# Local Self-Governance of Forests in Bolivia:

# Why do Some Communities Enjoy Better Forests than Others?

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## Abstract

Recent scholarship on natural resource governance suggests that successful collective outcomes varies with the strength of the local arrangements for compliance monitoring. We argue that the empirical focus on local monitoring may have overshadowed other theoretically important aspects of self-governance, such as rule making and sanctioning. We test this argument with data from personal interviews as well as satellite imagery for a representative sample of 200 communities in rural Bolivia. We find that self-organized monitoring is often an important influence on the performance of local resource governance arrangements, but community rule making and sanctioning are at least as influential.



**Keywords**: Bolivia, forestry, rural development, governance, self-organization, institutions

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## Introduction

In most parts of the non-industrialized world, forests are under threat. The loss of primary forest continues to increase (FAO, 2006) and the fourth assessment report from the Intergovernmental Panel on Climate Change shows that $CO_2$ emissions related to tropical deforestation now constitutes about 17 percent of total global GHG emissions (IPCC, 2007).

The loss of forests is not just an ecological tragedy but often also a human one. Forest loss in many less developed countries disproportionately hurt the already vulnerable groups, such as the rural populations that rely mostly on subsistence agriculture and natural resources management (Arizpe et al, 1996; Comfort et al., 1999). Several recent policy initiatives— including community forestry programs and payment for environmental services— seek to alleviate rural poverty by enhancing the opportunities of rural communities to benefit directly from sustainable forest use.

Many scholarly papers and reports provide theoretical support for this shift to local level resource governance (i.e. Ostrom 1990, Arnold 1990, Ascher 1995, Clugston and Rogers 1995). Much of the current research argues that local users hold important time- and place-specific knowledge that is necessary for the creation of successful governance regimes (Gibson and Koontz 1998; Berkes 1989; Bromley 1992; McCay and Acheson, 1987; McKean 1992; Ostrom, 1999; Hayek 1948). Two recent empirical papers suggest that rural communities that manage

forests do so at least as well, and often better, than national governments (Chhatre and Agrawal, 2009; Nelson and Chomitz. 2009).

This central trend notwithstanding, results from recent research in countries with active community forestry programs--such as in Nepal and Mexico-- suggest that these programs have had rather mixed outcomes: some communities govern their resources successfully while others do not do as well (Bray and Merino, 2002; Nagendra et al, 2005). The question that we address answer in this paper is why there seems to be such divergent outcomes of locally governed forests.

The core finding from previous research is that community-organized monitoring activities is key to explaining local variability of forest conditions (Ostrom and Nagendra 2006; Agrawal and Chhatre, 2006; Chhatre and Agrawal, 2008; Coleman, 2009; Gibson et al 2005). Here, we argue that there may be other aspects of self-governance apart from monitoring and enforcement arrangements, which also help explain why some communities enjoy better forest conditions than others. Our idea is that it makes good theoretical sense to distinguish between at least three aspects of self-organized governance activities: rule-making, monitoring and enforcement, as well as sanctioning. By incorporating these complementary measures of self-organization, we believe we are in a better position to gain a nuanced understanding of the particular aspects of self-organization that are most important for resource governance outcomes. We argue that communities with self-organized systems for rule-making, monitoring, *or* sanctions are more likely to enjoy relatively good forest conditions.

While this distinction is not new—previous theoretical work on common pool resource governance (i.e. Ostrom, 1990, Bromley et al, 1992) has pointed out that users who seek to self-organize the governance of these resources face distinct collective dilemmas in the three different

self-organization activities—some of the recent empirical work in the realms of community governance of forests has been less sensitive to such distinctions.

We test our argument about the specific institutional conditions that help rural communities to manage and conserve their forests by using new and unique data from a nationally representative sample of 200 rural communities in Bolivia. As far as we know, this is the first data collection effort related to any resource commons for a nationally representative sample. We conduct multivariate tests of our three proposed self-governance drivers of environmental variability: the strengths of rule creation, monitoring and enforcement arrangements, and sanctioning systems.

Although an official community forestry policy has yet to be issued by the government of Bolivia, our study of how communities in Bolivia are currently coping in the absence of the new policy framework will hopefully be a useful input into the formulation and design of the new policies.

The rest of the paper is structured as follows: In the next section, we review previous empirical research in the area of community self-governance of CPRs. We then develop our argument about the need to differentiate between different aspects of self-governance and move beyond the current tendency in the empirical literature to lump all local institutional functions into one community monitoring and enforcement variable. Section 4 describes the context in which we propose to test this argument empirically: The Bolivian forestry sector. After providing a brief outline of the methods used to collect the data in the field, we carry out the multivariate statistical analysis and test the paper's central argument. We end by interpreting the statistical results with observations from qualitative case study material and discussing the policy implications of our study.

**Previous Research**

Many scholars have conducted research on the factors that cause forest degradation. Hardin's influential 1968 article "The Tragedy of the Commons" advocated one of two policy prescriptions to overcome the tragedy: privatization of property rights to individual owners or government command-and-control regulation backed by its coercive powers. Hardin's policy prescriptions have not found much support in the empirical literature. On the contrary, a large body of empirical studies have found that the exclusive management of forest by governments through parks and protected areas or by individual land owners through their privatized property rights to forests have been unable to stop forest degradation, and community self-governance of forests have often proven to be more successful when it comes to sustaining healthy forests overtime, although none of the three forms of forest governance is inherently superior (Gibson, et al 2005;; Ostrom, 1990; Hayes and Ostrom, 2005; Nagendra 2007).

A growing body of scholarship on common-pool-resource governance has shown that a tragedy of the commons may be averted through the self-organization of natural resource users (Ostrom, 1990 and 1999; Agrawal 2001 and 2005, Agrawal and Chhatre 2006). Community self-governance, however, is not the only and is not always the best solution for the long-term conservation of common pool resources (Agrawal 2001, Agrawal 2005; Berkes 2004, Andersson and Pacheco, 2004; Gibson et al 2000). This means that the full devolution of property rights and governance responsibilities to local communities of forest users is no guarantee for achieving healthy and stable forests (Ostrom 2007, Nagendra 2007). Research has shown that the extent to which communities successfully manage their forests over the long term is systematically linked to the strength of the local institutional arrangements associated with forest use (Wade, 1994; Baland & Platteau, 1996; Berkes, 1989; NRC, 1986).

