If the government officials have the tendency to work with Oropendola's residents and allocate resources to deal with their issues, less attention may be given to members of other communities. It is possible that other communities have more need for the financial and administrative help in dealing with their risks.

Finally, risks from natural disasters – flood, drought, wind – have become more prominent in both communities. Nevertheless, neither community has any plan or strategy to manage those risks collectively. Moreover, further analysis shows that "did nothing" is the most

common response to these risks; 76% of respondents reported this reaction in Caracara, and 46% in Oropendola.

These findings suggest that risk management policies can make a difference in the livelihoods of the people and their forests. For example, providing affordable loans not only can reduce locals' reliance on the forest, but also can provide a reliable and manageable way to recover from hardship. Furthermore, risk management programs can help locals draft and implement plans to manage risks from natural disasters. Outside agencies can help forest users identify their impacts on the forests and ways in which their activities induce risk. In addition, natural disaster management programs can help forest users cope when risks are realized. Finally, initiating development programs that shift livelihoods from subsistence to sustainable forestry will benefit both the communities and the environment. As shown in Oropendola, this development path can help community members improve their living standards, their ability to cope with future risks, and their forest's condition.

Chapter 7

How Does Risk Affect Property Rights Preferences?

7.1 Introduction

As discussed in chapter 2, many policies guided by the ETLR have failed to deliver on the promises of better land security, social harmony, and economic advancement. Alternatively, some scholars began to revisit common property rights arrangements and examine how this land tenure system can be implemented to effectively govern resources that are classified as CPR. Common property rights grant ownership, along with a bundle of rights, to a group of people who commit to working together in order to secure long-term benefits from the resources. McKean (2000) outlines four advantages of using common property rights for managing forests (see section 2.2). One of her arguments states that common property rights arrangements can act as a risk management strategy. Forests, under common property rights arrangements, provide a bigger shared safety net that provides forest products during times of hardship. This argument is supported by empirical case studies' findings that some communities use common property rights to manage risk. However, we lack a quantitative test of that argument. Hence, the first part of this chapter is designed to test this theory using data collected from Caracara and Oropendola. It aims to answer the research question about how risk exposure and coping ability affect forest users' preference for common property rights arrangements.

Furthermore, studies discussed in chapter 2 conclude that defining and implementing a certain property rights arrangement does not necessarily lead to a particular natural resource outcome (Agrawal et al., 2008; Casimir & Rao, 1998). Thus, the second part of this chapter is to build a profile of the forest users who prefer a higher level of common property rights. The goal is to understand how forest users' perceptions of the forest and the interrelationships in the community affect their preferences for common property rights, and how a preference for common property rights influences their decisions, actions, and behavior towards forest governance. I compare two groups of forest users – one that prefers a higher level of common property rights and another that prefers a lower level – in four categories: trust, perception of forest conditions, reliance on forest resources, and participation in forest management activities.

A regression model tests the relationships among risk exposure, coping ability, and common property rights preferences. Findings from this analysis show that risk exposure does not drive preferences for a higher level of common property rights. Rather, a lack of valid coping strategy options for dealing with risk is a significant factor. By calculating the odds ratios, the model shows that forest users who lack valid coping strategy options are 12.4 times more likely to favor common property rights, holding other variables constant. This finding supports McKean's argument; common property rights can be used as a viable risk management strategy, especially for forest users who lack other coping mechanisms.

To test for correlations among forest users' perceptions, their behavior, and their preferences for common property rights, I run chi-squared tests to compare the two groups and calculate the correlation coefficients. This analysis shows that lack of trust among community members is likely to affect one's preference for a higher level of common property rights. This finding aligns with Ostrom's (2005) theory indicating that trust is an important factor facilitating

collective action. In addition, forest users who consider the forest to be a very important source for subsistence and cash income are likely to prefer a higher level of common property rights. This finding is consistent with the argument that common property rights arrangements benefit forest users who have higher dependency on forest resources. Lastly, forest users who favor common property rights are likely to participate more in monitoring their property. This finding supports Gibson's (2005) argument that rule enforcement is crucial to effective natural resource governance.

7.2 Risk and property rights preferences

Two hypotheses are tested in order to examine the relationships among risk exposure, coping ability, and property rights preferences. McKean (2000) argues that common property rights arrangements are a good alternative for managing risk. She suggests that the common property rights arrangement spreads environmental risks across a larger forest area and distributes possible losses among more people, thus reducing individuals' potential losses. This argument implies that common property rights arrangements are beneficial to forest users, especially to those who encounter higher levels of risk. When high-risk forest users agree to govern their forest as common property, risk is born by a larger pool of people. When risks are realized, users have a bigger resource base that they can utilize in order to cope. McKean's argument is supported by case studies documenting the use of common property rights to manage risk (Axelrod & Fuerch, 2006; Banks, 2003; Nugent & Sanchez, 1998; Robledo et al., 2012). However, there is a lack of quantitative test to verify this argument. Therefore, the first hypothesis examines the influence of risk exposure on forest users' preferences for common property rights. It states that the more risks a household experiences, the more likely it is to prefer a higher level of common property rights.

In addition to risk exposure, the availability of coping strategy options can play an important role in shaping forest users' behavior when harm from risk is realized. As mentioned in chapter 2, some households rely more on forests as safety nets because they lack the human capital to accumulate emergency cash, or they face barriers to obtaining loans. For these households, setting aside some forest area as common property is a choice that they can make without putting themselves at a disadvantage. Common property rights arrangements are a less costly and more accessible option for managing risk, and should be preferred by these forest users. The second hypothesis tests this relationship. It states that the fewer coping strategy options a household has, the more likely it is to prefer a higher level of common property rights. To summarize, Table 7.1 shows the two hypothesis and the variables:

Hypothesis	*DV*	*IV/proxy measures*
H1: The more risks a household experiences, the more likely it is to prefer a higher level of common property rights	Common property rights preference	Number of risks cited
H2: The fewer coping strategy options a household has to deal with risk, the more likely it is to prefer a higher level of common property rights	Common property rights preference	Number of occasions that valid coping strategy options are not available to deal with the risk encounter

Table 7.1 Summary of hypotheses and variables for testing risks and property rights preference

7.2.1 Analysis and results

As part of the household survey of Caracara and Oropendola during the 2012 visit, the respondents were asked to state their preferences for using common property rights to manage their forests. Forty-three answers were collected; two respondents did not answer this question. Table 7.2 presents the list of options from which the respondents could choose, and the distribution of their answers.

Preferences	*Frequency*
0: no portion of the forest should be common property, i.e. all private	9 (21%)
1: a bigger portion of forest to be private property than common	3 (7%)
2: the same portion of forest to be private property as common	4 (9%)
3: a bigger portion of forest to be common property than private	4 (9%)
4: no portion of the forest should be private property, i.e. all common	23 (53%)
Total	43 (100%)

Table 7.2 Distribution of common property rights preferences

Table 7.2 shows that more than half of the respondents favor common property rights. Over 70% of respondents stated that at least half of the forest should be managed as common property. In order to test how risk exposure and availability of coping strategy options affect the above preferences, i.e. H1 and H2, I develop an ordered logistic regression model. This model is suitable for this analysis because the dependent variable (DV) is an ordinal (ordered-category) variable. In addition to the DV, I add several control variables to the model. They are: (1) age of the household head, (2) gender of the household head, (3) the ratio of the number of children under 15 to the number of adults in the household, (4) income, and (5) a community indicator. The first four control variables are added because studies have suggested that households that are headed by women or older adults, or that have more children or are poorer, have a higher reliance on forest resources (see section 2.2). Therefore, it is likely that their dependency on forest resources influences their preference for a higher level of common property rights. Therefore, adding these four control variables can test the impact of risk exposure more accurately. The fifth control variable – a community indicator – is added because findings from chapter 5 show that Caracara and Oropendola have quite a few contextual differences that may lead residents of a certain community to favor common property rights. A control for community can address that issue.

Table 7.3 presents descriptive statistics of the variables for testing H1 and H2. Recall from chapter 6 that residents of the two communities reported a total of nine different kinds of risk, and they used five different coping strategy options to deal with the risks. Also, residents of both communities reported "Did nothing" when they encountered certain risks, but "Did nothing" is not a valid coping strategy option so it is not included in the analysis. Note that some residents chose to skip certain questions, so the last column of Table 7.3 shows the number of responses collected for that particular variable.

Variables	*Min*	*Mean*	*Max*	*Standard deviation*	*N*
Number of risks cited	0	1.667	3	0.879	45
Frequency of lacking valid coping strategy options	0	0.978	3	0.866	45
Age of household head	22	43	78	12.156	43
Women-headed household					12
Kids under 15 to adult ratio	0	1.139	5	0.974	40
Income (in Boliviano)	200	6352	26800	7333.961	36

Table 7.3 Descriptive statistics of variables for testing risk exposure, coping ability, and common property rights preference

One possible concern is the need to distinguish past problems from risk, since past problems, like the death of an animal, may not occur again. As shown in Table 6.2 and Table 6.4, only two incidents of "animal died" were reported, and one of the respondents indicated that "animal died" is a risk that she anticipates to occur again. Given the small variation, no further distinction was made in the following analyses.

Regression results of the ordered logistic model are shown in Table 7.4. An interesting finding is that the level of risk exposure is not a significant factor driving forest users to favor common property rights; H1 is not supported by the data collected from the study area. However, the results support H2 – the availability of coping strategy options is a highly

significant factor influencing forest users' preferences for common property rights arrangements. In addition, women-headed household are more likely to support common property rights arrangements. This finding aligns with the argument that women-headed households have a heavier reliance on the forest, so the common property rights arrangement is more favorable for this group. People in Oropendola are also more likely to prefer common property rights; this result is consistent with the findings from chapter 5, which suggest that the more harmonious nature in Oropendola encourages collective activities, including managing the forest as common property.

	Preference towards common property rights
Risk count	-0.166 (0.651)
Lack of valid strategy count	2.515** (1.127)
Age of household head	-0.113 (0.077)
Women household head	4.143** (2.027)
Child to adult ratio	1.400 (1.099)
Income	0.001* (0.001)
Oropendola	6.649** (2.399)
Observations	31

Note: Standard errors are in parentheses[5]
* significant at 10% ** significant at 5%

Table 7.4 Ordered logistic regression results of risk exposure, coping ability, and common property rights preference tests

[5] *Model passed the parallel regression assumption test*

Finally, income has a minor positive significance toward common property rights preference; wealthier households prefer a higher level of common property rights. This finding contradicts the argument that poorer households that rely more on forest resources prefer a higher level of common property rights. Two lines of reasoning can be used to explain this result in the context of the study area. First, wealthier households favor common property rights because they receive more financial benefits from the arrangement. As seen in Oropendola, the successful implementations of the Forest Management Plan and the FSC certification have given some residents higher returns from forestry and forest management activities. In Caracara, common property rights arrangements have allowed the local elites to trade more timber or participate more in coca cultivation for cash income. For both communities, common property rights arrangements benefit the involved parties financially, and these benefits likely influence their preferences for a higher level of common property rights in managing their forests. Second, it is possible that forest users who have the means to shift away from subsistence living prefer to manage the forest as common property. Since these forest users are able to obtain cash income elsewhere, they may be inclined to keep the communal forest intact in case they need to access forest resources during an emergency.

In order to interpret the relationships and gauge the impact of each significant IV on the DV, I calculate the odds ratios (Table 7.5). The non-significant IVs are skipped for further analysis.

	Odd ratio of preference for common property rights
Lack of valid strategy count	12.37**
Women household head	62.99**
Income	1.001*
Oropendola	771.73**

* significant at 10% ** significant at 5%

Table 7.5 Odds ratios of preference for common property rights

The odds of favoring a higher level of common property rights are 12.37 times greater when a forest user has one fewer valid coping strategy options, holding other variables constant. For women-headed households, the odds of favoring a higher level of common property rights are 62.99 times higher than man-headed households, holding other variables constant. For each additional Bolivianos earned, the odds of favoring a higher level of common property rights are 1.001 times higher, holding other variables constant. Lastly, the residents of Oropendola are 771.73 times more likely than the residents of Caracara to favor common property rights arrangements, holding other variables constant.

This odds ratio analysis shows that the group that is least likely to favor common property rights arrangements is Caracara's households headed by men with sufficient coping strategy options to deal with risk. On the other end of the spectrum, women-headed households in Oropendola, with no valid coping strategy options to deal with risk, are most likely to favor common property rights. In order to compare the different groups' preferences for common property rights, I run four scenarios and calculate the predicted probabilities that each group will favor full common property rights. The four scenarios are: (1) men-headed households from Oropendola, (2) women-headed households from Oropendola, (3) men-headed households from Caracara, and (4) women-headed households from Caracara. Since income is less significant than the other variables in influencing common property rights preferences, the following

analysis ignores the variations of income by holding the income at the corresponding median of that community. Figure 7.1 presents the analysis for all four groups.

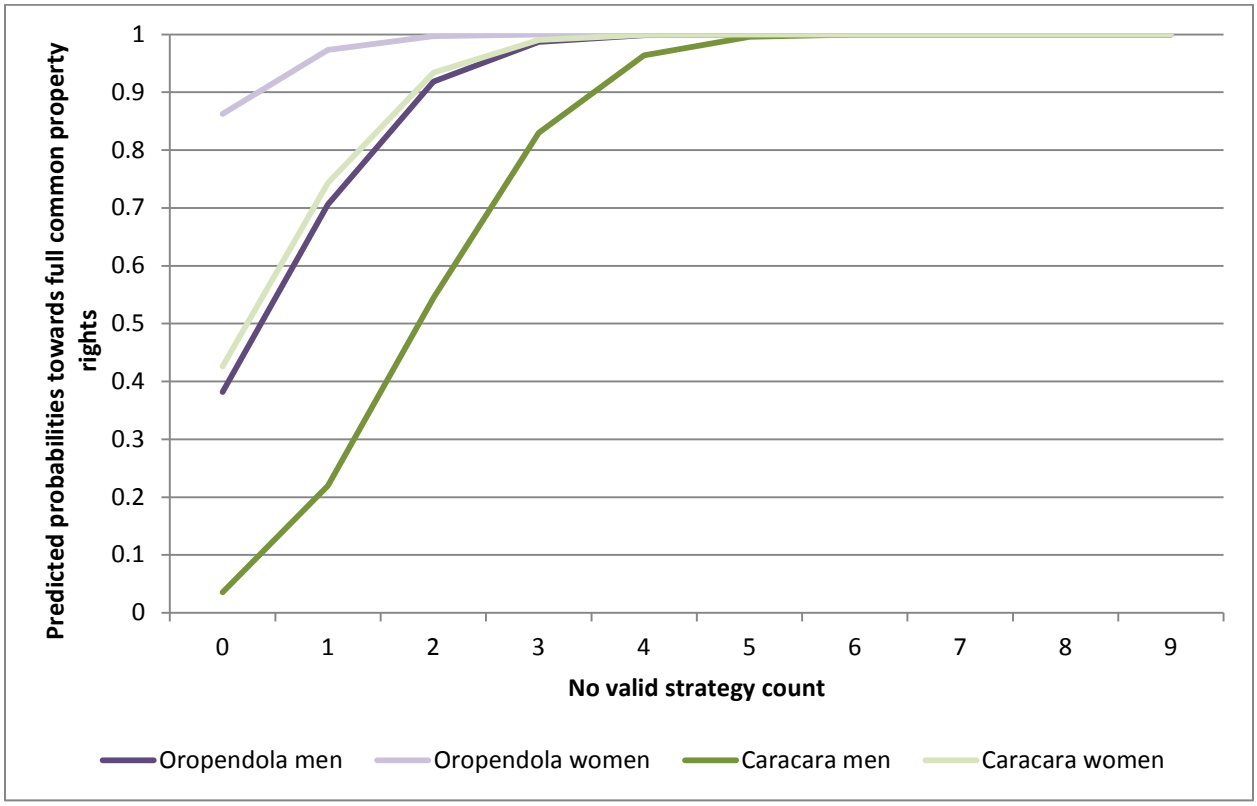

Figure 7.1 Predicted probabilities of four groups' preferences for full common property rights

Figure 7.1 shows that all four groups move toward a higher level of common property rights when (the frequency of) the lack of valid coping strategy options increases. In both villages, women in general favor common property rights more than their male counterparts. Men-headed households in Caracara (the group that is least likely to favor common property rights) have only a 6% chance of preferring full common property rights if they have coping strategy options to manage risk. However, if they lack valid coping strategy options to deal with just one risk, the likelihood of preferring full common property rights jumps to 26%.

Women-headed households in Oropendola (the group that is most likely to favor common property rights) has a 88% chance to prefer full common property rights even when using the

forest to manage risk is not their concern. If they lack valid coping strategy options to deal with just one risk, the likelihood of preferring full common property rights jumps to 98%.

For the remaining two groups, i.e. men-headed households in Oropendola and women-headed households in Caracara, their likelihoods of preferring full common property rights are quite similar. When they have options to deal with risk, men in Oropendola will have a 42% chance of preferring full common property rights while women in Caracara will have a 47% chance. When these two groups lack strategy options to deal with just two risks, their likelihoods of preferring full common property rights increases to over 90% for both groups. This analysis shows how the lack of valid coping strategy options for dealing with risk can shape forest users' preference in favoring common property rights, even for the group that is least likely to prefer common property rights.

Table 7.6 shows the sensitivity analysis of the impacts of different significant factors on property rights preferences. The lack of valid coping strategy options has less impact on the property rights preferences of high-income households. While residents of Oropendola generally prefer a higher level of common property rights, the lack of coping strategy options has a greater effect on the preferences of the low- to mid-income men-headed households than the women-headed households. For residents of Caracara, the lack of valid coping strategies has less impact on the low-income men-headed households than the other low- and mid-income groups in general.