More specifically, several scholars have identified a large number of variables that affect the effectiveness of local communities' efforts to govern common pool resources. Agrawal (2001b) reviews three major studies on community governance of CPRs (Wade 1994, Baland & Platteau, 1996, Ostrom, 1990) and identify over 40 variables that are potentially influential determinants of community self-governance of CPRs. The characteristics of local institutional arrangements that appear to be the most important, judging from the cases examined in these three major studies, include the rule-making process, the characteristics of the rules, monitoring of rule compliance, the enforcement of rule-compliance, and the application of sanctions on non-compliers.

Our review of the empirical literature related to the self-governance of forests identified five studies that engage in systematic comparative analyses of the local institutional effects on forest governance performance (Gibson, Williams and Ostrom, 2005; Ostrom and Nagendra, 2006; Agrawal and Chhatre 2006; Chhatre and Agrawal, 2008; Coleman, 2009). With some variation in magnitude of the effects, all of these studies find that that the local arrangements for monitoring and enforcement have a positive impact on local forest conditions. None of these studies, however, include other aspects and functions of self-governance—such as self-organized rule-making or sanctioning systems. This means that the empirical analyses in these studies may have overestimated the effect of monitoring and enforcement vis-a-vis other aspects of self-governance.

Gibson, Williams y Ostrom (2005) analyze empirical data from 178 user groups in eight different countries. Controlling for the influence of social capital and resource dependency, they find that local monitoring and enforcement activities positively affect the local perceptions of forest conditions. Consistent with these results, Ostrom and Nagendra (2006) show that local

participation in the recurrent monitoring and enforcement of rules for entry into and use of resource systems is significantly associated with positive changes in both forest basal area and tree stem densities (p. 19230).

Chhatre and Agrawal (2008) examine the relationship between local enforcement and forests used as commons. Analyzing a multi-country dataset from the IFRI research program with observations from 152 community user groups in nine different countries, their multivariate regression analysis finds that high levels of community enforcement actions has a strong positive effect on the probability that a given community's forest is improving its biophysical condition. They also find that enforcement plays a moderating role in that it tempers the negative effect of some of the drivers of forest destruction. In Agrawal and Chhatre (2006), the same authors analyze a set of communities in the Indian Himalayas and find a positive effects of monitoring and enforcement arrangements (as well as using cash fines) on local perceptions of forest conditions. Finally, Coleman (2009) uses longitudinal data on rural communities' use of 46 forests and finds that groups that carry out monitoring and enforcement activities are more likely to have forests in stable or improving conditions.

All of these studies acknowledge that community monitoring and enforcement activities are no panacea for governing forest commons, and in the words of Ostrom and Nagendra (2006): "focusing on monitoring alone is not sufficient" (page: 19230). That said, the empirical analyses in these studies do not test the possibly independent effects of other self-governance variables. Here, we argue that there are both empirical and theoretical reasons for why future empirical studies would benefit from expanding the focus on monitoring and enforcement activities and consider other aspects of self-governance that are of equal theoretical importance.

Considering only monitoring and its effects on forest conditions may cause problems for the empirical analysis because the observed effects of monitoring may be driven by variation in other variables related to self-organization more broadly. If these are not accounted for in the econometric model, the results may produce a based coefficient that overestimates the effect of monitoring vis-à-vis other governance variables. Moreover, lumping together different forms of self-organization into one single variable may result in theoretical ambiguity regarding the influence of different aspects of self-organization on collective outcomes. In this paper, we seek to shed light on the potential differential effects of a more complete set of self-governance functions.

## Theory and Hypotheses

In this section, we develop an empirically-grounded theory about how self-governance affects forest resource outcomes. Based on theoretical expectations and qualitative evidence, we propose that variability in forest conditions is systematically linked to three aspects of self-governance: rule making, monitoring and enforcement, and sanctioning. Because these three actions may be governed by separate and independent institutional arrangements, we hypothesize that each of the three functions has an independent effect on forest conditions.

### *Empirical grounding*

Through our qualitative observations of decision making in a large number of rural communities in Bolivia, as well as in Guatemala and Peru, we have seen that forest communities are often explicitly strategic in their choices of institutional arrangements. One common strategy is to mix self-organized and externally provided institutions for different governance purposes. When mixing, user groups choose a particular combination of self-organized and externally

provided rules systems that makes the most sense for their particular needs and circumstances. The choice that makes most sense for a user group often depends on local contextual factors such as the spatial extent of the forest, the number of members of the user groups, and the magnitude of external pressures on the forest. Consider the following example of how institutional choices are made in two Bolivian communities.

In one forest-dwelling community, located in the buffer zone to the Amboró National Park in the Department of Santa Cruz, forest users are formally constrained by national laws and regulations with regards to what resources they can legally access and use. In reality, however, community members have negotiated "practical exceptions" to these impositions with the local national park rangers, and rely on their own, self-organized set of rules-in-use when it comes to forest use. Together they have worked out a pragmatic and mutually beneficial arrangement through which local residents assist the park service in keeping the "big fish" loggers and poachers from illegitimate entry and use of the protected area and buffer zone, while the park service allow local forest users to continue with their small-scale logging and charcoal operations--activities that are considered illegal by the national government rules but are nevertheless governed by the local user rules. Because of the relatively small size of the community and large size of the forest used for community purposes, it is costly for the community to do their own monitoring and sanctioning so they rely mostly on the park rangers for the organization of these actions.

In another community about 300 miles to the Northeast, a Chiquitano indigenous community in the Municipality of San Ignacio, the situation is quiete different. This community faces a different circumstance as it is claiming property rights to a 10,000 hectare swat of contiguous forest land, which contains many high-value species of timber. Historically, this is a forest area

that the community has used for grazing as well as for harvesting a variety of forestry products, including timber and wild game. The community has a strong tradition of self-reliance in their governance arrangements, but has found that their own sanctioning mechanisms are in conflict with those of the regional and national governments. Concerned that a conflictive relationship with the state might jeopardize their chances of acquiring formal title to their pending property claim, they have decided to refrain from applying their traditional sanctioning mechanisms when they have arrested outside transgressors and have instead handed over these individuals to the local government authorities for public prosecution.

What these qualitative observations tell us is that it sometimes is rational for local groups to be selective in the types of governance functions that they decide to self-organize. It may sometimes be too costly to self-organize all governance functions related to forestry activities. It would make sense for empirical studies to recognize this possibility and consider a variety of complementary measures of self-organization in empirical studies of resource governance.

Recognizing the possibility of "outsourcing" the supply of some governance functions to external actors is consistent with earlier theoretical work on the self-governance of common pool resources, a literature we draw on to build our main research hypothesis about self-governance drivers of environmental change.

***Theoretical rationale***

When groups of individuals try to self-organized themselves to govern common-pool resources as common property, they are faced with at least three collective-action dilemmas (Ostrom, 1990; Bromley et al, 1992; Cardenas, 2000). The first-order problem concerns motivating the individuals in a group to come together and agree on a set of self-imposed constraints regarding access to and the use of the resource. The problem is that the start-up costs

of such organizational efforts are often quite high and members of the group are tempted to free ride on the efforts of other group members to assume these costs.

A second-order dilemma presents itself to groups that would like to monitor compliance of rules regarding access and use of commonly held resources: the problem is to motivate group members to contribute their time and efforts to the monitoring and enforcement activities. This dilemma exists regardless of the origin of the rules--whether they originate in the local group or in the national capital. Self-organized monitoring may require group members to patrol the area themselves to make sure outsiders do not poach and that group members adhere to the agreed upon rules. But it could also mean that the group agrees to hire a third party for this task. Either way, to make monitoring arrangements work properly requires group members' active contribution in terms of monetary resources, time, or sweat equity.

Finally, a third collective action dilemma for all commons governance is related to the sanctioning of individuals who have violated the established rules. Local groups basically have at least four alternatives to deal with this dilemma. They can either, self-organize the sanctioning and do it entirely on their own, they can seek help from an outside authority to support their local sanctioning system, they can ask a third party to carry out sanctions, or they can do nothing.

Since forest conditions are in part a function of effective restraints on harvesting practices--monitoring activities are arguably a valid proxy for an effective self-governance system. It is also conceivable, however, that any given community decides to self-organize only one or two of the three collective action functions (rule-making, monitoring or sanctioning). For example, it may make sense for a community to self-organize the rule making and sanctioning actions, but not the monitoring activity, perhaps because the forest is simply too large for them to do this on their own. In another community, it may make sense to take the central government's rules as

given, to self organize the monitoring actions, and then ask the central government to bring violators to justice in a national court system. Both these hypothetical communities would, however, have self-organized components of their governance arrangements and would thus be considered self-governing systems.

The possibility that communities are strategic in choosing which governance functions they self-organize and which ones they defer to external provision, raises doubts about the theoretical adequacy of using merely community-organized monitoring activities as a proxy for self-governance. Exercising their institutional choice, local communities may in fact select from no less than *seven* different combinations of self-governance arrangements in which at least one of the functions (rule-making, monitoring, or sanctioning) is self-organized.[1] Hence, to consider the effects of self-governance on forests and other common pool resources, it seems important to consider multiple functions of self-governance, not just monitoring. Our own qualitative field observations in Bolivia suggest that this is not merely a theoretical possibility but often an empirical reality. What we still do not know, however, is to what extent each of the three functions has a discernible and independent effect on forest condition measures. That is what we set out to investigate empirically in this paper.

***Research Hypothesis***

From these empirical and theoretical foundations we derive the following research hypothesis: Communities with self-organized systems for rule-making, monitoring, *or* sanctioning are more likely to enjoy relatively stable and healthy forest conditions. Next we introduce the

[1] The seven combinations of self-governance arrangements are: 1) all three functions 2) functions 1 and 2 only; 3) functions 1 and 3 only; (4) functions 2 and 3 only; 5) function 1 only; 6) function 2 only, and 7) function 3 only.

empirical context in which we seek to test this proposition with multivariate statistics: a large sample of forest-dependent, rural communities in Bolivia.

**Background: Community Forestry in Bolivia**

Rural communities in Bolivia represent an excellent context in which to examine the effects of self-organized institutional arrangements on forest outcomes. First of all, the degree of scarcity and salience of forest resources varies a great deal from one community to another (Andersson and Pacheco, 2004). A rural community in the highlands will typically face higher levels of scarcity for most forest products compared to communities in the forest-rich lowlands. The salience of these resources, on the other hand, will to a large degree depend on a combination of subsistence and market values. This variation--which is likely associated with the country's rich diversity of biophysical, socioeconomic, and cultural characteristics--has been generally linked to the supply of self-organized institutions (Gibson and Becker, 2000), which is the group of independent variables of interest in this study. Hence Bolivia is what we might call an institutional scholar's dream research scenario.

Moreover, the forestry sector constitutes an important contribution in the current's government's efforts to reduce rural poverty in Bolivia (Pacheco et al, 2008), making this type of research policy relevant in the Bolivian context. In fact, Bolivian legislation has evolved to become increasingly supportive of self-governance of forests, making this a very policy-relevant area of research (Larson et al. 2008). It is our hope that our research will be able to contribute with new knowledge that is useful for this policy making process.

Since the mid 1990s, Bolivia has made efforts to create an enabling policy environment for community forestry. The 1996 forestry and agrarian reform laws recognized smallholders and indigenous groups as legitimate forest users, and decentralized many of the previously centralized

governance responsibilities to regional and municipal governments. UN agencies, among others, have praised Bolivia for their political will to decentralize and modernize the governance structure of the country's forestry sector (FAO, 1999; UNDP, 1998). The forestry and agrarian laws allow local communities and individuals to acquire formal rights to manage forests, either as individual or as common property. The implementation of these new sets of property rights, however, has been spotty and slow. Many rural communities are still unclear about their formal rights to both land and resources. Community titling is far from complete. As Larson et al note: "To date, state agencies, with their small regional staffs and budgets, have manifested little capacity to defend the communally titled lands" (Larson et al, 2008: 112).