Caracara					Oropendola				
Lacking valid strategy option count	Gender	Income			Lacking valid strategy option count	Gender	Income		
		Low	Med	High			Low	Med	High
0	M	0%	6%	100%	0	M	19%	42%	90%
1	M	2%	26%	100%	1	M	51%	74%	98%
2	M	13%	58%	100%	2	M	80%	93%	100%
3	M	41%	85%	100%	3	M	95%	99%	100%
0	F	7%	47%	100%	0	F	71%	88%	100%
1	F	30%	77%	100%	1	F	92%	98%	100%
2	F	62%	94%	100%	2	F	99%	100%	100%
3	F	87%	99%	100%	3	F	100%	100%	100%

Table 7.6 Predicted probabilities of full common property rights preferences by different significant factors

7.3 Property rights preferences and users' actions and behavior

Many case studies have shown that certain property rights arrangements do not lead to particular resource outcomes (Agrawal et al., 2008; Casimir & Rao, 1998). Although property rights regimes incentivize certain approaches to resource management, they do not dictate users' actions (Mwangi, 2007; Tucker et al., 2007). Instead, property rights regimes create incentives, and they motivate users to make certain decisions and take certain actions that could affect resource outcomes. In other words, the property rights arrangement alone does not determine forest outcomes; rather, the decisions and actions of the users within the confines of the property rights are important factors. So in order to understand how common property rights arrangements motivate adoption of better forest governance practices, it is necessary to understand first how forest users who prefer a higher level of common property rights differ from forest users who favor a lower level. I investigate the differences between these two groups from four different angles.

First, I compare forest users' perceptions of the relationships among community members in the two groups. As Ostrom (2005) suggested, trust is an important element influencing the likelihood of collective action. Without trusting relationships, community members are less able to ensure that the benefits of governing the forest as common property will be shared fairly. This lack of trust likely drives forest users to secure their individual benefits instead of working together for the good of the entire community. As a result, forest users who perceive a lack of trust among community members are less likely to favor common property rights arrangements, so the third hypothesis (H3) states that households that perceive a lack of trust among community members prefer a lower level of common property rights than other households. Since the 2012 household survey did not ask the respondents a trust question directly, I use internal conflict as the proxy to indicate the level of trust within a community. In the survey, the respondents were asked if there is any internal conflict among community members; they could respond yes or no, and these dichotomous responses will be used to test H3.

The level of trust that users have in the forest governance system is another important factor. If the forest users do not trust the rules and/or the institutions that govern the forest, which is the situation in Caracara, those forest users are less likely to favor common property rights arrangements. To test this argument, the fourth hypothesis (H4) states that households that have negative feelings toward the forest governance system prefer a lower level of common property rights than other households. In the household survey, the respondents were asked three questions about their opinions of the forest governance system. The first question asked if the forest rules are clear, and the respondents could answer yes or no. The second question asked if the forest rules are fair, and they could answer not fair, somewhat fair, or completely fair. The third question asked if the penalty is fair, and again they could answer not fair, somewhat fair, or

completely fair. To test H4, I combine the answers of the above three questions into one system trust indicator. I count the answers "not fair" and "rule unclear" as negative responses, and the rest as positive responses. If the respondent gave more negative responses than positive responses, I put the overall response into the weak system trust category. Otherwise, I put the overall response in the normal system trust category. Responses were dropped if a respondent gave an equal number of positive and negative responses. (This could occur as a result of some missing answers.) The system trust indicator is then used to test H4.

Second, forest users' perceptions of forest conditions also may affect how they think the forest should be governed. As Libecap (1989) and Netting (1976) indicated, the unpredictability of a resource is likely to create a preference for private property rights because users can easily secure their share of the benefits whenever they are available. I hypothesize that when the forest condition is deteriorating, forest users are less likely to foresee benefits in the long run. This drives them to choose a lower level of common property rights so that they can capture short-term benefits under a private property rights regime. The fifth hypothesis (H5) states that households that perceive a decline in forest conditions prefer a lower level of common property rights than other households. In the 2012 survey, respondents were asked to rate forest conditions based on six parameters: (1) abundance of common trees, (2) abundance of trees for food, (3) abundance of trees for firewood, (4) abundance of trees for timber sale, (5) diversity of tree species, and (6) diversity of animals. For each of these six questions, the respondents could indicate if the condition is improving, not changing, or worsening. To construct a binary variable for comparison among the six parameters, I count the number of "improving" responses and the number of "worsening" responses from each respondent. If the number of "worsening" responses is more than the number "improving" responses, the overall worsening forest

condition indicator is set to true. Otherwise, the indicator is set to false. This overall worsening forest condition indicator is used to test H5.

Third, as scholars have suggested, common property rights arrangements benefit groups that have a high dependency on natural resources (Acharya, 2005; Netting, 1976). So, I design a hypothesis to test the relationship between dependency on forest resources and preferences for common property rights. The sixth hypothesis (H6) states that households that consider forest resources to be very important for both cash income and subsistence prefer a higher level of common property rights than other households. In the 2012 survey, respondents were asked about the importance of forests for subsistence and for cash income. For both questions, the respondents could answer not important, somewhat important, or very important. If a respondent answered "very important" to both questions, I group that into the high importance category. Otherwise, the respondent is grouped under the normal importance category. This importance indicator is used to test H6. I focus on the very important ratings because only one respondent out of 45 indicated that the forest was not important; the remaining answers are combinations of somewhat important and very important. Therefore, a better indicator of forest importance is to use the very important answers to both the cash income and subsistence questions.

Last, I test how preferences for common property rights affect forest users' participation in forest management activities. As the definition suggests, common property rights arrangements grant ownership to a group of people and allow them to manage the resource jointly. So in order to make this property rights regime effective, the involved parties need to engage in collective management activities. I test four of these activities: attending meetings, establishing rules, monitoring the property, and resolving conflicts. These activities are selected

because they are good indicators of collective resource management (IFRI, 2008; Poteete et al., 2010).

The seventh hypothesis (H7) states that households that prefer a higher level of common property rights are more likely to attend forest management meetings than other households. The data to test H7 come from the survey question asking respondents if they attend forest management meetings. The dichotomous yes or no answers will be used for testing. The eighth hypothesis (H8) states that households that prefer a higher level of common property rights are more likely to participate in rule creation. The ninth hypothesis (H9) states that households that prefer a higher level of common property rights are more likely to participate in monitoring their forest than other households. The tenth hypothesis (H10) states that households that prefer a higher level of common property rights are more likely to participate in conflict resolution than other households. To test the relationships for H8, H9, and H10, I use the answers from the survey questions asking respondents how frequently they engage in each of those activities. The respondents could answer never, rarely, sometimes, and often. Three forest management activity indicators are created to represent participation in each activity. If a respondent's answer is positive – rarely, sometimes, or often – I treat that as a "yes" response and factor that into the corresponding indictor. If the answer is never, a "no" response is stored with the corresponding indictor. These indicators are used for testing H8 through H10. In sum, I hypothesize that forest users who favor common property rights are likely to be more involved in forest management activities, and the last four hypotheses are created to test that relationship.

To summarize, Table 7.7 shows the hypotheses and the variables for testing common property rights preferences and forest users' actions and behavior:

Hypothesis	*Variables/proxy*
H3: Households that perceive less trust among community members prefer a lower level of common property rights than other households	1. Prefer a higher level of common property rights, and 2. Have experienced internal conflicts
H4: Households that have negative feelings toward the forest governance system prefer a lower level of common property rights than other households	1. Prefer a higher level of common property rights, and 2. Have weak trust of the forest governance system indicted by unclear and unfair rules and penalty
H5: Households that perceive that forest conditions are worsening prefer a lower level of common property rights than other households	1. Prefer a higher level of common property rights, and 2. Consider forest conditions worsening, i.e. decreases in plant and animal abundance and diversity
H6: Households that consider forest resources very important prefer a higher level of common property rights than other households	1. Prefer a higher level of common property rights, and 2. Regard forest as very important for both subsistence and cash income
H7: Households that prefer a higher level of common property rights are more likely to attend forest management meetings than other households	1. Prefer a higher level of common property rights, and 2. Attend forest management meetings
H8: Households that prefer a higher level of common property rights are more likely to participate in rule creation than other households	1. Prefer a higher level of common property rights, and 2. Participate in rule creation
H9: Households that prefer a higher level of common property rights are more likely to participate in monitoring their forest than other households	1. Prefer a higher level of common property rights, and 2. Participate in monitoring activities
H10: Households that prefer a higher level of common property rights are more likely to participate in conflict resolution than other households	1. Prefer a higher level of common property rights, and 2. Participate in conflict resolution

Table 7.7 Summary of hypotheses and variables for testing groups with different levels of common property rights preferences

Finally, to formulate the variable indicating whether or not a forest user prefers a higher level of common property rights, I use the data from the same question asking respondents about their preferences for common property rights (see Table 7.2). Then I separate the respondents into two groups. The first group contains households that prefer less than half of the forest to be

governed as common property. The second group contains households that prefer at least half of the forest to be governed as common property. Data from these two groups are used for the following analysis.

7.3.1 Analysis and results

Table 7.8 presents the distributions of the variables used in H3 through H10. To test for independence between two variables for each hypothesis, I use a chi-squared test or the Fisher's exact for a table with thin cells (frequency less than five). The two groups of forest users – one that prefers a higher level of common property rights and the other that prefers a lower level of common property rights – are compared across the attributes outlined in Table 7.5. In addition, I calculate the correlations between the variables in order to understand the dynamics of the relationships. Table 7.9 presents the combined results of the independence testing and the correlations.

Variables	*No*	*Yes*	*Count*
Prefer a higher level of common property rights	12	31	43
Have experienced internal conflicts	27	17	44
Have weak trust of the forest governance system	24	12	36
Consider forest condition worsening	4	39	43
Regard forest as very important for both subsistence and cash income	18	20	38
Attend forest management meetings	22	17	39
Participate in rule creation	16	23	39
Participate in monitoring activities	27	12	39
Participate in conflict resolution	33	6	39

Table 7.8 Distribution of variables for testing groups with different common property rights preferences

	Coefficient with a higher level of common property rights
Have experienced internal conflicts	-0.338** (42)[a]
Have weak trust of the forest management system	-0.126 (35)[a]
Consider forest condition worsening	-0.014 (41)[a]
Report high importance of forest for subsistence and for cash income	0.330* (37)[a]
Attend forest management meetings	-0.083 (37)
Participate in rule creation	-0.074 (38)[a]
Participate in monitoring activities	0.309* (38)[a]
Participate in conflict resolution	-0.063 (37)[a]

* Chi-squared test result with significant at 10%
** Chi-squared test result with significant at 5%
[a] Fisher exact test
Sample size (n) in parentheses

Table 7.9 Correlation of variables and result of independence testing of groups with different levels of common property rights preferences

The independence test results suggest that the level of internal conflicts and the level of forest product usage are highly correlated with a preference for a higher level of common property rights. The negative significant correlation between the level of internal conflicts and preference for a higher level of common property rights indicates that households that perceive more conflict among fellow community members are less likely to favor a higher level of common property rights. This finding supports H3; the correlation suggests that households that experience internal conflict are 34% less likely to favor a higher level of common property rights in governing their forest.

The perceived importance of the forest also has a mild significant correlation with forest users' preferences for a higher level of common property rights. This relationship is positive, and it suggests that households that consider the forest to be highly important for subsistence and for cash income are 33% more likely to prefer a higher level of common property rights. This result supports H6.

The last mild significant correlation is between participation in monitoring activities and preference for a higher level of common property rights. The relationship is positive and supports H9. This result indicates that households that prefer a higher level of common property rights are 31% more likely to engage in more monitoring activities of their common property.

The rest of the hypotheses – H4, H5, H7, H8, and H10 – are not supported by the data collected from the study area. This suggests that a lack of trust of the forest governance system and perception of declining forest conditions do not affect forest users' preferences for common property rights in the study area. Furthermore, there is no relationship between a higher level of common property rights preferences and the level of participation in forest management meetings, rule creation, and conflict resolution.

7.4 Discussion

Results from section 7.2 present some interesting findings. Although the residents of Caracara and Oropendola have to deal with a variety of risks, their levels of risk exposure do not affect their preferences for common property rights. Instead, a lack of valid coping strategy options turns out to be a highly significant factor in their favoring common property rights arrangements. This outcome supports McKean's (2000) argument that common property rights can be a valid option for managing risk. In addition, this finding strengthens the forest-as-safety-net argument. For forest users who lack valid options for dealing with risk, forests do act as their

safety net. Therefore, in order to ensure their rights to access and use a larger forest area to collect necessities during hardship, forest users prefer the forest to be managed as common property and lean toward a higher level of common property rights.

Additionally, users' preferences change drastically when they lack valid coping strategy options for dealing with risk, even in the group that is least likely to favor common property rights, i.e. men-headed households in Caracara. These forest users are seven times more likely to prefer full common property rights arrangements when they lack only one valid strategy option to manage their risk.

Based on this analysis, using forest products should be a valid coping strategy option for residents of Caracara and Oropendola. However, the coping strategy options reported by the respondents (Table 6.12) present a puzzling observation. None of the respondents stated that they harvest forest products or wild food as coping strategy in the past 12 months. In other words, the respondents did not actually rely on their forest or use forest products to cope during times of adversity. Nevertheless, ensuring a common property rights arrangement is still important for the residents who lack other valid coping strategy options. One explanation for this situation is related to the kind of risks that residents of both communities were exposed to. The risk maps (Figure 6.2 and Figure 6.3) show that Caracara encountered high levels of flood risk, while drought in Oropendola had the most harmful effect. In Caracara, flooding prevents access to the forest; residents would not be able to harvest forest resources when it is flooded. In Oropendola, drought could affect forest productivity and make harvests less rewarding and useful. As a result, residents of both communities did not use many forest products to cope with risk. I elaborate on this observation in order to emphasize that actual usage of forest products does not always reflect forest users' reliance on the forest. By looking just at the results from

Table 6.12, one may conclude that the forest is no longer functioning as a safety net for the people of Caracara and Oropendola. This could be an erroneous finding because the situational factors are ignored. That residents of Caracara and Oropendola did not use forest product to cope with risk does not mean that the forest is not a safety net for them. In this case, forest resources were difficult to access and could be less reliable, so these residents lean on more accessible and reliable strategy options like financial aid and loans. Simply put, it is necessary to study the contextual factors and understand the dynamics between individual risk and the availability of coping strategy options before drawing conclusions about these relationships.

Another concern about using common property rights arrangements as a coping strategy is the effectiveness of this governance option. As shown in Caracara, acting collectively and using common property rights to govern the forest loses effectiveness over time due to conflicting land use interests among community members. The failure to deliver the presumed benefits has been shown to drive the remaining members to abandon the practice. This negative feedback changes forest users' preferences for collective action and property rights arrangements. On the other hand, Oropendola shows a positive feedback loop in which benefits of collective action and common property rights have rewarded all of the community members. As a result, these governance preferences are strengthened.

One may argue that risk is a significant factor in driving common property rights preferences because forest users are seeking short-term financial benefits from that arrangement. Since neither community is able to monitor the usage of its communal forests, common property rights arrangements allow the rent-seeking members to abuse the system and engage in unauthorized timber trading, or even coca trading in the case of Caracara.

Nonetheless, the stable forest condition in Oropendola since 2006 indicated that rent-seeking does not drive Oropendola residents to engage in common forest management; there is no sign of excessive logging or abuse of the system by community members. As in Caracara, the residents who lack valid coping strategy options and favor common property rights arrangements generally fall on the lower end of the economic spectrum. These community members are less likely to have the resources to engage in timber or coca trading. Therefore, this alternative explanation is less convincing in the study area.

The second section of this chapter examines how preferences for common property rights may affect forest users' decisions, actions, and behavior. I compare forest users who prefer different levels of common property rights, across four categories: trust, perception of forest conditions, reliance on forest resources, and participation in forest management activities. Results show that trust among community members has a significant correlation with common property rights preferences, but trust in the forest governance system does not. Forest users who trust each other prefer a higher level of common property rights, and this finding aligns with Ostrom's (2005) theory that trust is an important factor influencing collective action.

In addition, forest users who consider the forest to be very important for subsistence and cash income also prefer a higher level of common property rights. This result supports empirical findings suggesting that forests managed as common properties provide better access for people whose livelihoods depend on forest resources (Berkes et al., 1989; Feeny, Berkes, McCay, & Acheson, 1990; Reddy & Chakravaty, 1999; Runge, 1986).

Although lack of trust in the forest governance system and poor perceptions of forest conditions both have negative correlations with forest users' preferences for common property rights, the relationships are not significant. I hypothesize that the deteriorating forest conditions

and the lack of system trust are less influential in shaping forest users' preferences because of cultural and political factors of Bolivia forest communities. Managing forests as common properties is the traditional land tenure system and is also supported by regulations, so residents of both Caracara and Oropendola are likely to retain this custom even if they perceive the conditions for governing the forest as common property to be less than ideal.

The correlation between monitoring and preferences for a higher level of common property rights is the only significant relationship among the different forest management activities. This result coincides with empirical findings suggesting that local rule enforcement is an important factor in effective collective natural resources governance (Gibson et al., 2005). I argue that local rule creation occurs less often today because many rules were established in 2006, as part of the Forest Management Plans, and local forest users rarely need to create new rules.

As for participating in conflict resolution, only 2 respondents (11%) reported there are internal conflicts in Oropendola, so there is little need for people to engage in conflict resolution. In Caracara, 15 respondents (60%) reported internal conflicts. Nonetheless, findings from chapter 5 show that many residents are not satisfied with the outcomes when disputes were brought to the Community Board; this could be why residents of Caracara no longer engage in conflict resolution.