The government led by Evo Morales, has implemented several new initiatives that attempt to make it easier for local communities to acquire property rights related to forests. Two parallel paths exist towards formal rights to manage forests: one for indigenous communities and another one for non-indigenous communities. To date, priority has been given to indigenous communities (Government of Bolivia, 2008). Little systematic evidence exists, however, on the outcomes of such efforts. In this paper, we present new evidence that has the potential to inform Bolivia's future policy decisions.

**Data and Methods**

To test our hypothesis about potentially positive effects of self-governance on forest conditions, we collected and analyzed data on self-organized use and management of forest resources in Bolivia. In total, we visited 200 rural communities in the country. To reduce costs and logistical complexity of field data collection, we employed a clustered, two-stage sampling design. In the first stage, we randomly selected 100 municipal territories. For each municipal territory, we

documented the distance between each rural community and a major road. To ensure that sampled communities would be accessible by field teams in a reasonable amount of travel time, we systematically eliminated all communities from our sample list whose distance to a major road exceeded 50 km. From the list of remaining communities, we randomly selected two communities in each of the 100 municipalities.

In each community, our field teams collected data on forest characteristics, demographics, decision making and governance activities related to forest use. The field teams conducted a one-day workshop in which a series of questions were discussed. The results of the discussions were coded into a data base. In addition, we draw on complementary forest data derived from Landsat TM satellite imagery from, 2000, and 2007. With the processed satellite data we were able to calculate forest cover change for 167 of the 200 communities. Finally, we use the 2002 national census data for some of the demographic and infrastructure variables that we use for controls in the statistical tests. All of the data used in the empirical tests are described in some detail in the next section. To assess the extent to which our three measures of community self-organization has any systematic influence on perceived forest conditions, we employ Ordinary Least Square and Logistic regression techniques.

***Dependent Variables***

As outcomes, we employ two continuous and two binary variables that are proxy measures for local forest conditions:

*Forest Cover:* This is a continuous variable that indicates local group members' assessment of the proportion of the community's land area that is covered by forest.

*TM Forest Change:* This is a continuous variable constructed with the help of satellite imagery and our forest cover change map, measuring the change in forest cover in 165 communities[2] during the 2000-2007 period. The higher the number the more forest cover was lost during the period.

*Forest Biodiversity:* This is a binary variable that measures whether community members perceive that the forest that they use is more biologically diverse relative to surrounding forests.

*Forest Vegetation Density:* This is a binary variable that indicates whether community members perceive that the forest resources that they use has a higher density of trees compared to surrounding forests in the area.

The variation for all four dependent variables is presented in Figure 1, showing that local residents in about 20 percent of all rural communities in Bolivia perceive that they have forests in relatively good shape. For the 165 communities that we had satellite imagery for, we found that 47 percent lost less than one percent of their forest cover during the 2000-2007 time period. We now turn to multivariate analysis of the factors--and in particular the multiple aspects of self-governance--that can help us understand this variation.

[Figure 1 here]

***Independent Variables***

Given our theoretical focus and the findings from previous research, we specify a conceptual model that includes ten independent variables, of which three are related to self-governance activities and are therefore of particular theoretical interest here. The other seven variables are

[2] We failed to acquire cloud-free images for all of the 200 communities in our sample. We do not believe that the missing data bias our analysis and hence assume that the process that produced the missing data is random and not systemically associated with any particular characteristic that would affect our results.

included as control variables as they represent plausible determinants of forest condition variation. What follows is a brief description of these variables, including our theoretical predictions with regards to their effects on local forest condition perceptions in Bolivia.

*Self-organized rule systems*: This variable measures the existence of self-made rules concerning (i) the type of forest use that is permitted; (ii) the quantity any local resident may harvest, or (iii) the specific location where harvesting may take place. This gives us an additive index of self-made rules that ranges from 0 to 4. Based on previous work (Ostrom, 1999; Agrawal, 2001), we expect that the more types of self-made rules that exist in a given community, the more likely it is to have a forest in a relatively good and stable condition.

*Self-organized monitoring and enforcement activities:* On an ordinal scale from 0 to 2, this variable describes the extent to which a community organizes its own monitoring and enforcement activities. Supported by findings from earlier empirical work we predict that community-organized monitoring and enforcement activities have a positive effect on forest conditions (Gibson et al., 2005, Ostrom and Nagendra, 2006; Agrawal and Chhatre, 2006; Chhatre and Agrawal, 2008; Coleman, 2009).

*Self-organized sanctioning activities:* This ordinal variable (0-2) indicates the degree to which the community implements its own system of sanctions for punishing those individuals who have been caught violating established rules (regardless of origin). The stronger such self-organized systems are the more likely that the community enjoys relative good forest conditions (Ostrom, 1999; Coleman and Steed, 2009).

*De Jure Property Rights:* In Bolivia all communities are going through a national program for land titling. We asked community members at what stage in this process they were. If they had had the initial study concluded we assigned a value of 1, if they had already received their title,

we assigned a 2. Having formal property rights to forests may, as suggested by many previous studies, affect the long-term stakes that local community members have in the resource (Alston et al, 1996; Nepstad et al., 2006; Chomitz et al., 2006)

*Forest area*: This variable is continuous and indicates the size of the forest (in hectares) that the community controls and uses. Recent empirical studies have found that the size of forest exerts a significance influence on community efforts to manage forests and we predict that the larger the forest the better shape the forest will be in (Chhatre and Agrawal, 2009; Coleman and Steed, 2009)

*Indigenous*: This is a continuous variable that indicates the proportion of the community that considers itself part of a lowland indigenous ethnic group. Previous qualitative studies have claimed that indigenous communities in the lowlands have traditions and cultures that are often more amenable to the self-governance of natural resources (Becker and Leon, 2000; Birk, 2000; Nelson and Chomitz, 2009).

*Population pressure:* We asked local community members about the current population count as well as the area of the community's forest. We divided the number of inhabitants with the forest area. All other factors held constant, we predict that places with high population pressure are less likely to enjoy good forest conditions (Kaimowitz and Angelsen, 1999; Harrison, 1991).

*Literacy rate:* We asked what proportion of adult community members know how to read and write. The higher the literacy rate—a proxy measure of human development—the more likely it is for the community members to have off-farm employment and thereby reducing the extractive pressure on the forest (Rudel, 1989; Andersen, 2002; Jorgensen, 2003; Andersson, 2004).

*Soil Degradation:* In one of our final questions, we asked community members who attended our one-day workshop about what proportion of community members cultivate soils that are degraded. We predict that this measure of socioeconomic status has a negative effect on forest conditions as poor households will be more dependent on the forest for supporting their livelihood (Southgate et al, 1991; Skole and Tucker, 1993; Chomitz and Gray, 1996).

*Distance to primary road:* We asked respondents about the distance (in km) to the nearest primary road. We predict that this variable is negatively correlated with forest condition because residents of such communities will perceive stronger short-term market incentives to produce agricultural commodities (Pfaff, 1997; Hecht and Cockburn, 1990). The descriptive statistics for these variables are presented in Table 1 below.

[Table 1 here]

**Results**

The results from all four multivariate regression models, as shown in Table 2, lend support to the hypothesis that the three self-governance functions have independent and positive effects on forest conditions and the effects of local governance arrangements go beyond local monitoring activities.[3]

[Table 2 here]

[3] The results are robust to a number of pots-estimation tests. The three independent variables of interest are not highly correlated with each other (pearson r< 0.4 for all combinations) and we calculated the Variance Inflation Factor for each variable which confirmed that there is no concern for multicollinearity (avg VIF=1.1). The F-statistics for the OLS models (1, 4) are 15.26 ($p < 0.001$) and 2.27 ($p<0.02$) respectively. The residuals for both OLS models are normally distributed. To avoid heteroskedasticity problems all models are estimated with robust standard errors. For the two OLS models, we also examined whether individual observations have a strong influence by using the Cook's Distance and Leverage statistics. None of these diagnostic tests indicated a violation of the standard regression assumptions.

In the first model, which uses the locally perceived forest cover as the dependent variable, community rule-making and monitoring activities have statistically significant, positive, and independent ($p<0.05$) effects on the percent forest cover in rural communities. Controlling for other potentially influential variables, our analysis finds that a one level increase in the rule-making ordinal variable corresponds to a 3.4 percent average increase in community forest cover. A one-level increase in community monitoring corresponds to a 7.4 percent increase in forest cover. When considering forest cover change in 2000-2007 as the outcome variable (model 2) and the only local governance variable that appears to have a statistically significant positive effect on forest cover is community rule making. Holding all other variables constant, a one unit increase in community rule making is associated with a three-percent increase in forest cover change, meaning that communities who self-organize to create their own rules for a forest access and use loose less forest cover over time. Community rule making has a similar effect on relative forest biodiversity (model 3): holding all other variables constant at their mean values, the average effect of a one-unit increase in this variable corresponds to an eight-percent increase in the likelihood of a community's forest being more biologically diverse than neighboring forests.

Finally, in model 4, we examine the effect of the independent variables on the local group's perceived vegetation density of their forests relative to neighboring communities' forests. The only self-governance variable that has a statistically significant effect on forest density is community sanctioning. As a community strengthens its autochthonous sanctioning system from non-existence to the strongest possible level, the probability of observing relatively dense forest vegetation increases by about 19 percent.

The multivariate analysis suggests that monitoring-and-enforcement is not the only aspect of self-governance that makes a difference for forest conditions. In fact, in three out of the four

models, the effect of community monitoring is not statistically distinguishable from zero and in none of the four full models is the M&E variable the sole significant self-governance variable. These results would suggest that the governance arrangements for community rule-making and sanctioning are at least as important as community monitoring when it comes to understanding local variations in forest conditions.

To assess the extent to which previous empirical studies on local forest governance--which employ reduced models that focus on monitoring and enforcement arrangements only--may have over-estimated the effect of this variable, we compare our model specification with an alternative, reduced model that includes community monitoring as the only local governance variable, omitting the community rule making and sanctioning variables. The results of the reduced model regressions, presented in Appendix 1, show that the omission of other self-governance variables does produce an overestimation of the effect of community monitoring on three out of four measures of forest conditions. Comparing the regression coefficients for the community monitoring variable in the four full models in Table 2 with the coefficients in the reduced models (models 1b-4b in Appendix 1) we can conclude that size of the bias is about 20 percent in model 1, 0 percent in model 2, 18 percent in model three and 250 percent in model 4.

From a Bolivian forestry policy perspective, one of the most surprising findings may be that indigenous ethnicity has no statistically significant effect in any of the four models. This finding is important not only because it challenges much of conventional wisdom in the field forest governance, but also because the Government of Bolivia's policy framework is to some extent based on the notion that indigenous communities are better stewards of forested lands than other types of dwellers. When it comes to acquiring formal forest management rights, the Morales government has issued a decree that gives preferential treatment to indigenous communities

compared to non-indigenous communities that might also apply for such management rights (Government of Bolivia, 2008). We find no empirical support for such ethnic differentiation. Compared to predominantly indigenous communities, local groups that have low ratios of indigenous members are just as likely to be stewards of forests in good conditions.

**Conclusion**

The main findings of the paper both support and challenge parts of the existing research on forest commons governance. Consistent with much of the extant literature, our results show that the self-governance efforts of forest user groups are key to understanding inter-community variation in forest conditions. At the same time, our findings from the Bolivian context challenge some aspects of previous research results from global comparative studies, in particular when it comes to the role of community monitoring in explaining local forest conditions. We submit that there is more to successful local forest governance than merely community monitoring and enforcement, as our results demonstrate that in Bolivian communities community rule-making and sanctioning systems also represent important ingredients of strong forest governance arrangements.

Our findings carry implications for future directions in both the realms of research and policy. In research, there are several ways in which future studies can build on and further strengthen this field of inquiry. By collecting over-time data on self-governance, the robustness of the findings will increase. While this paper has sought to unpack and operationalize self-governance as a multi-dimensional concept by measuring three distinct functions there are arguably more dimensions to consider. For example, future studies might go beyond the rule-making process to consider the extent to which the rules themselves have their origins in the local customs and practices. Many more dimensions are likely to exist. We leave these opportunities and challenges for future studies in this exciting area of research.

For actors involved in the Bolivian forest policy arena, our study raises several issues for debate. First, our results indicate that the Bolivian government should re-examine its rationale behind the existing policy that effectively differentiates communities based on their predominating ethnicity of origin. If the goal of the policy is to promote good stewardship of the country's forest resources, we show that there are other factors, independent from ethnicity, that are more important influences on local groups' abilities to govern forests.