Issues associated with elite capture in Caracara could also explain why residents are not participating in forest management meetings, even if they prefer to manage the forest as common property. Given the dominance of the Vargas family, other residents' opinions are likely to receive less respect during the meetings. As a result, these residents may be discouraged from attending further meetings. In Oropendola, the maturity of the system could explain the

insignificance of attending forest management meetings. Since rules were established, Oropendola residents have satisfactorily shared income from their forest activities, so they may be less eager to spend time in community meetings.

Furthermore, I want to reiterate the fact that both Caracara and Oropendola practice mixed property rights systems. They set aside forest areas for *chacos*, which are given to individual families for farming, and these *chacos* are managed as private properties. When the respondents were asked about their property rights preferences, they referred to the forest area outside their *chacos*. It is important to acknowledge that a mixed property rights system allows forest users to benefit from both private and common property rights arrangements. Within its *chaco*, a family is free to cultivate the preferred crops and harvest when it sees fit. Private ownership of *chacos* ensures that individual effort will be rewarded and investment will be secured. On the other hand, the jointly owned and managed communal forests allow forest users to engage in activities that require more organization, e.g. hunting and timber trading. Furthermore, managing the forests as common properties also allows forest users to access a larger area to collect NTFP during normal times or when they experience hardship. The benefits of mixed property rights systems have been documented by scholars who present cases that suggest that property rights arrangements, in reality, do not fall neatly into the ideal categories of public, private, or common (Acharya, 2005; Arnold, 1998; Banks, 2003; Le, 2008; Marschke, Armitage, Le, Truong, & Mallee, 2012). The cases of mixed property rights arrangements in Caracara and Oropendola contribute to this body of literature.

When it comes to choosing the appropriate property rights arrangement for managing resources, I argue that decision makers are balancing the costs and benefits of each option and choosing the one that is most beneficial to them within the timeframe they prefer. Since forest

users are likely to incur costs from risk, considering how to manage risk will be part of the calculation. The common property rights arrangement can contribute to effective risk management and could be a preferred option, especially for forest users who lack other coping strategy options for dealing with risk.

Many respondents told me that their forests are part of their heritage, and that they are working to maintain forest productivity for future generations. Based on findings from this chapter, one way that policymakers can help these rural communities achieve their goals is to improve their ability to deal with risk. This analysis shows that, although the forest is considered an important safety net, forest resources can be inaccessible at times. Therefore, rural risk management programs can start by offering non-forest-based coping alternatives. In addition, policies can help promote the use of flexible property rights systems that fit the context of the community. For instance, the mixed property rights system allows private property rights on individual farming plots while supporting the management of the communal forest as common property. Finally, programs can promote the benefits of common property rights arrangements as a risk management strategy, and encourage forest management practices that preserve the communal forest as a sustainable and reliable resource.

Chapter 8

Conclusion

This study investigates how involuntary risk influences the livelihoods of rural forest users, and analyzes how those influences may affect forest outcomes. Involuntary risks – risks that are imposed on people – create challenges for many rural households and communities. In the study areas, households reported risks from sickness, theft, outside intrusion, market volatility, and natural disasters. These risks are diverse in nature; some of them affect almost the entire community, while others cause harm to a handful of households. Some had prolonged impacts, while others imposed temporary stress. Some are idiosyncratic, while others are systemic. Regardless of the type of risk and its impact, many households in the study area lack valid coping strategy options. The goal of this study is to draw attention to the topic of rural risk management, and to provide empirical findings that can guide policymaking.

This chapter begins with a discussion about why risk is a crucial topic for study. Then, I explain the concept of risk management and the constraints of risk management. I also discuss how findings from this study contribute to our knowledge of rural risk management. Finally, I comment on the limitations of this study and provide suggestions for future research on this topic.

8.1 The risk chain

The risk chain (Figure 8.1) was proposed by scholars in order to understand the connections among risk, exposure, and outcomes (World Bank, 2013b). In a constantly changing world, shocks that occur suddenly or trends that manifest gradually towards negative outcomes can occur anytime. Both shocks and trends are risks, and their impacts on affected parties are influenced by the external environment and by internal conditions. For rural forest households, the external environment includes the geography of their community, market access, or social institutions; internal conditions refer to household characteristics that may amplify the harmful impact of certain risks.

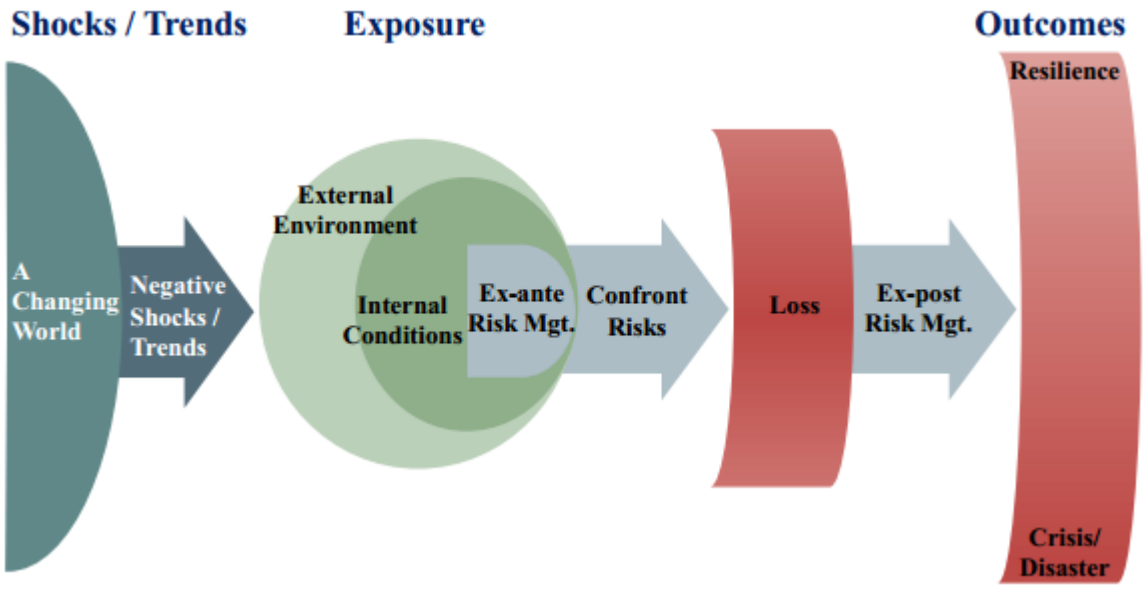

Figure 8.1 Risk chain (Source: World Bank Report: Managing Risk for Development 2014)

In order to reduce one's exposure to risk, individuals can conduct ex ante risk management activities, e.g. obtaining insurance. When risk is realized, the affected parties confront the risk and bear any resulting loss. Then, they can smooth out the losses through ex post risk management activities, e.g. filing an insurance claim. Two outcomes are likely: If risk

management is considered a priority, individuals are likely to develop effective risk management practices over time. As a result, the affected parties can build resilience against various risks and can sustain the harmful impact without suffering too many losses. If attention to risk management is low, the affected parties are less likely to handle the harmful impact effectively. This lack of resilience can lead to crisis and drive the affected parties toward poorer conditions.

Although Figure 8.1 shows a linear sequence along the risk chain, the relationships of the components can be complex and dynamic in reality. Three feedback effects may change the direction and the flow of the chain. The first one occurs between outcomes and ex post risk management, where poorly designed and executed ex post risk management programs can lead to new crisis. The second feedback effect is between outcomes and exposure, where a crisis may weaken one's defense system against risk and make her more vulnerable. The third occurs between outcomes and the changing world, where crises, mainly large-scale, in certain areas may have ripple effects worldwide and can lead to repetitive or new risks.

Risk can create harmful outcomes directly or indirectly. Affected parties experience direct harm from risks like drought or sickness. Indirect harmful outcomes are associated with realized risk. Since risks are interconnected, exposure to one risk may intensify the exposure to several risks. For instance, the health problems of an able male member of a household may lead to poor care of the farm, and that eventually can lead to food shortages that affect the whole family. Outside intrusion can result in loss of land, but confrontations with intruders can be life threatening, as seen in Caracara. In order to accurately calculate the impact of risk on rural forest users, we must consider not only the aggregated harmful results of all possible risks a forest user may encounter, but also the likelihood that realizing one of those risks may lead to additional risk exposure.

Risk can also be a barrier to development. As the poverty trap argument (M. Carter & Barrett, 2006) suggested, households below a critical asset level will remain trapped in poverty. Households' asset levels can be easily altered when a crisis hits; a crisis can drain a household's assets and force it into the trap. Risk management is one facet of development and poverty reduction. In the short term, helping rural forest users manage risk will make coping easier. Over the long term, effective rural risk management will protect forest users from falling into a state of poverty.

The risk chain helps us understand the causality of risk on different outcomes, and visualize where interventions could produce desirable outcomes. As we see in Caracara and Oropendola, different ways (or the lack thereof) to deal with various risks create very different outcomes. Some risk management mechanisms not only strengthen households' resilience, but also protect their forest resources from future threats. Other risk management mechanisms shield households from risk, but generate no beneficial outcome for the forests. And some forest users' indifference to risk management has degraded social and environmental conditions.

There are several advantages to taking a risk perspective to study social and environmental issues in rural communities, and to considering the role of risk in policy making. First, risk is a common aspect of many forest users' daily life. The direct, harmful, and uncertain impact of risk is an easy entry point for researchers to start a dialog with the forest users. I observed that forest users are willing to open up when researchers are interested in listening to their livelihood concerns and attempting to find ways to deal with those risks.

Second, risk can affect individuals, households, or communities. These different levels of risk require different ways of coping. Exploring different types of risks allows researchers to understand how each risk is addressed at different levels, and how the coping strategy options at

one level may interact with another level. In other words, risk is nested and interlinked. Therefore, drilling down to the lowest level to understand how an individual deals with risk will shed light on how she forms her governance preferences that may affect her community's ability to manage its risk.

Third, given the various potential impacts of the same risk, individuals are likely to employ many strategies to deal with a single risk. Hence, collecting information about coping strategy options from individual forest users can build a knowledge base on individuals' effective risk management mechanisms.

Finally, the indiscriminate nature of many risks makes everyone in the community a likely victim. Therefore, deepening our understanding of risk and improving risk management approaches will benefit all community members, rather than just a subset.

8.2 Risk management at a glance

Traditionally, risk management has been synonymous with crisis response. Disaster relief, emergency medical and food aid, and fiscal maneuvers to address financial crises are examples of some safety nets offered by aid agencies in the aftermath of a crisis. Without a doubt, these are important activities for addressing the immediate needs of the victims. Nevertheless, the lack of ex ante risk management has slowed development and poverty alleviation in many countries, and has stalled the progress in meeting the Millennium Development Goals (World Bank, 2013b). Furthermore, reactive risk management since the 1980s has been expensive and has failed to help victims build resilience against similar repetitive risks. This experience has driven a new line of thought: that risk management strategies should include the establishment of social safety nets before a crisis hits, and should involve the affected communities in order to achieve greater impact (World Bank, 2001).

As Figure 8.1 illustrates, risk management is an important element in shaping outcomes after a risk is realized. Risk management refers to "the process that involves confronting risks, preparing for them (ex ante risk management), and coping with their effects (ex post risk management). Risk management is an important determinant of a system's exposure and recovery capacity (World Bank, 2013b, p. 9)." The objectives of risk management are to bring about a sense of security and control of foreseeable risks, and to strengthen one's resilience to absorb, cope, and recover from risk while retaining her ability to function normally. In order to achieve these objectives, risk management is an iterative process that requires continuous evaluation and refinement. Four interconnected tasks comprise the process of risk management (World Bank, 2013b).

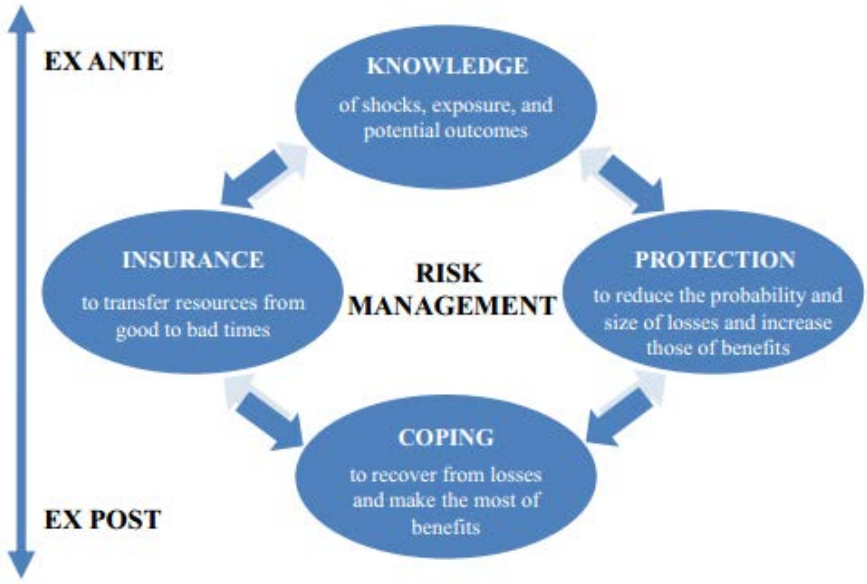

Figure 8.2 Risk management (Source: World Bank Report: Managing Risk for Development 2014)

The first task in risk management is acquiring relevant knowledge about the risk, exposure, and potential outcomes. This is an ex ante task that requires coordination of multiple entities. For instance, researchers collect and study information about risk; risk monitoring agencies distribute alerts and warnings; aid agencies and governments formulate and inform readiness plans; and the affected parties learn about the likelihood of experiencing certain risks and the available response options. The goal of this "knowledge" task is to better forecast what, when, and where a crisis will hit and to better prepare the affected parties when the inevitable occurs.

The second task is building protection. Once relevant knowledge is acquired, all parties should act to lower the probability and magnitude of the harm. Building protection can be done through prevention or reduction/mitigation, and it is a crucial aspect of risk management. Risk prevention strategies like vaccination programs, strengthening property security systems, and restoring coastal wetlands have been shown to weaken negative outcomes from certain risks. However, risk, by its very nature, is not totally preventable. Therefore, ex ante risk management also requires mitigation mechanisms that could limit losses and impacts of harmful outcomes. The choice of risk mitigation strategy represents the combination of knowledge, risk tolerance, and individual preference. For instance, the certainty that the next flood will occur within years may trigger the residents of a flood zone to act. Some of them may decide to migrate out of the area, while others may advocate strengthening the levees.

The third task is obtaining insurance. This task is different from the last building protection task; it acknowledges the harm one must endure, but tries to smooth out the harmful outcome when a risk actually strikes. There are two ways to insure against risk: The first way is to transfer resources from good times to bad times though self-insurance. The second way is to

transfer all or part of the bad outcomes to other parties through risk pooling. In Oropendola, some residents save up cash so that they can buy food when crops fail, as a self-insurance strategy. All residents manage their forest communally so that they can access a large forested area to collect NTFP when crops fail – a risk pooling strategy.

The last task is coping – an ex post action to recover from losses and to manage the impact of subsequent negative outcomes. Coping requires victims to exercise the steps in order to benefit from the risk management strategies established beforehand. Therefore, weak preparation in ex ante risk management can intensify losses and prolong the recovery period.

Various constraints can hinder the effectiveness of the risk management tasks. These constraints can be separated into two groups – internal conditions and external environment (World Bank, 2013b). Lack of resources and information to correctly identify risk, and assess the appropriate approaches to deal with risk, are some internal constraints. Others include deep uncertainty, cognitive failures, and behavioral biases that lead people to underestimate the likelihood that they will be victimized by risk and, therefore, weaken their desire to practice risk management.

External environment constraints could include miscalculated costs and benefits of risk; missing instruments – markets, financial establishments, and infrastructure – that make appropriate risk management options unavailable; a lack of institutions that makes some risk management options less effective; and exclusion based on gender, ethnicity, and political background that limits an individual's access to certain risk management options. All of these constraints could reduce the ability to prevent and prepare for foreseeable risks.

The responsibility of managing risk falls not only on those who are likely to be affected, but on society as a whole. Managing risk requires coordination among individuals, communities,

organizations, and governments, in order to identify risk, design mechanisms, share knowledge, and ensure preparedness. An effective risk management system relies on well-functioning social arrangements that can offer various, complementary ways to assist individuals in handling risk. Furthermore, many risk management mechanisms require collaboration across many levels – local, regional, national and multi-national.

Understanding forest users' abilities to cope with risk is a major goal of this study. In addition, this research contributes to the field by suggesting some risk management improvements grounded in findings from empirical analyses. Empowering rural forest users with knowledge about risk management, and guiding them to develop their preferred risk management strategies is undoubtedly beneficial. Effective risk management not only limits the harmful impact of risk, but also provides a stable environment in which forest users can pursue wealth and improvements in quality of life. Furthermore, assisting forest users with risk management is likely to reduce overuse of the forests. Forests are important resources not only for these local communities, but also for the larger global community, because they provide ecosystem services like biodiversity conservation, carbon sequestration, water retention, soil erosion prevention, and recreation. Improvements in rural risk management could have far-reaching benefits.

8.3 Policy implications

The general consensus is that "[p]oor people are typically more exposed to risk and have less access to effective risk management instruments than people with greater assets and endowments (World Bank, 2001, p. x) ." A lack of resources and knowledge make poor people less likely to engage in risk prevention and preparation. Their livelihood strategies, based primarily on natural resources, make them more vulnerable to shocks, especially environmental

ones, and their limited options for dealing with risk push them to rely heavily on natural resources as a safety net. In addition to having to deal with direct losses, households that lack appropriate coping strategy options also suffer from the effects of mismanaged risks. The consequences of poor risk management can be long-term or even permanent. "A growing body of research documents the role that shocks – above all, health and weather shocks and economic crises – play in pushing households below the poverty line and keeping them there (World Bank, 2013b, p. 30)." Other factors like gender, education level, age, and ethnicity can also make some people more vulnerable to certain risks or less able to cope with risk. In addition to increasing risk exposure and reducing risk management capabilities, this vulnerability makes it difficult for these groups to accumulate the wealth that could lead them out of poverty.

Nonetheless, this understanding focuses on risks at the community level, which are likely to impact many or all of the households in the community. I argue that the relationship between vulnerability and household characteristics is not as direct when it comes to household-level risk. Households with various characteristics are exposed to a variety of risks, both community-level and household-level risk, and it is difficult to make generalizations about what a typical vulnerable household looks like. In the study area, vulnerability is not limited to households that are classified as "poor". Although households that are headed by women or elderly, that have more children, or that are poorer may face more challenges, they may experience no exposure to certain household-level risk but high exposure to others. In addition, the "less-vulnerable" households in the study area are exposed to the various household-level risks as well.

In order to cope, affected households identify and implement coping strategy options that best fit their circumstances. Given these findings, I would argue that risk management programs that target the so-called vulnerable population are limited. "Risks are diverse in origin,

characteristics, and outcomes" (World Bank, 2013b, p. 28), so it is difficult to draw generalizations about the victims of these diverse risks. I am not downplaying the difficulty that older forest users have in finding wage labor work or that women have in getting loans. I do, however, raise the possibility that risk can force the "less vulnerable" households into hardship, and caution the inappropriateness of creating blueprints in addressing certain risks for certain populations.

Based on this finding, I offer two recommendations for reaching the appropriate audiences. First, risk management messages should be customized and direct in order to address the needs of the likely victims and to draw their attention. Second, risk management programs should be more inclusive in order to assist a wide base of households with various characteristics, rather than just targeting the presumed vulnerable ones. For each type of risk, it is important first to identify groups of likely victims, recall their memories from past events, and then improve their preparedness by sharing knowledge and guiding decision-making. Effective risk messages must reduce the psychological distance by highlighting personal relevance and clearly stating probability of reoccurrence. Improving relevant knowledge is an important first task in rural risk management. It is crucial to emphasize this need in effective risk management communication, and in targeting the likely affected households. By addressing the right audience with the right message, risk management programs are more likely to attract the likely victims who would participate in better preparing themselves for the foreseeable risks.

In addition to outside agencies, communities also play important roles in dealing with community-level risk. As shown in Oropendola, the residents act collectively to develop and implement sustainable forestry practices that reduce the likelihood of deforestation and ensure the secure distribution of forestry benefits. They also contribute to the well-being of the

community by investing in youth education. By pooling their risks and their opportunities together, residents of Oropendola are able to enjoy secured forestry benefits and likely improvements to their quality of life. In addition, community members could effectively solve many social and cultural issues. For example, Caracara residents who are affected by elite control and the unfair distribution of forest income can act collectively to raise the issues in community or tribal council meetings. By voicing their disapproval of the current practice, they make the elites aware of their concerns and their preferences in resolving the issues. If this effort still yields no result, the residents can inform the government official who is responsible for the execution of the Forest Management Plan.

Nevertheless, it can be difficult for a community to reach a decision to act collectively, as shown in Caracara. Based on the community-level risk analysis of the two communities using the SES framework, I offer four recommendations that could empower the community in managing its risk.

First, a respected leader makes a difference in guiding the community toward the common goal and establishing a sense of unity. One way to strengthen leadership within a community is to ensure that the leader is elected democratically and that the institutions governing the leader's activities have checks and balances. Also, the selected leader should be encouraged to acquire and improve her leadership skills. Most importantly, the communities' members, as well as outside parties that engage with the community, must show respect for the leader's position, style, and decisions.

Second, rule creation and enforcement are essential in order to guarantee fair treatment of all community members, and to reduce the likelihood of elite control. Community members should participate in rule-making and ensure that the drafted rules are clear and fair. Outside

agencies can assist in this process and can help communicate with and obtain buy-in from as many members as possible. In case there are conflicts, members should deploy the defined procedure to seek resolutions. A local NGO can act as mediators in resolving conflicts if a situation calls for intervention. In addition, outside agencies can be watchdog organizations to ensure that rules are enforced, conflicts are resolved with satisfactory results, and violations are punished.

Third, market penetration is inevitable in many rural communities. Although markets can introduce new risks into a community, markets can also create new opportunities. In Caracara, markets have offered local residents new ways to diversify their income sources, obtain daily necessities, and get access to essential services such as medical care, transportation, and education. By embracing market opportunities, some residents of Caracara were able to move away from subsistence living and improve their quality of life. In order to benefit from markets, rural communities, perhaps with the help of outside agencies, can formulate appropriate sustainable development plans. These economic diversification plans may help reduce the livelihood risk forest users face since diversification allows them to explore more sources for food and income.

Finally, communities can seek information and technology that improve rural livelihoods and the environment. The successful effort to earn FSC certification in Oropendola has shown that knowledge of sustainable forest practices can lead to positive outcomes for the community and its forest. To conclude, both the communities and outside agencies, including NGOs and governmental offices, play important role in community risk management. By strengthening leadership, enforcing rules, embracing market opportunities, and sharing knowledge and

technology, rural communities can foster conditions that promote collective action in risk management and build reciprocal networks.

It is certain that mechanisms that help reduce risk exposure are necessary and valuable. Offering protection mechanisms is one way outside agencies can help reduce forest users' exposure to risk. Protection can be instituted through infrastructure improvement or by dispersing new technology. Vaccinations, weather-tolerant seeds, flood walls, and water storage systems are some protection mechanisms that aid agencies can help deliver to rural communities, with the goal of reducing or preventing harm. Since "better decisions in the risky world can usually be made if additional information that reduces uncertainty is available (J. R. Anderson, 2003, p. 164)", improvement in knowledge-sharing and in dissemination of information can support residents in taking preventive actions. The goal is to empower the communities so that they can make more informed decisions in protecting themselves against risk.

However, prevention is only one side of risk management; there is also a need to help people cope when the harm from risks is realized. In other words, programs that assist forest users in identifying and implementing valid coping strategy options are equally crucial. When people turn to the forests as safety nets during times of hardship, degradation and biodiversity loss can occur more quickly (Takasaki et al., 2004). The good news is that coping assistance programs can help. Studies have shown that offering non-forest-based coping strategy options, like income or technology assistance packages, can lower the forest extraction rate (Fisher & Shively, 2005). Helping households acquire non-land-based physical assets can reduce their reliance on the forest and, therefore, decrease pressure on the forest (Debela et al., 2012). Providing access to capital and labor markets has a considerable mitigating effect on shocks, especially for the poorest households (M. R. Carter et al., 2007). Income from wages can allow

households to sustain their daily needs, while loans from markets or social arrangements can allow the poorer households to borrow against future earnings in order to rebuild lost assets. Improvements in education can also help households acquire better coping strategy options (Gentle & Maraseni, 2012; Rayhan, 2010).

According to a World Bank study (2013b), resource-strapped people commonly rely on self-protection risk management strategies, like accumulating cash during good times or risk-pooling. Although these strategies are much better than the typical response of doing nothing, some of these strategy options can be inaccessible to certain people or inappropriate for certain risks. This study shows that the availability of coping strategy options at either the household or community level shapes forest condition, users' preferences for forest governance arrangements, and the outcomes after a crisis hits. The importance of developing and deploying diverse coping strategy options cannot be understated.

Among the various coping strategy options, diversification is a common one for reducing one's exposure to particular risks (J. R. Anderson, 2003; Giesbert & Schindler, 2012). In Caracara, many residents diversify their income sources; jobs in the nearby market provide cash income that they can use to purchase food, reducing their reliance on their own crops and their vulnerability to weather shocks or crop failure. Forest users need alternative livelihood strategies in order to benefit from diversification. This need echoes the recommendation that outside agencies can help communities design and implement sustainable development programs. These programs would not only help forest users diversify their dependence on natural resources, but also provide a path for moving away from subsistence living. I support other scholars' suggestions that building better and more diverse safety nets is an important policy intervention (M. R. Carter et al., 2007; Debela et al., 2012; Rayhan, 2010). Better safety nets can prevent

households from losing their assets, while diversification can reduce the harmful impacts, therefore reducing household vulnerability as well as forest pressure.

Having access to insurance can also help forest users manage the harmful impacts of risk. Insurance can be formal or informal. Formal insurance contracts require payments of premiums and filing of claims when the loss is realized. Informal insurance operates through risk pooling and reciprocal networks, mainly within a community. Local governments and outside agencies can play a role in offering formal insurance and organizing informal insurance networks. Chapter 7 showed that forest users who lack valid coping strategy options are likely to prefer a higher level of common property rights for their forests. In order to assist this group of forest users, and to make this risk-pooling strategy operational, information about the benefits of using common property rights as a risk management strategy can be shared widely so that forest users with diverse levels of risk exposure will join the network.

Study result shows that if forest users have more valid coping strategy options, they report better forest condition. I hypothesize that this outcome is caused by less exploitation of forest resources because forest users have other non-forest-based coping strategy options, or by forest users' active management of their forest in order to make it a reliable source for subsistence and a safety net. In either case, risk management programs that help promote and provide coping strategy options will not only help the forest users directly, but also can establish favorable conditions for achieving better forest outcomes.

Sharing the findings from this study with the residents of the two communities will allow them to visualize how their fellow members perceive risk, which strategies they use to cope, what their preferences on common property rights are, and how risk and coping strategy options changed over time. Starting a dialog on risk could serve as a platform for exploring different

coping strategy options, discussing the limitations of their current risk management approaches, and most importantly, for motivating members to take steps toward improving their risk management approaches.

Although Oropendola manages its risk effectively and has a high level of social cohesion, the change in leadership, i.e. the stepping-down of the respected Chief, may bring disruption to the community. In my casual conversation with the people of Oropendola, I learned that some members are trying to run for the position, while the Chief is grooming his son to take over. This situation may bring tension to the community, so it could be beneficial for the people of Oropendola to learn from Caracara's experience and try to avoid unnecessary social conflicts. Residents of Caracara can leverage Oropendola's knowledge in establishing and enforcing institutions. Given that the policy on coca production is fluid, people from Caracara could benefit from practicing sustainable forestry and taking advantage of their geographical location to engage in different industries.

Risk management strategies, like risks themselves, should be diverse. Effective risk management programs should consider the nature of the risk, the scale of the impact (households, communities, countries), the duration of the harm (temporary, permanent), the cost and efficacy of implementing different strategy options, and the best instrument to deliver the strategy options (markets, governments, NGOs) to come up with wide arrays of strategies. These strategies should aim to advance knowledge, offer protection and insurance, and assist victims in coping. In order to achieve these goals, the tasks at hand must narrow the information gap, increase risk awareness, explore market alternatives, provide access to resources, strengthen institutions, and engage partners. Finally, a dialogue in community-driven risk management should be started, and cooperation among communities should be promoted so that knowledge

and best practices learned in one area can be adapted to assist likely victims in other areas. It is time to look at risk management strategies that go beyond prevention and humanitarian relief programs. Instead, developing, promoting, and implementing a diverse array of coping strategy options should be priorities in development and conservation agendas.

8.4 Challenges and limitations

In this section, I discuss some challenges encountered during field work and limitations of this study. Despite the long relationship between CERES and the communities, we encountered resistance when asking people to participate in the household survey, especially in Caracara. Some locals were not comfortable when we walked around their settlements and looked around their properties. Although many Oropendola residents were more receptive to CERES researchers and willingly participated in the household survey, some respondents just gave simple yes or no answers to our questions and were unwilling to elaborate on their responses.

During the first community meeting in Caracara, a man asked about the benefit of participating in our research, and he indicated that they had not received any financial or physical gains from years of participation with CERES. He said that other communities got solar ovens, clean water systems, etc. through working with NGOs, but CERES had given them nothing. He wanted to see “development projects” executed in his community in exchange for their participation. When we explained to him that CERES is a social science research institute, not a development agency, and that researchers are working to understand their issues in order to inform policy changes, he was not satisfied with the answers at all.

During an interview with a woman in Caracara, her husband jumped in and said that the CERES project has produced no value to them. Trees were being cut illegally in their forest but

no one would offer any help to stop that. Although they have obtained the land rights, they are still being pushed away from their property. He concluded that CERES research would not be useful to remedy the situation, and he directed his wife to withdraw from the interview. These two incidents demonstrate that gaining trust with community members, in order to get meaningful and sensitive information, is always a challenge for social scientists, especially when the rewards are not tangible. Furthermore, respondents who participate in the survey are self-selected, so the findings cannot represent the opinions of those who were unwilling to respond to the survey.

The two IFRI forests in this study are only a small subset of the communities' territories. Without data from the remaining area, it is hard to tell the actual condition of the whole forest. In Oropendola, past requests to observe areas outside the IFRI forest were declined by the Chief. Communities' resistance to showing IFRI researchers the forests beyond the defined area raises concern about the condition of the entire forest.

In both communities, self-reporting of risk can lead to recall problems, which may bias responses toward the most recent events or the biggest events. In Caracara, the power of the local elites may inhibit residents from discussing issues related to the elites freely. In Oropendola, some residents are reluctant to discuss internal conflicts with outsiders.

Many of the respondents were women because they are the ones at home during the time we conducted the survey. It is possible that the women's opinions do not fully represent their male counterparts'. In Caracara, we surveyed mainly residents who lie on the lower end of the economic spectrum, since the "richer" households were more likely to decline our interview. Hence, in comparing the two sites, the risk data collected in Caracara may show a higher risk exposure level and a lower coping ability. In Oropendola, all households we could reach during

the visit agreed to be interviewed. Only two households that lacked any adult Spanish-speaking member were dropped from the survey.

Moreover, count models do not convey the impact of a risk or coping strategy. For example, flooding has a much more harmful impact than an animal being stolen, but both risks received a count of one in the models. Similarly, selling an asset may have a more prolonged economic impact on a household than collecting more resources from the forest, but both coping strategy options carry a count of one. The lack of magnitude measurement is a limitation of the count models and this study. Nevertheless, count variables do allow us to measure the frequency, so comparing the same counts in a model (as shown in chapter 4) over time and space (as shown in chapter 6) can inform us about the differences and the changes.

Finally, as Agrawal (2001) discusses, many other factors also influence the effectiveness of governance and natural resource outcomes. Cultural beliefs of Oropendola residents lead them to respect the forest and use only what they need, and their relatively egalitarian social structure and high level of social cohesion motivate them to engage in sustainable forestry, collective actions, and fair sharing of benefits. These informal institutions have complemented the execution of the formal rules and regulations. One the other hand, the weakening of the cultural identity and the loosening of the social fabric have driven residents of Caracara to neglect their norms and focus more on individual rewards. To a certain extent, these cultural and social changes are also risks that can be investigated and studied.

8.5 Future research directions

Several improvements can be made to this study in order to construct a more comprehensive picture of risk in rural forest communities. An enhanced survey could provide more coping strategy options that respondents used but grouped under the “other” categories.

Possible additions are: get assistance from the government, grow more coca to sell, and crop diversification. The enhanced survey should also ask respondents why certain coping strategies were used to deal with certain risks. Understanding the choices of coping strategies will enhance our knowledge of forest users' preferences and constraints in applying different strategies.

Moreover, as I discussed earlier, the lack of mentioning outside intrusion as a risk in both communities is puzzling. An improved data collection procedure can include a revisit to ask the respondent to clarify the discrepancy. Incorporating the PRM data collection method into the IFRI household survey is recommended because PRM provides a more comprehensive way to collect and analyze risk data.

Furthermore, developing survey questions to measure the magnitude of each risk and coping strategy can allow us to address the limitation of the count models. One suggestion is to convert the impact of risk and coping strategy into a common unit of measure, e.g. money. For instance, researchers can ask how a risk affects a household in terms of monetary losses, or how much a coping strategy helps in financial terms. With these in-depth data, more elaborate analyses can be performed.

This study only collected a small number of data points for analysis. In order to advance our knowledge of this topic, a larger-scale study to investigate more forest communities will be beneficial. Furthermore, as shown in chapter 6, the evolving environment changes the community, the risks they face, and the availability of coping strategy options. In order to understand the interrelationships among these changes, revisits to the sites to collect longitudinal data are definitely necessary. Last but not least, the existing IFRI household dataset already contains valuable data on risk and coping strategy options. Launching an initiative to

systematically analyze that dataset in order to compare and contrast regional differences will definitely deepen our understanding of the topic.

Risk affects the well-being of forest users, their livelihoods, and their forests. Assisting forest users with risk management will not only reduce the harm they are exposed to, but also build their resilience against future risk. A stronger, more resilient household is likely to recover more quickly, and can allocate its wealth toward improving quality of life, rather than toward meeting immediate needs. Proactive risk management, rather than crisis response, will be more beneficial to rural communities.

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Appendix

Appendix 1 SANREM Household Survey

26 July 2006

IFRI – SANREM HOUSEHOLD QUESTIONNAIRE (V4)

IDENTIFYING INFORMATION

Name of country_____

IFRI Site ID _____

Control Information

Task	Date(s)	By who?	Status OK? If not, give comments
Interview			
Checking questionnaire			
Coding questionnaire			
Entering data			
Checking & approving data entry			

Identification and Location of Household

1. Household number		
2. Village	*(name)*	*(village ##)*
3. District		
4. Name and PID (see I.A.1 below) of primary respondent	*(name)*	*(PID)*
5. Name and PID (see I.A.1. below) of secondary respondent	*(name)*	*(PID)*
6. GPS location of household *(UTM format)*		*E* *N* *Zone*
7. Which IFRI User Group *(see community IFRI User Group Form)* is this household affiliated with?		