Second, the results of our analysis carry implications for Bolivia's recent decision to become one of only ten pilot countries in the United Nation's program on Reduced Emissions from Deforestation and Forest Degradation (REDD+). Our study shows that about half of all rural communities in Bolivia have been able to maintain stable forest resources during the 2000-2007 period, with no or less than 1 percent forest-cover loss. This is a remarkable feat in that the overall deforestation rate for the country as a whole during this time period was the highest ever recorded in Bolivia's recent history (FAO, 2006). This would suggest that rural communities should be given serious consideration when designing public policies to enhance the country's forest carbon stocks.

Finally, our study also indicate that to there may be limitations to what the national government can do to *directly* affect the forest carbon stocks in forests used by rural communities. Given the consistently positive effects of three different community self-governance functions, one approach the government might consider is to find ways to support communities in their home-grown efforts to govern their forest commons. Exactly how to do so, however, is a subject for future research.

## References Cited


Agrawal, A. 2001. Small is beautiful, but is larger better? Forest-management institutions in the Kumaon Himalaya, India. In C. C. Gibson, M. A. McKean, & E. Ostrom (Eds.), *People and Forests.* Cambridge, MA: MIT Press.

Agrawal, A. 2001b. Common Property Institutions and Sustainable Governance of Resources. *World Development*. 29(10):1649-72.

Agrawal, A. 2005: *Environmentality: Technologies of government and the Making of Subjets.* Duke University Press, Durhnam, NC;

Agrawal, A., and Chhatre, A., 2006. Explaining success on the commons: community forest governance in the Indian Himalaya. *World Development* 34: 149-166;

Alston, L.J., Libecap, G.D. and Schneider, R. 1996. The determinants and impact of property rights: Land titles on the Brazilian frontier. *J. Law Econom. Org.* 12 (x) 25–61

Andersen L.E., Granger C. W.,Reis E. J.,Weinhold D., Wunder S.(2002) *The Dynamics of Deforestation and Economic Growth in the Brazilian Amazon*. New York: Cambridge University Press

Andersson, K. 2004. Who Talks With Whom? The Role of Repeated Interactions in Decentralized Forest Governance. *World Development* 32(2): 233-249.

Andersson, K. and Ostrom, E. 2008. Analyzing Decentralized Natural Resource Governance from a Polycentric Perspective. *Policy Sciences* 41(1):1-23.

Andersson, K. and Pacheco, D. 2004. The Historical Origins of Forestry Policy in Bolivia: Lessons for Community Forestry. *Policy Matters* 13: 40-49

Arizpe et al, 1996

Arnold, J. E. M. (1990). *Social Forestry and Communal Management in India*. ODI: Rural Development Forestry Network (RDFN).

Ascher, W.1995. *Communities and Sustainable Forestry in Developing Countries*. San Francisco: Institute for Contemporary Studies Press.

Baland, J.-M., & Platteau, J. P. (1996). *Halting degradation of natural resources: Is there a role for rural communities?*. Oxford, England: Clarendon Press.

Becker, D. and R. León. 2000. Indigenous Forest Management in the Bolivian Amazon: Lessons From the Yuracaré People. In Gibson et al (Eds), 2000. *People and Forests.* Cambridge, MA: MIT Press.

Berkes, F. (Ed.) 1989. *Common Property Resources, Ecology, and Community-based Sustainable Development.* London: Bel- haven.

Berkes, F. 2004. Rethinking community-based conservation. *Conservation Biology* 18:621–630.

Berkes, 2007 PNAS

Birk, G. 2000. *Dueños del Bosque: Manejo de los Recursos Naturales por Indígenas Chiquitanos de Bolivia.* Santa Cruz de la Sierra, Bolivia: Apoyo para el Indígena-Campesino del Oriente Boliviano–Central Indígena de las Comunidades Originarias de Lomerío.

Bray and Merino, 2002;

Bromley, D. (Ed.). 1992. *Making the commons work: Theory, practice and policy.* San Francisco, CA: Institute for Contemporary Studies Press.

Chhatre, A. and Agrawal, A. 2009. Trade-offs and synergies between carbon storage and livelihood benefits from forest commons. *PNAS* 106:17667-70.

Chhatre, A. and Agrawal, A. 2008. Forest commons and local enforcement. *PNAS* 105(36): 13286-91

Chomitz, K.M., Buys, P. De Luca, G. Thomas, T.S. and Wertz-Kanounnikoff, S. 2006. *At Loggerheads? Agricultural Expansion, Poverty Reduction and Environment in the Tropical Forests.* Washington, DC: The World Bank

Chomitz, K.M. and Gray, D.A. 1996. Roads, land use and deforestation, *World Bank Econom. Rev.* 10 (x) 487–512

Clugston, R. and T. Rogers. (1995). Sustainable livelihoods in North America.“ *Development* 3 (9): 603.

Coleman, E.A. (2009). Institutional factors affecting biological outcomes in forest management. *Journal of Policy Analysis and Management* 28(1): 122-146.

Coleman, E.A. and Steed, B.C. 2009. Monitoring and sanctioning in the commons: An application to forestry. *Ecological Economics*. 68(7): 2106-2113

Comfort et al., 1999

Dietz, T., Ostrom, E. and Stern, P. 2003. The Struggle to Govern the Commons. *Science* 302(5652):1907–12.

Food and Agriculture Organization of the United Nations (FAO). 1999. *State of the World's Forests 1999.* Rome, Italy: Food and Agriculture Organization of the United Nations.

Food and Agriculture Organization of the United Nations (FAO). 2006. *Forest Resources Assessment 2005*. Rome, Italy: FAO

Gibson CC, McKean MA, Ostrom E, eds (2000) *People and Forests: Communities, Institutions, and Governance* (MIT Press, Cambridge, MA).

Gibson, C. C., Williams, J. T., & Ostrom, E. (2005). Local Enforcement and Better Forests. *World Development*, 33(2), 273-284.

Gibson, Clark and C. Dustin Becker. 2000. "The Lack of Institutional Supply: Why a Strong Local Community in Western Ecuador Fails to Protect its Forest." In Gibson, Clark, Margaret McKean, and Elinor Ostrom, eds. 2000. *People and Forests: Communities, Institutions, and the Governance of Forests*: 135-162.