26 July 2006

I. Household Characteristics

A. Who are the members of the household?
Note Technical Guidelines regarding definition of a household

1. Personal Identification number (PID)	Name of household member	2. Relation to household head**	3. Year born *(yyyy)*	4. Sex *(0=male 1=female)*	5. Education *(number of years completed)*	6. Occupation*
1		Household head				
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

* See codebook

Please answer questions 7-10 as relevant to the IFRI site. If not applicable code as N/A.

7. What is the ethnicity of the household head? _____

7a. Does the household head belong to the largest ethnic group in the village? _____ *(No/Yes)*

8. What is the religion of the household head? _____

9. Has any member of the household ever migrated? _____ *(No/Yes)*

9a. If yes, how many members of the household have migrated? _____*(number)*

10. What caste does your household belong to? _____

26 July 2006

II. Household Assets

A. Describe the house in which this household lives *(Enumerator's observation)*

1. What is the type of material of (most of) the walls? **	
2. What is the type of material of (most of) the roof ? **	

** See codebook

B. Please indicate the number of the following items that are owned by the household:

Item	Number of units owned by household
1. Car/truck	
2. Bicycle	
3. Motorcycle	
4. Mobile phone	
5. TV	
6. Radio	

C. Does the household own land? _____ *(No/Yes)*

If yes, please indicate the amount of land (in hectares) that you currently own.

*Note Technical Guidelines regarding definition of different land uses

Category	1. Area (hectares)	2. Ownership (code-tenure)
1. Cropland		
2. Pasture (natural or planted)		
3. Agroforestry		
4. Forest (including woodlots and plantation)		
5. Silvipasture		
6. Fallow		
7. Other vegetation types/land uses (residential, bush, grassland, wetland, etc.)		
8. Total land owned (1+2+3+…+7)		

D. Does the household rent land out? _____ *(No/Yes)*
D1. If yes, how much land is currently rented out? _____ *(hectares)*

E. Does the household rent land in? _____ *(No/Yes)*
E1. If yes, how much land is currently rented in? _____ *(hectares)*

26 July 2006

III. Access to Information

A. 1. What is the source of news about the external world for the respondent?
2. And, how frequently does the respondent interact with that source?

Source	1. Household Utilizes Source (No/Yes)	2. Frequency of use/interaction (i.e. daily, weekly, monthly, annually)
1. Newspaper		
2. Radio		
3. Television		
4. Cable television		
5. Visits to market		
6. Interaction with government officials		
7. Interaction with staff of NGO from outside of village		
999. Other *(specify)* _____		

B. Please list by name all persons in the village that provide you with information about political, economic and social issues. In addition indicate the relationship of each person to your household:

Category	1. Names of informants	2. Relationship to your household (e.g. relative; friend; local leader; civil servant; NGO representative etc.)
Political issues (e.g. politics; voting; rallies etc.)		
Economic issues (e.g. agriculture/farming; house construction; expenses for weddings and other events etc.)		
Social issues (e.g. religious occasions; festivals; health and medicine; travel outside village etc.)		

IV. Household Well-Being and Risk

A. In the past year, where did the household's food come from?

Source	Proportion of total
Food grown on land owned and cultivated by household	
Food grown on land cultivated but not owned by household (i.e. land rented in)	
Food purchased from the market	
Food given as gift or food aid	
Other *(please specify)*	

B. Has the household faced any major income shortfalls or unexpectedly large expenditures during the past 12 months?

Event	1. Degree of crisis* *0=no; 1=yes, moderate crisis; 2=yes, severe crisis*	2. How did your household cope with the income loss or cost?*
1. Serious crop failure		
2. Serious illness in family *(i.e. productive age-group adult unable to work for more than one month during past 12 months, due to illness, or to taking care of ill person)*		
3. Death of productive age-group adult		
4. Land loss (expropriation, etc.)		
5. Major livestock loss (theft, drought, etc.)		
6. Other major asset loss (fire, theft, flood, etc.)		
7. Wedding		
8. Funeral		
9. Other, specify:		

*See Technical Guidelines and Codebook.

V. Household Opinions *(on forest management)*

A. Do you agree with the statement:

"Forests should be protected"

Please indicate the extent of your agreement by using any number between 1 and 3 where

_____1 (Disagree)
_____3 (neither agree nor disagree)
_____4 (agree)

B. Which of the following two statements do you agree with the most:

_____ 1 *"Improvements in the condition of local forests are necessary for economic reasons such as their contribution of fodder, fuelwood, and timber".*

_____2 *"Improvements in the condition of local forests are necessary for non-economic benefits such as cleaner air, soil conservation, and water retention".*

C. Do you agree with the statement:

"To improve the condition of local forests, my family and I are willing to reduce our consumption of benefits from the forests."

Please indicate the extent of your agreement by using any number between 1 and 3.

_____1 (Disagree)
_____3 (neither agree nor disagree)
_____4 (agree)

D. What are the problems that your village is facing in protecting forests?

_____

_____

E. What suggestions would you make for improving the governance and management of forest resources in your village?

_____

_____

VI. Forest Rights

A. How far in minutes and kms is the household from the local forests of each governance type?

Forest type	2. Time to reach forest?	
	a. minutes	b. kms
1. Government forest		
2. Community forest		
3. Private forest		

A1. If a new household arrives in the village, how would you describe the rules about forest use in your community? Please respond yes or no to each question…

Forest Rights	Government forest	Community forest	Private forest
Allowed to enter the forest			
Allowed to harvest products from the forest			
Allowed to contribute to managing forest			
Allowed to make decisions			

about managing the forest			
Allowed to decide who can and can't enter forest			
Allowed to make decisions about selling or leasing forest land			

A2. In the past 12 months have you?

Forest Rights	Government forest	Community forest	Private forest
Entered the forest			
Harvested products from the forest			
Contributed to managing forest			
Made decisions about managing the forest			
Decided who can and can't enter forest			
Sold or leased forest land			

B1. Do you feel that the rules regarding forest use are: completely fair; more or less fair; or not fair?

Completely fair_____ More or less fair_____ Not fair_____

There are no forest use rules _____

B2. Do you feel that the penalties for breaking forest use rules are: completely fair; more or less fair; or not fair?

Completely fair_____ More or less fair_____ Not fair_____

There are no penalties for breaking forest use rules _____

VII. Participation in Organizations

A. Are you or any member of your household currently an official or a member in any local organization (including any forestry-related organizations)?

1. Name of organization	2. Household member name	3. Position (member or official)	4. Years of involvement

B. We are interested in learning about your household's involvement in groups that are focused on forest management (i.e. these can be either formal organized groups or informal groups that undertake forest management activities)

1. Are you or any member of your household involved in a group that undertakes forest management activities? *If 'no', go to 13.*		*(1-0)*
2. Is the group that your household is involved with formally organized or an informal group?		*Formal Or Informal*
3. What is the name of the group(s) your household is involved with?		
4. Does someone in your household normally/regularly attend meetings of the group? *If 'no', go to 6.*		*(1-0)*
5. **If 'yes':** in your household, who normally attends group meetings and participates in other group activities? *Codes: 1=only the wife; 2=both, but mainly the wife; 3=both participate about equally; 4=both, but mainly the husband; 5=only the husband; 9=other arrangements*		
6. How many person days (= full working days) did households member spend on group activities (meetings, policing, joint work, etc) over the past 12 months?		*Females (days)* *Males (days)*
7. Does your household make any cash payments/contributions to the group? *If 'no', go to 9.*		*(1-0)*
8. **If 'yes':** how much did you pay in the past 12 months? *(Lc$)*		
9. Did your household receive any cash payments from the group (e.g., share of sales) in the past 12 months? *If 'no', go to 11.*		*(1-0)*
10. **If 'yes':** how much did you receive in the past 12 months? *(Lc$)*		
11. What are your reasons for joining the group? *Please rank the most important reasons, max 3.*	**Reason**	**Rank 1-3**
	1. Increased access to forest products	
	2. Better forest management and more benefits in future	
	3. Access to other benefits, e.g., government support donor programs	
	4. My duty to protect the forest for the community and the future	
	5. Being respected and regarded as a responsible person in village	
	6. Social aspect (meeting people, working together, fear of exclusion, etc.)	
	7. Forced by Government/chiefs/neighbors	
	9. Other, specify:	
12. Overall, how would you say the existence of the FUG has affected the benefits that the household gets from the forest? *Codes: 1=large negative effect; 2=small negative effect; 3=no effect; 4=small positive effect; 5=large positive effect.*		
13. **If you don't participate in any**	**Reason**	**Rank 1-3**
	1. No formal or informal groups exist in the village	

group activities focused on forestry, why don't you? *Please rank the most important reasons, max 3*	2. I'm new in the village	
	3. Members of those groups generally belong to other group(s) (ethnic, political party, religion, etc.) than I do	
	4. Cannot afford to contribute the time	
	5. Cannot afford to contribute the required cash payment	
	6. Group membership will restrict my use of the forest, and I want to use the forest as I need it	
	7. I don't believe working in groups is very effective in managing the forest	
	9. Other, specify:	

VIII. Forest Resources

A. How would you rate the importance of the following forest-types with respect to their various uses and the services they provide to your household? *Only fill in if governance type is present in area.*

Governance	In-kind or subsistence income	Cash income	Contribution to the renewal of soil fertility	Soil erosion control and water conservation	Cultural/ spiritual
Government Forest					
Community forest					
Private forest					

1=Not important; 2=Some what important; 3=Very important

B. Has the collection time for fodder, fuelwood, and other forest products increased or decreased in the past 10 years? *(Check one for each relevant forest type)*

Forest type	Increased	Decreased
1. Government forest		
2. Community forest		
3. Private forest		

B1. If increased, how has your household responded?

Forest type	Household response to increased collection time	Rank 1-3
1. Government forest *Please rank the most important responses, max 3.*	1. Decline in quantity harvested	
	2. Plant trees	
	3. Purchase forest product	
	4. Use substitute for forest product *(eg. substitute kerosene for fuelwood)*	
	9. Other *(specify)*	
2. Community forest *Please rank the most important responses, max 3.*	1. Decline in quantity harvested	
	2. Plant trees	
	3. Purchase forest product	
	4. Use substitute for forest product *(eg. substitute kerosene for fuelwood)*	

	9. Other *(specify)*	
3. Private forest ***Please rank the most important responses, max 3.***	1. Decline in quantity harvested	
	2. Plant trees	
	3. Purchase forest product	
	4. Use substitute for forest product *(eg. substitute kerosene for fuelwood)*	
	9. Other *(specify)*	

C. Compared to other forests in this general region (<50 kms distance from your village), is the vegetation in the local forests you use dense or sparse? *(Check one for each relevant forest type)*

Forest type	Very sparse	Sparse	Average	Dense	Very dense
1. Government forest					
2. Community forest					
3. Private forest					

D. Compared to other forests in this general region (<50 kms distance from your village), has the condition of the forest you use changed in the past 10 years? *(Check one for each relevant forest type)*

Forest type	Improved	Worsened
1. Government forest		
2. Community forest		
3. Private forest		

IX. Household Income and Expenditures

A. Please rank the following sources of income (i.e. household income includes subsistence plus cash) in order of importance to your household. Include only those sources that contributed to household income during the past 12 months.

Rank	Income Source	*Examples*
	Unprocessed forest products	*Fuelwood; timber; wild fruits; game hunted in forest etc.*
	Processed forest products	*Charcoal; furniture; Purified honey etc.*
	Fishing and/or aquaculture	*Fish from the wild or ponds*
	Wild areas not including forests (for example, grasslands, wetlands etc.)	*Thatching grass; wild foods; game hunted in grasslands; papyrus from wetlands etc.*
	Own business (not related to forestry or agriculture)	*Small shop; transportation business etc.*
	Agricultural crops	*Annual and perennial crops; fruit from trees on homestead; etc.*
	Livestock	*Sale of animals; birth of new animals etc.*
	Livestock products	*Milk; eggs; butter; hides; dung etc.*
	Payment for forest services	*Carbon sequestration; watershed management etc.*
	Wage income	*Wage labor; civil servant; teacher; military etc.*
	Remittances and gifts	*Cash from relatives; financial support from NGOs etc.*
	Other (*specify*)	

B. What are the three most important sources of wage & other income for the household *(rank)*?

Rank	Wage and Other Income

	Local agricultural wage labor
	Local non-agricultural wage labor
	Migratory agriculture/forestry wage labor
	Service with government or private organizations *within* the village
	Service with government or private organizations *outside* the village
	Army or other military service
	Independent business not related to agriculture or forestry
	Remittances
	Support from government, NGO or similar
	Pension
	Other *(specify)*

C. How important are forests for: *(Check one for each item in column 1)*

Item	Very important	Somewhat important	Not important
1. Providing forest products for your household's use			
2. Providing forest products for sale (i.e. cash income for your household)			

D. How has the amount of forest products your household collected over the past 12 months changed from the amount that you collected in the previous year?
_____*(Decreased, No Change, or Increased)*

D1. If there has been a decrease or increase, what is the reason for the change?
_____

E. What number of animals do you currently own, and where do they feed?

Animal Type	Current number	Stall fed *(No/Yes)*	Grazed *(No/Yes)*	Where do they graze? (codes)

Questions for individual household members

26 July 2006

F1. Adult Male – Cash Expenditures

*** RECORD PID NUMBER OF ADULT MALE RESPONDENT _____

We are trying to understand how you spend your cash on a weekly basis. The following questions are with regards to purchases over the last week. That is between _____ and _____.

What expenditures (cash spent on goods and services) have you made over the last week?

Expenditures	Code	Date	Amount spent

F2. Adult Male – Time Use

We are trying to understand how you spend your time from the time you wake to the time you go to bed. Could you describe what you did yesterday?

Activity	Code	Time begun	Time end	Total Time
Total Time				

26 July 2006

G1. Adult Female – Cash Expenditures

*** RECORD PID NUMBER OF ADULT FEMALE RESPONDENT _____

We are trying to understand how you spend your cash on a weekly basis. The following questions are with regards to purchases over the last week. That is between _____ and _____.

What expenditures (cash spent on goods and services) have you made over the last week?

Expenditures	Code	Date	Amount spent

G2. Adult Female – Time Use

We are trying to understand how you spend your time from the time you wake to the time you go to bed. Could you describe what you did yesterday?

Activity	Code	Time begun	Time end	Total Time
Total Time				

26 July 2006

H1. Child – Cash Expenditures

*** RECORD PID NUMBER OF CHILD RESPONDENT _____

We are trying to understand how you spend your cash on a weekly basis. The following questions are with regards to purchases over the last week. That is between _____ and _____.

What expenditures (cash spent on goods and services) have you made over the last week?

Expenditures	Code	Date	Amount spent

H2. Child – Time Use

We are trying to understand how you spend your time from the time you wake to the time you go to bed. Could you describe what you did yesterday?

Activity	Code	Time begun	Time end	Total Time
Total Time				

Thank you for participating in the survey

Appendix 2 Summary of IFRI Research Instruments (IFRI, 2008, pp. II-4)

TABLE 1: SUMMARY OF IFRI RESEARCH INSTRUMENTS

Form Name	Number to be Completed per Site	Links to Other Forms	Explanations and Notes
O	One per site	None	Relates to all other forms that comprise a single site.
F	One for each IFRI forest at the site	One I. *One or more* S, U, and R (usually three Rs). One G for each U to which it is linked. Many Ps (usually 30). May link with A or V.	By definition, an IFRI forest is used by at least three households. Therefore, there must a minimum of one user group (Form U) using a minimum of one product (Form R) for each IFRI forest (Form F).
P	Usually 30 per forest	One F.	Records biological and physical data about each forest. The size of a statistically adequate sample of forest depends on the research question and the degree of diversity in the forest. See section III.A.3 of the manual.
S	Minimum of one per site	*One or more* U and F.	Entry of data about user groups requires a link to a settlement (Form S). Therefore, there must be at least one settlement per site.
U	Minimum of one per site	*One or more* S and F. One G for each IFRI forest utilized.	Entry of data about user groups requires a link to a settlement (Form S). For each forest with which the user group is linked, one Form G and at least one Form R (usually three or more) must be completed.
A	Completed only for sites with formal associations of forest users involved in forest management	*One or more* F and U.	Not all sites have Forest Associations.
G	*One or more* per site: One for each user group–forest relationship at the site.	One F and U.	Records data about the relationship between a particular user group and a particular forest. There must be one Form G for each user group-forest relationship.
R	*Three or more* per user group–forest relationship, unless the user group uses fewer products in a given forest.	One G.	Records data about a product a particular user group uses in or takes from a particular forest. Because Form R records data on quantities used as well as rules for use, a separate Form R must be completed for each user group–forest relationship for which it is relevant.
V	Completed only for sites with organizations involved in forest governance but not forest use.	*One or more* F.	Not all sites have nonharvesting governance organizations. When a nonharvesting organization is present, the form must specify which IFRI forest or forests it affects.
I	One for each organization identified.	One F.	The inventory is for organizations affecting management of each IFRI forest.

IFRI researchers use 10 different forms to collect social and biological data. These forms are named by a single character: O=Site Overview; F=Forest; P=Forest plot; S=Settlement; U=User group; A=Forest association; G=Forest–User Group Relationship; R=Forest product; V=Forest Governance; I=Organizational Inventory and Interorganizational Arrangements

Appendix 3 Household Survey for 2012 Site Visit

IFRI Household Survey for 3ie Project (final version: 8 April 2012)

IFRI Household Survey

CID: TAN **Site ID:**	**HH ID:** <HHID>
Nombre del distrito: <HDNAME>	GPS ubicación para hogar (Lat/Long en gradas decimal): *Latitude:* <HHLAT> ° *S* *Longitude:* <HHLONG> ° *E*
Nombre del pueblo: <FK_SETTLE>	
Código del pueblo: <HVCODE>	Categoria de riqueza del hogar (circular una): <HHWLTHCAT> **P (pobre)** **A(medida)** **W(riqueza)**
Categoria de MFP: <HPFM> **CBFM** **CBFM-control** **JFM** **JFM-control**	Marcan todos grupos usarios de IFRI que pertenece el hogar: 1. _____ <HUSRGRP1> 2. _____ <HUSRGRP2> 3. _____ <HUSRGRP3>
Nombre de encuestador:	
Fecha de entrevista (día-mes-año): <HINTERVDT>	

INFORMED CONSENT

Hola. Me llamo _____. Estoy trabajndo con el grupo Centro de Estudios de la Realidad Economica y Social de Bolivia. Estamos haciendo una encuesta sobre como las políticas distintas para la gestión forestal afectan la subsistencia de las familias, las maneras en que la gobernancia forestal está practicada en las comunidades, y las condiciones generales de los bosques. El objetivo de ésta investigación es comprender como mejorar el manejo forestal participativo de los bosques del país. Entiendo que su pueblo ha sido incluido en MFP, y entonces quisiéramos entender como lo ha sido funcionando por acá. Aproximadamente _____ personas en distintas pueblos de Bolivia participará en esta investigación, incluso ___ personas de su pueblo.

Como parte de esta entrevista, le vamos a preguntar sobre como usa usted los bosques cerca de su pueblo, los beneficios que provienen estos bosques a su familia, y que piensa pueda mejorar el manejo de estos bosques. Respondiendo a estas preguntas tomará aproximadamente 1-1.5 horas. Si decides a participar en esta investigación, le vamos a preguntar 30 preguntas de nuestro cuestionario. Si le pregunto en cualquiera cosa que no quiere responder, simplemente avíseme y seguiré a la próxima pregunta, o además usted puede bastar la entrevista a cualquiera vez. Todas las respuestas que nos dará serán confidenciales y no serán compartidos con nadie afuera de los miembros del equipo de encuesta. En cuanto hayamos acabado la encuesta, tendrá la oportunidad a preguntarme cualquieras preguntas que tal vez tenga sobre la entrevista.
En caso de que necesite más información sobre la encuesta, puede contactar la persona marcado en esta carta que le estoy proviniendo a su casa. Tiene algunas dudas? Puedo empezar la entrevista ahora?

ASIGNATURA DE ENTREVISADOR: _____ FECHA: _____

(Sigue con la entrevista si la respondiente está de acuerdo en ser entrevistado)

Control de calidad con relación a la finalización y la entrada de data del encuesta			
Tarea	**Fecha**	**De quién?**	**Comentarios?**
Encuesta comprobada por datos que falta			
Finalización de la entrada de data			

IFRI Household Survey for 3ie Project (final version: 8 April 2012)

A. Información general sobre migración de familias, tierra, explotaciones de ganado, y otros bienes

A1. ¿Por cuantos años a sido este pueblo su lugar de residencia? <HRESYEARS> _____ años
(1) ¿Qué fue su razón primaria para mudarse aquí? <HRESY>_____

A2. ¿Han migrado algunos miembros de su familia a otro sitio alguna vez? <HMIGRATE> _____ ☐ Si____ ☐ No

(1) ¿Si responden sí, en qué año más o menos?: <HMIGYEAR>_____
(2) ¿Si responden sí, por qué migró(aron)? <HMIGWHY>_____

A3. ¿Cuantos hectáreas de tierra dueña la familia este año?

Uso de tierra	Area (hectáreas)
Tierra Agrícola: (1) Tierras de cultivo para producir para la subsistencia o para la venta	<HCROPAREA> **(a1. _____ % *regada)*** <HAREAIRRIG>
(2) Agroforestal	<HAGROAREA>
(3) Pastos y otros usos no agricolas	<HPASTAREA>
Tierra Forestal: f (4) Plantaciones (árboles plantados)	<HPLANTAREA>
(5) Bosque natural (no plantado)	<HFORAREA>
(6) Cuantas hectáreas tiene la familia en total:	<HTOTALAREA>

AJ3a. ¿Ha vendido tierra alguna vez?
Cuánto, y a quíen? _____

A4. ¿Usa la familia tierra de la cual no es dueña para uso agricola? <HNOTOWN> ☐ 0. No ☐ 1.Sí, Alquilado

_____ ☐ 2.Sí, aparcería ____☐ 3.Sí, Tierra privada provenido gratis __ ☐ 4.Sí, Tierra de acceso abierto

A4a. Si "Sí," ¿cuál es el área total de tierra que la familia cultiva este año pero no es dueña? <HNOTOWNAR>____*hectares*

AJ1. ¿Como describiría usted los derechos de propiedad que tiene en los bosques locales? *Pregunta abierta*

_____

_____

_____

_____

AJ3. ¿Tiene acceso al bosque para caminar y pasear? ☐ Sí ☐ No
Comentarios:

AJ4. ¿Tiene acceso al bosque para extraer recursos? ☐ Sí ☐ No

a. Si responden "sí": ¿Cuales tipos de recursos retraen y/o usan del bosque – por ejemplo madera, hongos, comida, o otros? *Pregunta abierta*

_____

_____

_____

b. Cuanta nivel de extracción está permitido para cada recurso que usa del bosque?
_____ (cantidad a)
_____ (cantidad b)
_____ (cantidad c)
_____ (cantidad d)

AJ5. ¿Participa usted en el proceso de hacer decisiones sobre el manejo del bosque? ☐ Sí ☐ No

c. Si responden "sí": Que papel tiene en el proceso? (*pregunta abierta)*

_____

_____

_____

AJ6. ¿Participa en decisiones para transferir derechos del bosque o excluir otra gente del uso del bosque? ☐ Sí ☐ No

d. Si responden "sí": De que manera? (*pregunta abierta)*

_____

_____

_____

AJ7. ¿Hay limitaciones sobre en los tipos de productos, o la cantidad de productos, que está permitido usar del bosque?
☐ Sí ☐ No

e. Si hay limitaciones, ¿cuales son los tipos y cantidades que imponen ellas? (*pregunta abierta)*

_____

_____

_____

AJ8. ¿Está permitido vender tierra? ☐ Sí ☐ No

AJ9.¿Idealmente, qué porción de la tierra debe ser manejada comunalmente y/o de forma privada?
☐Toda es común
☐ Más común que privada. ¿Qué porcentaje es común? _____%
☐ Media común y media privada
☐ Menos común que privada. ¿Qué porcentaje es común? _____%
☐ Toda es privada

AJ10. ¿Cómo calificaría la calidad de su tierra?
☐ Muy buena ☐ Buena ☐ Más o menos buena ☐ Mala ☐ Muy mala

A5. Queremos preguntarle sobre sus manejo de ganado:

¿Cuántas animales posee su familia?	**Número de animales estimados**	**¿En corrales o pastoreados por mayor parte? (1 = corrales ; 2 = pastoreados)**
(1) Animales grandes y de medio tamaño (vacas, obejas, cabras, cerdos, burros)	<HLGANIMNO>	<HLGANIMFED>
(2) Animales pequeñas (*gallinas, patos, conejos, etc.)*	<HSMANIMNO>	

A6. Por favor indique el numero de los siguientes bienes o artículos que posee el hogar:

Item	# owned	Item	# owned	Item	# owned
Radio	<HRADIO>	Cocina de gas/electricidad	<HSTOVE>	Casa	<HHOUSE>
Teléfono (fijo)	<HPHONE>	Tocadiscos/cintas	<HRECRD>	Ventilador / A/C	<HFAN>
Teléfono (móvil)	<HCELL>	Automovil	<HCAR>	Antena parabolica	<HDISH>
Mosquitero	<HMSQNET>	Motocicleta	<HMBIKE>	Azada	<HHOE>
Maqunia de coser	<HSEWING>	Bicicleta	<HBIKE>	Arado	<HPLOW>
Televisión	<HTELEVIS>	Carro tirado por animales	<HCART>	Computadora	<HMILK>
Vidéo / DVD	<HDVD>	Carretilla	<HBARR>	Sembradora de abono mineral	<HFERT>
Refrigerador	<HFRIDGE>	Linterna	<HLNTRN>	Maquina de fresar	<HHDMLL>
Barco / canoe	<HBOAT>	Planchador	<HIRON>	Maquina de café despulpado	<HCOFFEE>
Motor fuera de borda	<HENG>	La trilla de maquina	<HTHRSH>	Otra:	<HASTOTH>

B. Ingresos de hogar.

B1. ¿Cuales son las fuentes de ingresos para la familia, y ingreso total estimado por los últimos 12 meses? {H_INC}

Cuales de los siguientes son fuentes de ingreso en efectivo par su familia? (por favor marque todos que aplican en la columna siguiente)	### <H_INCSRCE>	Marcar la fuente más importante para dinero en efectivo <HINCMOSTIMP>	**Por favor estima el ingreso anual del hogar de todos miembros del hogar en los últimos 12 meses excluyendo este mes**	
			Cantidad de dinero por producto en el mes anterior del mes de encuesta (Bs) <H_INCMO>	Cantidad de dinero por los últimos 12 meses (Bs) <H_INCYR>
(1) Venta de productos agrícolas				
(2) Venta de animales				
(3) Venta de productos de animales				
(4) Venta de productos agrícolas para exportación				
(5) Ingreso de negocio				
(6) Salario o sueldo efectivo				
(7) Otras ganancias casuales				
(8) Remesas efectivas				
(9) Pesca				
(10) Venta de alcohol producido				
(11) Venta de productos del bosque (e.g. carbón, leña , madera, miel, plantas medicinales, alimentos silvestres)				
(12) Renta recibida:				
(13) Otra (Especificar): <H_INCOTH>				
(14) Ingreso total de familia estimada				<HINCTOT> **Bs**

AJ11. ¿Cuánto dinero gasta su familia en la energía (incluso madera) cada semana (tiempo colectando madera, o dinero que gasta en fuentes de energía)? _____(bolivianos y/o horas; marcar los que aplican)

AJ12. ¿Cuánto gasta en dinero y tiempo su familia en la comida cada semana? _____(bolivianos y/o horas; marcar los que aplican)

AJ13. ¿Qué porcentaje de la comida de la familia está producido por ustedes mismos?
_____% (porcentaje)

AJ13a. ¿En los últimos 5 años, cómo ha cambiado la condición del bosque?

- ☐ 0 – ha empeorado mucho
- ☐ 1 – ha empeorado un poco
- ☐ 2 – ha quedado casi igual
- ☐ 3 – ha mejorado un poco
- ☐ 4 – ha mejorado mucho

AJ14. ¿Cómo ha afectado el plan de manejo indígena a la condición del bosque?

- ☐ 0 – La ha empeorado mucho
- ☐ 1 – La ha empeorado un poco
- ☐ 2 – No la ha afectado
- ☐ 3 – La ha mejorado poco
- ☐ 4 – La ha mejorado mucho

B2. Si su familia alcanza algunas necesidades de subsistencia por productos que cosecha de los bosques (carbon, leña, madera, miel, o frutas por ejemplo), que es el valor monetario de esos productos que su familia:

Venda: <HSELLVALUE> Bs (por los últimos 12 meses excluso este més de encuesta)
Consume en casa: <HCONSVALUE>Bs (por los últimos 12 meses excluso este més de encuesta)
R: ¿Qué productos de bosque no vende o no vendería nunca?

C. Perturbaciones a la bienestar de las familias

C1. ¿Durante los últimos 12 meses, fue su casa afectada gravemente por algunas de los eventos siguientes?

1.	2.	3.	4.	AJ (5.)	6	7	8	AJ (9.)
Perturbacion ID	**Perturbacion**	**Sí/No**	**Enumera las perturbaciones en orden de importancia:** <HSHOCK1> <HSHOCK2> <HSHOCK3>	**Ocurrencia en los últimos 5 años (Sí/No)**	**¿Causó la perturbación una reducción de ingreso y/o bienes?** 1 = Perdida de ingresos 2 = Perdida de bienes 3 = Los dos 4 = Ninguna <HSHOCK1INC> <HSHOCK2INC> <HSHOCK3INC>	**¿Cómo dispersado fue esta perturbación con respeta a quien la afectó?** 1 = Sólo esta familia 2 = Algunas familias en la comunidad 3 = Mayoría de familias en la comunidad 4 = Todas familias en la comunidad <HSHOCK1WHO> <HSHOCK2WHO> <HSHOCK3WHO>	**¿Cómo su familia reaccionó a la perturbación?** <HSHOCK1HOW> <HSHOCK2HOW> <HSHOCK3HOW>	¿Espera que la perturbación va a ocurrir otra vez? 1 = ocurriendo ahora 2= muy probable 3=probable 4= poco probable 5 = no sé
101	Perdida de cultivos por sequía	<HDROUGHT>						
102	Perdida de cultivos por inundación	<HFLOOD>						
103	Enfermedad o peste de cultivos	<HCRPPEST>						
104a	Animales murieron	<HSTOCKDIED>						
104b	Animales fueron robados de los vecinos							
104b	Animales fueron robados de los miembros de otras comunidades							
104b	Animales fueron robados (No sabe que robó)							
105	Perdida de trabajo con suelo o falta de pagamiento de sueldo	<HJOBLOSS>						
106	Gran caída en los precios de cultivos	<HPRICEFALL>						
107	Gran aumento en los precios de cultivos	<HPRICERISE>						

108	Gran aumento en precio de las entradas para cultivos	<HINPUTRISE>						
109	Falta de agua grave	<HWATERLOW>						
110	Perdida de tierra	<HLANDLOSS>						
111	Enfermdad grande o accidente de algun miembro de la familia	<HILLNESS>						
112	Muerte de miembro de familia	<HDEATH>						
113	Hogar dañado o destruido	<HHOUSEDEST>						
201	Perdida de cultivos por fuego							
202	Perdida de cultivos por ventarrón							
114	Otro <HSHOCKY> (*elaborar*):	<HSHOCKOTH>						

Codes for C1.8:
1 = Cosechar más productos forestales
2 = Cosechar más alimentos silvestres que no se encuentra en el bosque
3 = Cosechar más productos agricolos
4 = Gasta dinero ahorro
5 = Venta de bienes (tierra, animales, etc.)
6 = Hace más labor casual
7 = Ayuda de amigos y relaciones
8 = Ayuda de ONG, organización comunitaria, o organización religiosa
9 = Obtener una préstamo de una asociacion de credito, prestamista de dinero, etc.
10 = Disminuir los gastamientos de familia
11 = Hizo nada en particular
12 = Otra (especificar) <HSHK1HOWY> <HSHK2HOWY> <HSHK3HOWY>

AJ. ¿Ha visto cambios en la calidad de los bosques?

La abundancia de árboles comunes	☐ Aumento ☐ No cambio ☐ Disminución ¿Tienen la preocupación? ☐ Sí ☐ No
La abundancia de árboles alimentos	☐ Aumento ☐ No cambio ☐ Disminución ¿Tienen la preocupación? ☐ Sí ☐ No
La abundancia de árboles leña	☐ Aumento ☐ No cambio ☐ Disminución ¿Tienen la preocupación? ☐ Sí ☐ No
La abundancia de árboles comerciales	☐ Aumento ☐ No cambio ☐ Disminución ¿Tienen la preocupación? ☐ Sí ☐ No
Diversidad de especies de árboles	☐ Aumento ☐ No cambio ☐ Disminución ¿Tienen la preocupación? ☐ Sí ☐ No
La diversidad de especies animales	☐ Aumento ☐ No cambio ☐ Disminución ¿Tienen la preocupación? ☐ Sí ☐ No

AJ.¿Cómo ha cambiado el uso de su familia de estos productos debido al plan de manejo indígena?

_____

_____

Plan de Manejo Indígena (AJ)

1. Existe algún plan de manejo indígena ☐ Sí ☐ No
2. ¿Si existe algún programa, quién lo implementó? _____
3. ¿Cuando fue implementado? _____
4. ¿Ha recibido dinero o beneficio del plan? _____
5. ¿Cuánto dinero ha recibido por el plan? _____
6. ¿Qué tan satisfecho está usted con el plan?

   ☐ 0 – No satisfecho ☐ 1 – Poco satisfecho ☐ 2 – Muy satisfecho

7. ¿Ha reducido o cambiado su uso del bosque por la existencia del plan? ☐ Sí ☐ No
8. ¿Cómo ha cambiado su uso del bosque por el plan? (*Pregunta abierta)*

   _____

   _____

   _____

9. ¿Hay gente que reciben pagos o beneficios del plan pero todavía extraen más del bosque de lo permitido por el plan?
   ☐ Sí ☐ No
10. ¿Han impactado el plan a los miembros de la comunidad en una manera justa? ☐ Sí ☐ No

Si respondieron "Sí" a pregunta 4 o 5:

11. ¿Cómo ha cambiado sus decisiones como gerente como respuesta al programa? (*Pregunta abierta)*

    _____

    _____

    _____

    _____

Si respondieron "Sí" a pregunta 5 (si han recibido dinero / pagos del plan):

12. ¿Ha pagado algún costo para reducir el uso del bosque por otro gente, como cuesta de exclusión u otro costo?
☐ Sí ☐ No
Si respondieron "Sí" : ¿Cuanto ha pagado? _____ (Bolivianos)

13. ¿Cuál es su opinión del plan en total? (pregunta abierta)

_____

_____

14. ¿Generalmente, como evaluaría el nivel de justicia en el plan?
☐ 0 – No es justo ☐ 1 – Poco justo / más injusto que justo
☐ 2 – Más o menos justo / más justo que injusto ☐ 3 – Muy justo
☐ 4 – Tan justo como puede ser

15? ¿Quiénes son las personas más importantes que están involucradas en el plan de manejo del bosque?