Gibson, Clark and Tom Koontz. 1998. "When Community is Not Enough: Communities and Forests in Southern Indiana." *Human Ecology* 26: 621-647.

Government of Bolivia, 2008. Decree #xxyy)

Hardin, G. 1968. The Tragedy of the Commons. *Science* 162:1243–1248

Harrison, S. 1991. Population growth, land use, and deforestation in Costa Rica, 1950–1984, *Interciencia* 16 (x) 83–93.

Hayek, F. 1948. *Individualism and Economic Order*. Chicago: University of Chicago Press.

Hayes, Tanya, and Elinor Ostrom. 2005. "Conserving the World's Forests: Are Protected Areas the Only Way? *Indiana Law Review* 37(3): 595-617.

Hecht, S. and Cockburn, A. 1990. *The Fate of the Forest: Developers, Destroyers and Defenders of the Amazon*, Harper Collins, New York

Heckathorn, D. D. (1989). Collective action and the second order free rider problem. *Rationality and Society*, 1, 79–100.

IPCC, 2007. *Fourth Assessment report.* Bonn, Germany: International Panel on Climate Change (IPCC).

Jorgensen, A.K. 2004. Uneven Processes and Environmental Degradation in the World-Economy. *Human Ecology Review* 11(2):103-117

Larson, A. M. Cronkleton, P. Barry, D. Pacheco, P. 2008. Tenure Rights and Beyond: Community Access to Forest Resources in Latin America . *CIFOR Occasional Paper No. 50.* Bogor, Indonesia, Center for International Forestry Research (CIFOR).

McCay, Bonnie J., and James M. Acheson. 1987. *The Question of the Commons: The Culture and Ecology of Communal Resources*. Tucson: University of Arizona Press.

McKean, M.A. 1992b. Success on the commons: a comparative examination of institutions for common property resource management. *J. Theor. Polit.*, 4(3): 247 - 282.

Nagendra, H. Karna, B. Karmachaya, M. 2005. Leasehold Forestry…Conservation and Society.

Nagendra, Harini. 2007. Drivers of Reforestation in Human-Dominated Forests. *PNAS* 104(39):15218–23.

Nelson, A. Chomitz, K.M. 2009. Protected Area Effectiveness in Reducing Tropical Deforestation: A Global Analysis of the Impact of Protection Status. *Independent Evaluation Group Evaluation Brief 7.* Washington, D.C. : The World Bank.

Nepstad, D., Schwartzman, S., Bamberger, B., Santilli, M., Ray, D., Schlesinger, P., Lefebvre, P., Alencar, A., Prinz, E., Fiske, G., and Rolla, R. 2006. Inhibition of Amazon Deforestation and Fire by Parks and Indigenous Lands. *Conservation Biology* 20 (1): 65-73.

NRC (National Research Council) 1986. *Proceedings of the Conference on Common Property Resource Management.* Washington, DC: National Academy Press

Ostrom 2007 A diagnostic approach for going beyond panaceas. *PNAS* 104(39): 15181–15187.

Ostrom, E. & Nagendra, H. (2006). Insights on linking forests, trees, and people from the air, on the ground, and in the laboratory. *PNAS* 103(51): 19224–19231.

Ostrom, E. (1990). *Governing the Commons: The evolution of institutions for collective action.* Cambridge, UK: Cambridge University Press.

Ostrom, E. (2001). Reformulating the commons. In J.Burger, E. Ostrom, R. B. Norgaard, D. Policansky, & B. D. Goldstein (Eds.), *Protecting the commons: A framework for resource management in the Americas* (pp. 17–41). Washington, DC: Island Press.

Ostrom, E. 1999. Self-governance and Forests. *CIFOR Occasional Paper No. 20.* Bogor, Indonesia: CIFOR.

Pacheco, P. Barry, D. Cronkleton, P. Larson, A. M. 2008. The role of informal institutions in the use of forest resources in Latin America . *Forests and Governance Programme Series No. 15.* Bogor, Indonesia, Center for International Forestry Research (CIFOR).

Pagdee, A. Yeon-Su Kim, and P. J. Daugherty. 2006. What Makes Community Forest Management Successful: A Meta-Study from Community Forests throughout the World. *Society and Natural Resources* 19(1): 33–52.

Pfaff, Alexander S. P. 1997. "What Drives Deforestation in the Brazilian Amazon? Evidence from Satellite and Socioeconomic Data." Policy Research Working Paper 1772. World Bank, Policy Research Department, Washington, D.C. Processed.

Rudel, T.K. 1989. Population, development, and tropical deforestation: A cross-national study, *Rural Sociology* 54 (x): 327–338.

Skole, D. and Tucker, C. 1993. Tropical deforestation and habitat fragmentation in the Amazon: Satellite data from 1978 to 1988. *Science* 260: 1905–1910.