_____

_____

Conflicto (AJ)

15. ¿Generalmente, como evaluaría la nivel de justicia en la gobernancia y administración del bosque?
☐ 0 – No es justo ☐ 1 – Poco justo / más injusto que justo
☐ 2 – Más o menos justo / más justo que injusto ☐ 3 – Muy justo
☐ 4 – Tan justo como puede ser

16. ¿Ha sido conflicto en los bosques con relación a los derechos de propiedad dentro de la comunidad? ☐ Sí ☐ No

17. ¿Ha sido conflicto en los bosques con relación a los derechos de propiedad con otras comunidades? ☐ Sí ☐ No

18. ¿Si hubo conflictos en los bosques, como fueron resueltos? (*Pregunta abierta)*

(Por ejemplo por arbitración por tercer partido, negociación, adjudicación formal, etc)

_____

_____

19. ¿Quién es la autoridad principal responsable para regular y hacer cumplir las reglas en el bosque? (*Pregunta abierta)*

_____

_____

E. Dependencia de Familia en Productos Forestales {H_REL}

E1. Quisieremos preguntarle sobre el uso de su familia de los productos forestales para subsistencia y ingreso en efectivo por el último mes

1.	2.	3.	4.	5.	6.	8.	9.	10.	11.	12.
Producto forestal <H_RELPRDSUB>	*¿Uso familiar es por mayor parte para subsistencia o para ingreso?* *1 = Subsistencia* *2 = .dinero* *99 = No colecta este producto* <H_RELSCASH>	Tipo de manejo forestal desde la recolección del producto *1 = Gobierno* *2 = MFC* *3 = Comunitaria* *4 = Privada* <H_RELPRDFM>	¿Tambien obtiene este product por Fuentes a parte de los bosques? (Si/No) <H_RELOTH> **¿Si "si," cuanto (%)** de su necesidad total de familia esta obtenido de zona forestal? <H_RELPERC>	Cantidad colectado del bosque marcado en columna 3 **en el mes pasado** <H_RELQY>	Unidad (kilos, etc.) <H_RELU>	Precio por unidad en el mercado local (Bs) <H_RELPR>	% de cosecha total que fue vendido por dinero en efectivo **%** <H_RELSD> <H_RELAT>	¿La cantidad que fue cosechado en el mes pasado fue normal por cuantos meses del año para su familia? <H_RELMONTH> *(Marque el numero de meses, y también circule el código que corresponde abajo)* <H_RELCODE>	*Cambio en la cantidad de cosecha desde que el MFC fuera implementado en este pueblo (sitios de tratamiento)* ***OR*** *Cambio en cosecha desde 2000 (sitios de control)* *-1 = Desminuido;* *0 = No cambio;* *1 = Aumentado* <H_RELCHNG>	*Razón citada para la respuesta a E1.11* <H_RELCHGY>
a. Leña o carbón										
b. Hoja o hierba para forraje de animales										
c. Madera										
d. PNMF, *Describe:* ____ <HNTFPDESC>										
e. Otro producto importante *(Describe):* ____ <HOTHIMP1>										
f. Otro producto importante *(Describe):* ____ <HOTHIMP2>										

Codes for E1.10:

1 =La cosechan normal de mi casa es más o menos similar de mes a mes en el año pasado
*2 = Mi familia típicamente cosecha **mucho menos** que ésta cantidad cada mes*
*3 = Mi familia típicamente cosecha **mucho más** que ésta cantidad cada mes*
4 = Otra explicación (describe): <H_RELMOYY>_____

D. Interacciones de las familias con los bosques y las actividades del manejo forestal

D1. ¿Tiene conocimiento de los diferentes bosques con distintas tipos de manejo? (incluso local o por el gobierno nacional, de manejo forestal comunitario, o por la comunidad) ☐ Si ☐ No <HFORMANG> {H_INT}<H_INTFTYPE><H_INTFNAME>

Nombre(s) de los bosques gobermentales:
Nombre(s) de bosques con manejo conjunto por gobierno y comunidad:
Bosques comunitarios (nombre(s)):
Bosques privadas (nombre(s)):

D2. ¿Cómo calificaría la importancia de los bosques en su zona con respeto a los beneficios que provienen directamente a su familia?

Tipo de gobernancia forestal	Importancia actual para la subsistencia *0 = No importante* *1 = Algo importante* *2 = Muy imporante* *99 = No aplica* <H_INTSUBS>	Importancia actual para ingresos en efectivos *0 = No importante* *1 = Algo importante* *2 = Muy imporante* *99 = No aplica* <H_INTINCOME>	*Razones citadas* <H_INTRSN2>
Bosque gobermental			
Bosque manejado conjunto por gobierno y comunidad			
Bosque comunitario			
Bosque privado			

D3. ¿En su opinion, cuales grupos son lo más activos en el manejo forestal, y cuales reciben los beneficios mayores?
NOTA: PROBABALMENTE TENEMOS QUE CAMBIAR ESTAS PARA BOLIVIA PORQUE FUERON CREADOS PARA EL CONETXTO TANZANIO

Codes:
1 = Campesnos elejidos o apuntados a comites forestales;
2 = Casi todos los campesinos, más o menos igualmente;
3 = Gobierno del Pueblo;
4 = Empleos de departamento forestal local;
5 = Departamento Forestal del Distrito;
6 = ONG nacional o local;
7 = Otra (elaborar);
88= No sabe.

Tipo de manejo forestal	Grupos son lo más activos en el manejo forestal (el uso y manejo): (1st & 2nd más importantes) <H_INTDEC1><H_INTDEC2>		Grupos que reciben los beneficios mayores: (1st & 2nd más importantes) <H_INTLGSH1> <H_INTLGSH2>		**Razones citadas** <H_INTRSND3>
Bosque gobermental	*1*	*2*	*1.*	*2.*	
Bosque manejado conjunto	*1.*	*2.*	*1.*	*2.*	
Bosque comunitario	*1.*	*2*	*1.*	*2.*	
Bosque privado	*1.*	*2.*	*1.*	*2.*	

D4. Por favor díganos sus opiniones sobre las reglas forestales y los sanciones por romper las reglas, para bosques debajo de tipos de manejo diferentes

Tipo de manejo forestal	**Claridad de reglas** a. Reglas sobre cosecha y manejo *0 = No claro, poco conocido* *1 = Claro y bien conocido por su familia* <H_INTCLEAR>	**Justicia de Reglas** b. Reglas para el uso y manejo del bosque son: *0 = No justo **(explique por qué);*** *1 = Más o menos justo* *2 = Completamente justo* *88 = No sabe* <H_INTFAIR><H_INTFAIRY>	**Sancinoces por romper las reglas** c. Sancionces para los que rompen las reglas, irrespectivamente de sue status en el pueblo, son aplicados: *0 = No justamente **(explain how);*** *1 = Más o menos justamente* *2 = Completamente justamente* *88 = No sabe* <H_INTRULEPEN> <H_INTRULEPENY>
Bosque gobermental			
Bosque manejado conjunto			
Bosque comunitario			
Bosque privado			

D5. Por favor díganos sobre la participación de su familia en el ultimo año en actividades forestales para el bosque/los bosques cerca de su pueblo:

Actividad: *0 = Nunca;* *1 = Raramente;* *2 = A veces;* *3 = Frecuentamente;*	¿Ha harvestado algún product foretal para subsistencia o para la venta? <H_INTHARVEST>	¿Ha participado en crear las reglas sobre el uso, cosecha, o manejo forestal? <H_INTCREATE>	¿Ayudado a monitar o enforzar las reglas del bosque? <H_INTMONITOR>	¿Ayudado a resolver conflictos en el bosque? <H_INTRESOLVE>
Bosque gobermental				
Bosque manejado conjunto				
Bosque comunitario				
Bosque privado				

D6. Por favor cuentanos sus opinions sobre el pueblo y el liderazgo del comité de recursos naturales del pueblo (CRNP)

	Codes *1 = very dissatisfied* *2 = dissatisfied* *3 = satisfied* *4 = very satisfied* *5 = don't know*
A. ¿Qué tan satisfecho está con el liderazgo del gobierno del pueblo generalmente? *Explicar:*	<HGOVTSATISF>
B. ¿Qué tan satisfecho está con el liderazgo del comité de recursos naturales del pueblo actual? *Explicar:*	<HVECSATISF>
C. ¿Participó usted o otro miembro de su familia en elegir el comité actual de CRNP?	**No / Sí** <HVECELECT>
D. ¿Qué tan satisfecho está con la manera en que están elegidos los miembros del CRNP? *Explicar:*	<HVNRCSATISF>
E. ¿Qué tan satisfecho está con el manejo conjunto forestal (MCF) en su pueblo? *Explicar:*	<HJFMSATISF>
F. ¿Qué tan satisfecho está con la ejucución de MCF en su pueblo? *Explicar:*	<HENFSATISF>
G. ¿Piensa que su familia tiene información Buena sobre la forma en que se maneja los ingresos y gastos por el CRNP? *Explicar:*	**No / Sí** <HINFOSATISF>
H. ¿Piensa que su familia tiene conocimiento suficiente del manejo forestal para participar en desarrollar las reglas del manejo forestal para guiar el CFM? *Explicar:*	**No / Sí** <HKNOWSATISF>

D7. Por favor cuentenos sobre su participación en los reunions diferentes en su pueblo por el ultimo año.

		¿Con qué frecuencia asistó usted o un miembro de su familia a estos reunions cuando se llevaron a cabo? *0 = Nunca* *1 = Raramente* *2 = A veces* *3 = Frecuentamente* *4 = Casi siempre*	Main reason for missing meetings? *1 = No tiene interesa* *2 = No siente que son utiles* *3 = No se informe por los reuniones* *4 = Demasiado ocupado por trabajo o viaje* *5 = No habia ningun reunion* *6 = Otra razon (especificar☺*
A	Reuniones del pueblo	<HATTENDVILL>	<HMISSVILLY> <HMISSVILLYY>
B	Reuniones de CRNP	<HATTENDVEC>	<HMISSVECY> <HMISSVECYY>

D8. ¿Qué consejos daría para maejorar la gobernancia y manejo de los bosques por grupos en su pueblo?
<HSUGGEST>_____

_____

D9. ¿Si los bosques en su zona han mejorado por los últimos años, ha tenido su familia algún impacto positive o negativo por estos mejoramientos (como menos erosión del suelo o aumentación de asalto a los cultivos por animales del bosque)?
Impactos positivos:

<HPOSIMPACT>_____

_____

Impactos negativos: <HNEGIMPACT> _____

_____

D10. Quisieremos preguntarle sobre la participación de su familia en grupos con enfoque de manejo forestal

(1) ¿Está usted o algun miembro de su familia involucrado en algún grupo que hace actividades del manejo forestall? *Si 'no', ve a 13. (0=No; 1=Sí)* <HINVOLVE> *1a. Si "sí", en cuales bosques hace actividades del manejo forestal?* <HINVNAME> _____		
(2) ¿Es un grupo organizado formalmente o informalmente? *(1=Formal; 2=Informal)* <HFORMAL>		
(3) ¿Como se llama el grupo con quien están involucrados? <HINVGRPNAME>		
(4) ¿Asiste alguien de su familia a los reunions de este grupo regularmente? *(0=No; 1=Sí)* <HREGATTEND> (5) **Si 'No'**, cuál es lo mayor razon por no asistir? <HREGATTDY> *1 = No les interesa* *4 = Demasiado ocupado con trabajo/viaje* *2 = No sienten útiles* *5 = No había ningun reunion* *3 = No están informados del reunion* *6 = Otra razon (especifique)* <HREGATTDYY>		
(6) **Si 'Sí:** ¿en su familia, quien normalmente asiste los reunions del grupo y participa en otras actividades del grupo? <HREGATTDWHO> *Codigos: 1=sola esposa; 2=los dos, pero la esposa por mayor parte; 3=los dos igualmente; 4=los dos, pero el esposo por mayor parte; 5=solo el esposo; 6=otro acuerdo, especifique* <HREGATDWHOY>		
(7) ¿Cuantas persona-días (días de trabajo completas) gastaron los miembros de la familia en actividades del grupo (reunions, monitoreo o ejecución, trabajo conjunto, etc.) por los últimos 12 meses? <HPERSONDAYS>		<HWOMANDAYS> *Mujer-dias* <HMANDAYS> *Hombre-dias*
(8) ¿Cuáles fueron sus razones mayors por juntar el grupo? *Califique los 2 razones más importantes*	**Razon** *1. Mejor acceso a los productos forestales para la familia* *2. Ayudar a mejorar el manejo forestall actual* *3. Acceso a otros beneficios cmo apoyo gobermental, programas de los donantes* *4. Mi obligación proteger el bosque para generaciones del futuro* *5. Ser respetado o estimado como persona responsable en el pueblo* *6. Aspeto social (conocer gente, trabajr juntos, miedo de exclusion)* *7. Obligado o apresurado por el gobierno o jefes o vecinos* *8. Otra, especifique:* <HJOINOTH1><HJOINOTH2>	**Calificación 1-2** <HJOINGRPY1> <HJOINGRPY2>
(9) **¿Si no participle in ninguna actividad de grupo con enfoque forestall, por qué no?** *Califique las 2 razones más importantes.*	**Razón** *1. No hay grupo formal ni informal en el pueblo* *2. Soy nuevo en el pueblo* *3. Miembros de los grupos generalmente pertenece a otros grupos que yo (basado en origen etnico, riqueza, afiliación politica, o religión)* *4. No se lo puede permitir el tiempo* *5. No se lo puede permitir el pagamiento* *6. Ser miembro del grupo restringirá mi uso del bosque, y quiero usar el bosque por qué lo* *7. No creo que trabajar en grupos es muy efectivo para manejar el bosque* *8. Otra, espificique:*<HNOOTHER1><HNOOTHER2>	**Calificación 1-2** <HNOJOINY1> <HNOJOINY2>

F. Construcción de familia, Energía de familia, y Seguridad Alimentaria

F1. Por favor describa la construcción del hogar en que vive esta familia (*observaciones del encuestador*):

(1) ¿De que tipo de material está fabricado las paredes exteriores? <HWALLS>

☐ 1. barro / zarzo / piedra ☐ 2. Madera (tablas) ☐ 3. Hierro/hojas metales

☐ 4. Ladrillos cocidos al horno ☐ 5. Concreto / cemento ☐ 6. Hiebra / Fibre / paja

☐ 7. Otra (describa: <HWALLSOTH> _____)

(2) ¿De qué tipo de material está fabricado el techo? <HROOF>

☐ 1. Paja ☐ 2. Madera (tablas) ☐ 3. Hierro / hojas metales ☐ 4. Azulejos

☐ 5. Otra (Describe: <HROOFOTH> _____)

F2. ¿Qué tipo de combustibles usa la familia para la preparación de alimentos? <HFUEL>

☐ Leña ☐ Carbón ☐Biogas ☐ Querosen ☐ LPG (gas) ☐ Electricidad

☐ Otra (Describe: <HFUELOTH> _____)

G. Datos para identificación

G1.(1) Nombre de cabeza de familia: <HHEADNAME > _____(2) ☐ H ☐ M <HHEADGEND>

G2.(1) Nombre de encuestado: <HRESPNAME> _____(2) ☐ H ☐ M <HRESPGEND>

G3. Origen etnico de familia: <HHHETHNIC> _____

G4. Número de miembros de familia: <HMEMBNO> _____

G5. Edad y educación de los miembros de familia (incluyendo el encuestado): {H_MEM}

Miembro de familia <H_MEMB>	Ocupación primaria <H_MEMOCC>	Relación con encuestado <H_MEMREL>	Género <H_MEMGEN>	Edad <H_MEMAGE>	Años de educación alcanzado <H_MEMED>
(1)					
(2)					
(3)					
(4)					
(5)					
(6)					
(7)					
(8)					
(9)					

AJ. ¿Cómo calificaría la calidad de su salud?

☐ Muy bien ☐ Bien ☐ Más o menos ☐ Mal ☐ Muy mal

AJ. ¿Has estado enfermo en los últimos 3 meses?

☐ Sí. ¿Cuántos días no pudo trabajar? _____ ☐ No ☐ No me acuerdo

20. AJ. ¿Tiene alguna preocupación por el bosque o los árboles? *Esta es una pregunta abierta*

_____

_____

_____

Fin de entrevista

Instrucciones para encuestador:

1. Por favor asegúrese de dar las gracias al respondiente para su cooperación durante la entrevista.
2. Por favor asegúrese de preguntar al respondiente si tiene algunas dudas o preguntas con relación a la entrevista
3. Por favor tome el tiempo para verificar que no hay ningunas preguntas quedando blancos en la forma que deberían sido completados (menos que el respondiente elijo a no responder).

Appendix 4 Plant Species of the five communities (2006)

Oropendola

Species	Count
Ampelocera ruizii Klotzsch	9
Aniba guianensis	4
Aspidosperma rigidum Rusby	27
Astrocaryum murumuru C. Martius	43
Attalea phalerata Mart. ex Spreng.	17
Bactris major Jacq.	5
Caesalpinia pluviosa DC.	1
Cariniana ianeirensis R. Knuth	1
Casearia gossypiosperma Brig.	1
Casearia sylvestris Sw.	1
Cecropia sp	10
Cedrela fissilis Vell.	2
Ceiba speciosa St. Hilaire	3
Celtis pubescens	1
Clarisia racemosa Ruiz & Pav¢n	3
Cochlospemum vitifolium	2
Cordia alliodora (Ruiz & Pav¢n) Oken	1
Enterolobium contortisiliquum (Vell.) Morong	1
Esenbeckia almawilla	3
Ficus sp.	4
Gallesia integrifolia (Sprengel) Harms	15
Garcinia brasiliensis Planch. & Triana	1
Guadua chacoensis (Rojas) Londono y Peterson	1
Guadua paniculata	1
Guazuma ulmifolia Lam.	9
Hura crepitans L.	14
Inga sp.	19
Jacaratia digitata (Poepp. & Engl.) Solms	7
Machura Unc	1
Maroacelia Cordifolia	1
Melicoccus lepidope	6
Morriri cauliflora	13
Myrcianthes sp.	6
Myroxylon balsamum (L.) Harms	1
Ocotea guianensis Aubl.	39
Oxalix griseaC.) Standl.	3
Pachira inermis	4
Physocalymma scaberrima Pohl	1

Species	Count
Pourouma cecropiifolia C. Martius	10
Pouteria macrophylla (Lam.) Eyma	8
Pouteria nemorosa Baehni	11
Pseudolmedia laebis	118
Ruprechtia laxiflora Meisn.	10
Sapium glandulosum (L.) Morong	4
Schiglobrium Parahyba	4
Schinopsis brasiliensis Engler	1
Schizolobium amazonicum	2
Smilax flavicauli	45
Solanum palinacuna	6
Stereulia apelata	1
Stylogyne ambigua (C. Martius) Mez	1
Sweetia fruticosa Spreng.	1
Talisia esculenta (Cambess.) Radlk.	5
Terminalia oblonga (Ruiz & Pav¢n) Steudel	24
Theobroma cacao	30
Trema micrantha (L.) Blume	1
Triplaris americana L.	3
Uncaria tomentosa	1
Unonepsis sp.	2
Vataireopsis speciosa Ducke	6
Virola sebifera Aublet	3
Ximenia americana L.	1
Xylopia sericea A. St.-Hil.	1
Zanthoxylon sp.	9

Pauraque

Species	Count
Acacia loretensis	10
Adiatum obliquom	1
Alibertia Edulis	2
Annona hypoglauca	3
Apeiba tiborbou	4
Aspidosperma rigidum	2
Aspidosperma sp.	10
Astrocaryum gratum	15
Batucarpus Costarecensis	2
Bombacopsis paraensis	2
Brosinum alicastrum	10
Buddleja Globosa	1

Species	Count
Calophyllum brasiliensis	2
Cariniana estrellensis	1
Cecropia polystachya	12
Cecropia Polystachya Trecul	19
Cedrela Balansae	1
Ceiba petandra	2
Cellichalys sp	7
Celtis shippil	7
Clarisia biflora	4
Clarisia racemosa	9
Cucurbita spp..	4
Desconocido	21
Desconocido Arantaya BOL	1
Desconocido Avatayalen BOL	1
Desconocido Chima BOL	1
Desconocido Evanto BOL	1
Desconocido Huapi BOL	1
Desconocido Mucu mucu BOL	1
Desconocido Palo Nopa BOL	2
Desconocido Palo Vidrioso BOL	1
Desconocido Pichana BOL	2
Desconocido Puca ¤awi BOL	3
Desconocido Reto¤ada BOL	1
Desconocido Sama BOL	1
Didymopanax morototoni	1
Endlicheria paniculata	7
Euterpe precatoria	19
Ficus insipida	3
Ficus sp	4
Gallesia intergrifolia	6
Genomona sp	2
Guarea aff guidonia	2
Guazuma ulmifolia	2
Heisteria spruceana	5
Hura crepitans	6
Inga sp	9
Iriartea deltoidea	32
Jacaritia digitata	1
Jessenia Batava.	1
Leonia crassa	17
Licania oblongifolia	9

Species	Count
Lunania Parviflora	42
Macluria Tinctoria	1
Margaritaria nobilis	7
Meconia Affinis	3
Mouriri sp	2
Myroxylon balsamun	3
Ormosia bopiensis	11
Oxandra espintana	1
Pentaplaris davidsmithii.	30
Perebea sp	2
Peschiera cymosa.	7
Philodentron camposportianum	2
Poulsenia armata	11
Pourouma cecropiifolia	2
Pouteria macrophylla	4
Prinari aff klugii.	5
Protium sp	12
Pseudolmedia laevis	76
Rheedia acuminata	7
Rheedia Gardneriana	3
Rubiaceae Macroenemum sp	17
Salacia gigantea	1
Salacia impressifolia	1
Salix humboldtiana	1
Senna spectabilis	2
Sloanea eichleri	1
Socratea exorrhiza	13
Sorocea aff. pileata	10
Tabebuia Avellandeade	1
Terminalia oblonga	12
Tetragastris altissima	3
Tetragastris panamensis	15
Theobroma cacao	13
Trema micrantha	1
Treplaris americana	5
Trichilia inaequilatera	37
Triplaris poeppigiana	7
Triplaris sp	6
Urera Caracasana	4
Virola peruviana	7
Xylopia ligustrifolia	6

Potoo

Species	Count
Acacia loretensis	1
Acrocopmia tatai	1
Amburana cearensis	2
Aspidosperma sp	8
Aspiusperma rigidum	6
Astrocaryum murumuru	37
Attlea phalerata.	15
Brosinum alicastrum	1
Caesalpinia pluviosa.	1
Calo`hyllum brasiliense	2
Calycophyllum sproceanum	1
Cecropia cf. polystachya	7
Cecropya Polystachya Trecul	9
Ceiba cf. speciosa	3
Celtis shippil	2
Centrolobium ochroxylum	1
Clarisia racemosa	63
Cordia sp	24
Croton cf draconoides.	1
Cucurbita spp	1
Derris sp.	5
Desconocido	13
Desconocido ?rbol peludo BOL	1
Desconocido Barbasca BOL	1
Desconocido Canel¢n BOL	1
Desconocido Canoillo BOL	1
Desconocido Chilica BOL	2
Desconocido Chiquillo BOL	1
Desconocido Chiro BOL	11
Desconocido Coca de monte BOL	3
Desconocido Colorado BOL	2
Desconocido Comida de loro BOL	1
Desconocido Cura de monte BOL	3
Desconocido Escoba BOL	1
Desconocido Frutilla BOL	2
Desconocido Goma de monte BOL	1
Desconocido Huapi BOL	3
Desconocido Itapallu BOL	8
Desconocido Jab¢n BOL	2
Desconocido Jarara BOL	1

Species	Count
Desconocido Liana BOL	1
Desconocido Manzana de monte BOL	8
Desconocido Manzanillo BOL	4
Desconocido Mapati BOL	2
Desconocido Mata palo BOL	1
Desconocido Mondadiente BOL	1
Desconocido Ojel BOL	1
Desconocido Palo bomba BOL	1
Desconocido Palo Oca BOL	1
Desconocido Palo retoxo BOL	1
Desconocido Palto de monte BOL	1
Desconocido Papalisa BOL	1
Desconocido Papaya de Monte BOL	1
Desconocido Papel Papel BOL	1
Desconocido Picapica de monte BOL	2
Desconocido quina rat¢n BOL	1
Desconocido Sangre de grado BOL	1
Desconocido Simayu BOL	5
Desconocido Sululo BOL	4
Desconocido Taruma BOL	1
Desconocido Tola BOL	1
Desconocido Toquito BOL	1
Desconocido Tutumillo	3
Desconocido Uxa de gato BOL	4
Desconocido Villca Blanco BOL	2
Desconocido Wara de monte BOL	1
Dipterex adorata	2
Duguetia spixiana	11
Duguetia Spixiana.	2
Ficus killipii	2
Ficus sp	11
Gallesia Integrifolia	9
Guarea aff guidonia	1
Hymenaea Courbaril	4
Inga sp	13
Iriartea deltoidea	18
Jessenia Batava.	18
Leonia crassa	6
Lunania Parviflora	4
Maclura tinctoria	7
Mouriri sp	2

Species	Count
Myroxiylon balsamum	1
Ochoroma piramidale	4
Ormosia sp.	9
Oxandra espintana	5
Parkia p,ndula	2
Pentaplaris davidsmithi	27
Pentaplaris davidsmithii	3
Poulsenia armata	12
Poulsenia Armata..	2
Pouter¡a sp..	3
Pouteria nemurosa	3
Pouteria sp.	30
Pseudolmedia laevis	7
Rheedia gardenaria	2
Rubiaceae Macroenemum sp	5
Sapium marmierii	16
Schefflera morototoni.	2
Senna sectabilis.	4
Sloanea Fragans	15
Spondia nombin	5
Styloceras columnare.	22
Tapirira guianensis	3
Terminalia amaz¢nica	6
Tetragastris altissima.	12
Theobroma cacao	2
Trema micranta	1
Trichilia inaequilatera	29
Triplaris americana	5
Triplaris setosa	3
Urera Caracasana	1
Virola flexuosa	2

Caracara

Species	Count
Acalypha sp..	1
Albizia sp.dd	1
Ampelocera ruizii	14
Aniba guianensis	8
Annona sp	10
Annona sp.	10
Apeiba sp.	18

Species	Count
Apeibaalbiflora	1
Aspidorperma affiedum	10
Aspidorperma affiedum Ruby i	3
Astrocaryum chonta	27
Boerbanavia sp	1
Brosimum gruianense	1
Brosimum latesceus	6
Byrsonima inodorum	52
Callichlamys sp.	53
Calycophyllum sproceanum	5
Casearra sp	97
Cecropia sp.	93
Ceiba pentandra	2
Chlorophora tinctoria	12
Claricia racemosa	1
clusia ramosa	15
Cordia nodosa	32
Cordia tetrandra	10
Dipterix adorata.	5
Dussia Tessamannis	13
Ephedranthus amaz¢nicus	16
Erythrina sp.	2
Eschweilera coriacea	85
Euterpe precatoria	6
Ficus sp.	21
Fusaea longifolia	65
Genipa americana	2
Geonoma sp.	1
Guarea sp.	22
Gynerium sagittatum	5
Helicenia sp.	1
Hirtella sp.	2
Hyptis sp.	4
Hyronima oblongadd	66
Inga sp	131
Iriartea deltoidea	85
Leonia sp.	25
Licania sp.	27
Lycianthes aserifolia	1
Macrocnemum sp.	26
Margaritaria nobilis	5

Species	Count
Monstera sp.	2
Myrsine sp.	27
Nectandra s	2
Nectandra sp.	35
Nectandra sp.dd	7
Oenocarpus bataua	26
Philodendron undulatun	3
Pourouma cecropiifolia	3
Pouteria nemurosa	31
Pouteria sp.	17
Pseudolmedia s	3
Pueraria sp.	1
Rheedia macrophylla	2
Salacia gigantea	11
Sapium haematospermum	34
Schedea sp.	34
Simarouba sp.	11
Simphonia sp.	36
Socratea exorrhiza	166
Spondias mombio	1
Sterculia apetata	17
Swartzia jorori	25
Talisia acutifosilia	16
Tapirira guranengis	78
Terminalia sp.	8
Trema micranta	4
Triparis amricana	22
Triplophyllum sp.	3
Uncaria sp.	45
Vernonia paterns	24
Virola sebifera	4
Virola sp.	4
Vitex sp.ss	2
Zanthoxylum sp.	20

Coquette

Species	Count
Acacia Loretensis.	4
Aniba guianensis	2
Annona maricata	4
Annona sp.	45

Species	Count
Aspidosporma discolor	7
Aspiusperma rigidum	4
Astroceryum Chonta	167
Bactris major	22
Brosimum guianense	20
Brosimuni Latescens	18
Buchenayia Punctata	6
Byrsonima indorum	34
Callichlamys sp.	14
Calophyllum brasiliense	3
Calycophyllum sproceanon	10
Carimana sp.	2
Carludovica palmata	1
Cassia spectabilis	2
Cecropia sp.	24
Cedrela o dorato	5
Ceiba pentandra	4
Celtis shippil	8
Chlorophora Tinotoria	15
Claricia biflora	8
Claricia racemosa	21
Clorisla sp.	1
Copaifera duckei	1
Cordia allcadore	3
Cordia nodosa	82
Desconocido 1	26
Desconocido 2	3
Desconocido Aliso	1
Desconocido Arbusto de bajura	1
Desconocido Arbusto de Curichi	2
Desconocido azucaro	2
Desconocido Bulepto	2
Desconocido Ca¤oto	2
Desconocido Cautochata	1
Desconocido Chorromto.	65
Desconocido Corosi	5
Desconocido gargatoo	7
Desconocido Isiri	16
Desconocido Itintina	1
Desconocido Lima	2
Desconocido Malua	5

Species	Count
Desconocido Moradillo	4
Desconocido Motojobovillo	1
Desconocido Nealula	17
Desconocido Neve neve	4
Desconocido Palta	2
Desconocido Pilipifo	4
Desconocido Pilipili	5
Desconocido Pispichata	3
Desconocido Pitir£	3
Desconocido Porropto.	9
Desconocido Puneneshtu	27
Desconocido Pushira	7
Desconocido Samuerume	1
Desconocido Sasta	4
Desconocido sharrama	3
Desconocido Shoe	13
Desconocido Sinsi mali	2
Desconocido Siwiuta	19
Desconocido Soto dajarra	5
Desconocido Sujo	2
Desconocido Tewishca	1
Desconocido Tojolochata	2
Desconocido Tushwli	2
Desconocido Unobueno	6
Desconocido Ushujatanti	1
Didinopamay morotoloni	1
Dussia tessamannii	15
Dypterix Oderata	10
Endlicheria paniculata	2
Ephedrantus amazonicus	24
Erythrina sp	4
Eschcueilera sp.	19
Ficus sp	43
Fusaea longifolia	54
Genipa americana	7
Guarea sp.	147
Guatteria sp.	3
Guazuma ulmifolia	29
Gynerium sagillatum	5
Hacmatos Permum	3
Heliconia sp.	4

Species	Count
Hura crepitans	83
Inga sp	175
Iriartea deltoidea.	1
Jacaratia spinosa	3
Licania sp	47
Lunania Parviflora	38
Macrocnemum sp.	40
Margaritaria nobilis	26
Musa balbisiana	5
Myroxylon peruiferum	1
Nectandra sp.	42
Ocotea sp.	7
Ormosia sp.	2
Paullina sp.	1
Persia lauvigata	2
Poulsenia armata	69
Pouruma sp.	9
Pouteria biloculori	12
Pouteria sp.	13
Pseudolmedia laevis	13
Qualea Acuminata	3
Randia armata.	3
Rheedia achachairu	5
Rheedia acuminatta	16
Salacia gigantea	1
Sapium Haematospermun.	32
Sapium marmieri	18
Sheelea princeps	75
Sheelea sp.	9
Simphonia globulifera	7
Sloanea Fragans	8
Sloanea guianensis	14
Sloanea obtusifolio	40
Sloanea sp.	12
Socratea.	22
Spondias mombin	22
Stryphnodendron purpureum	5
Swartizia	31
Tallisia sp.	11
Tapirira guranengis	15
Terminalia sp.	37

Species	Count
Theobroma cacao	91
Theobroma specosum	16
Triparis amricana	7
Triplaris sp.	3
Uncaria sp	17
Urera baccifera	1
Urera sp.	5
Veronia Paterns.	31
Virola perubiana	25
Virola sebifera	10
Vitex psudalea	1
Zanthoxylum sp.	10

Appendix 5 Plant Species of the Oropendola and Caracara (2012)

Oropendola

Species	Count
Ampelocera ruizii Klotzsch	17
Aniba Guianensis	4
Aspidosperma rigidum Rusby	18
Astrocaryum murumuru C. Martius	51
Attalea phalerata Mart. ex Spreng.	31
Caesalpinia pluviosa DC.	1
Cecropia sp	5
Clarisia racemosa Ruiz & Pavón	2
Cordia alliodora (Ruiz & Pavón) Oken	6
Erythrochiton fallax Kallunki	2
Ficus sp.	5
Guadua chacoensis (Rojas) Londono y Peterson	8
Guazuma ulmifolia Lam.	3
Hura crepitans L.	13
Inga sp.	15
Melicoccus lepidope	6
Myrcianthes sp.	2
Ocotea guianensis Aubl.	20
Oxalix griseaC.) Standl.	1
Physocalymma scaberrima Pohl	2
Piper sp	5
Pourouma cecropiifolia C. Martius	15
Pouteria macrophylla (Lam.) Eyma	20
Pouteria nemorosa Baehni	5
Pseudolmedia laebis	4
Schizolobium amazonicum	15
Smilax flavicauli	73
Solanum palinacuna	7
Stereulia apelata	4
Tabebuia serratifolia (Vahl) G. Nicholson	7
Terminalia oblonga (Ruiz & Pavón) Steudel	7
Theobroma cacao	23
Triplaris americana L.	2
Vataireopsis speciosa Ducke	5
Virola sebifera Aublet	1
Ximenia americana L.	1
Zanthoxylon sp.	18

Caracara

Species	Count
Ampelocera ruizii	5
Annona sp.	2
Apeiba sp.	8
Astrocaryum chonta	3
Brosimum latesceus	8
Byrsonima inodorum	9
Cecropia sp.	21
Ceiba pentandra	1
Chlorophora tinctoria	2
Cordia nodosa	8
Cordia tetrandra	8
Dipterix adorata.	1
Dussia Tessamannis	5
Eschweilera coriacea	10
Ficus sp.	1
Fusaea longifolia	5
Gynerium sagittatum	2
Hirtella sp.	1
Hyptis sp.	1
Hyronima oblongadd	11
Inga sp.	25
Iriartea deltoidea	4
Licania sp.	4
Macrocnemum sp.	5
Myrsine sp.	14
Nectandra sp.	2
Nectandra sp.2	1
Oenocarpus bataua	6
Pouteria nemurosa	5
Pouteria sp.	1
Pseudolmedia sp.	1
Sapium haematospermum	4
Schedea sp.	2
Simphonia sp.	15
Socratea exorrhiza	46
Tapirira guranengis	18
Trema micranta	3
Triparis amricana	2
Uncaria sp.	1