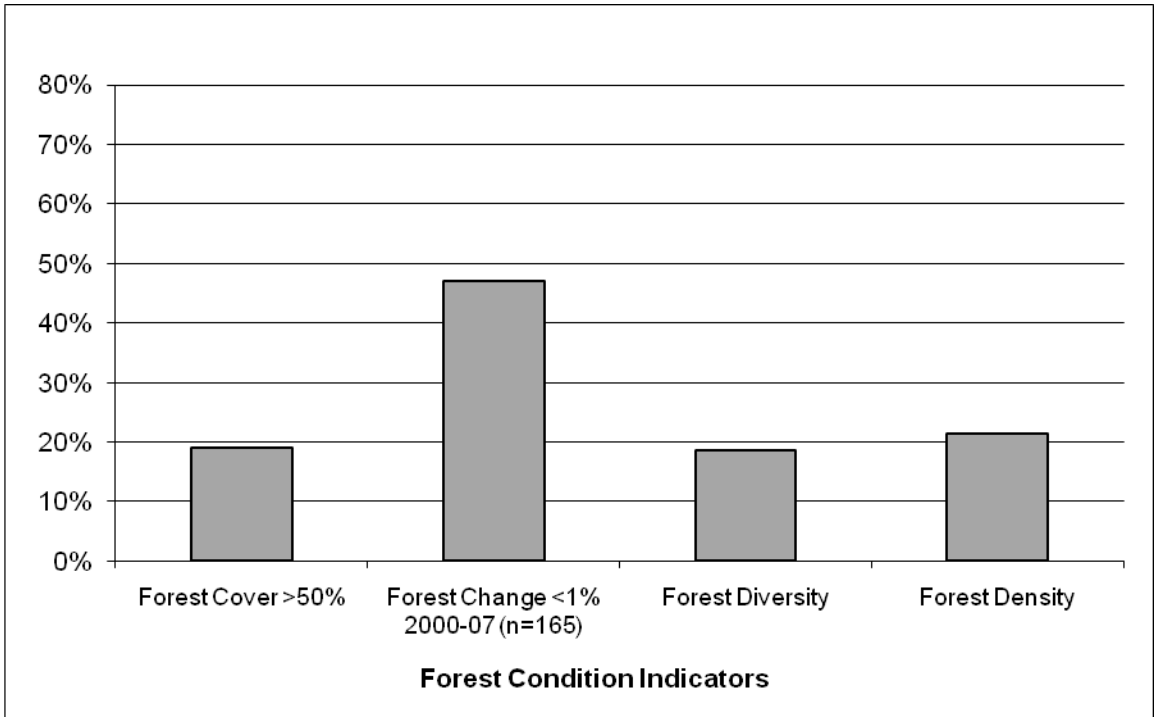
Southgate, D., Sierra, R. and L. Brown. 1991. The causes of tropical deforestation in Ecuador: A statistical analysis, *World Develop.* 19 **(**9**):**1145–1151

United Nations Development Program (UNDP). 1998. *Capacity 21 Program 1998 Annual Report.* New York: United Nations Development Program.

Wade, R. (1994). *Village republics: Economic conditions for collective action in south India*. San Francisco, CA: ICS Press.

Wunder, S. 2001. Poverty alleviation and tropical forests—what scope for synergies? *World Development* 29:1817–1833.

**FIGURE 1:** Proportion of Communities that Enjoy Relatively Good Forest Conditions



**TABLES**

**Table 1:** Descriptive Statistics for all Variables Included in the Analysis

| ***Variable*** | ***Obs*** | ***Mean*** | ***StDev*** | ***Min*** | ***Max*** |
|---|---|---|---|---|---|
| Dependent | | | | | |
| Forest Cover | 200 | 29.13 | 26.8 | 0 | 99 |
| TM Forest Cover Change (2000-2007) | 165 | 0.09 | 0.17 | 0 | 0.99 |
| Relative Forest Vegetation Density | 200 | 0.22 | 0.412 | 0 | 1 |
| Relative Forest Vegetation Diversity | 200 | 0.18 | 0.39 | 0 | 1 |
| Independent | | | | | |
| *Institutions* | | | | | |
| Community rules for forest use | 200 | 1.01 | 1.17 | 0 | 4 |
| Community Monitoring System | 200 | 1.04 | 0.75 | 0 | 2 |
| Community Sanctions | 200 | 0.71 | 0.82 | 0 | 2 |
| *Controls* | | | | | |
| De jure property rights | 200 | 0.57 | 0.51 | 0 | 2 |
| Forest Cover (1000 ha) | 200 | 5.60 | 31.04 | 0.004 | 370 |
| Indigenous | 200 | 0.46 | 0.50 | 0 | 100 |
| Population pressure on forests | 200 | 60.64 | 190.9 | 0.001 | 1800 |
| Distance to nearest primary road | 200 | 9.70 | 16.25 | 0.00 | 90.0 |

**Table 2:** Regression Results: The Effects of Self-Governance Regimes on Forest Conditions in Bolivia

| ***Independent Variables*** | ***Model 1 Forest Cover*** | ***Model 2 TM Forest Change*** | ***Model 3 Forest Diversity*** | ***Model 4 Forest Density*** |
|---|---|---|---|---|
| | *OLS* | *OLS* | *Logit* | *Logit* |
| Community Rules | 3.41** | -0.03** | 0.58** | 0.34 |
| | (1.48) | (0.01) | (0.20) | (0.19) |
| Community Monitoring | 7.50*** | -0.01 | 0.60 | 0.19 |
| | (2.45) | (0.02) | (0.34) | (0.29) |
| Community Sanctions | 2.86 | 0.02 | 0.20 | 0.61** |
| | (2.26) | (0.02 | (0.28) | (0.25) |
| De jure property rights | 12.44*** | -0.01 | 0.67 | -0.28 |
| | (2.98) | (0.03) | (0.44) | (0.40) |
| Forest Area | 0.00** | 0.00 | 0.00 | 0.00 |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Indigenous | 0.06 | 0.00 | 0.00 | -0.03 |
| | (0.06) | (0.00) | (0.01) | (0.02) |
| Population pressure on forests | -0.03*** | 0.00 | 0.00 | -0.00 |
| | (0.01) | (0.00) | (0.00) | (0.00) |
| Literacy rate | -0.06 | -0.01 | 0.00 | 0.02 |

| | | | | |
|---|---|---|---|---|
| | (0.07) | (0.01) | (0.01) | (0.01) |
| Households with degraded soils | -11.72** | -0.04 | 0.14 | 0.43 |
| | (4.27) | (0.03) | (0.79) | (0.47) |
| Distance to primary road | -0.00 | -0.00*** | 0.01 | 0.00 |
| | (0.14) | (0.00) | (0.01) | (0.01) |
| Constant | 15.85*** | 0.19** | -3.48*** | -3.34*** |
| | (5.53) | (0.07) | -0.76 | (0.88) |
| F | 15.28 | 2.29 | - | - |
| Wald $chi^2$ | - | - | 34.03 | 27.73 |
| Prob > F | 0.00 | 0.01 | - | - |
| Prob > $chi^2$ | - | - | 0.00 | 0.00 |
| $R^2$ | 0.35 | 0.07 | - | - |
| Pseudo $R^2$ | - | - | 0.17 | 0.15 |
| Observations | 200 | 165 | 200 | 200 |

*Note: Columns list coefficients with robust standard errors in parenthesis.*

*Two-tailed hypothesis tests: **= p<0.05; ***=p<0.01*

**Appendix 1** (for on-line supplement)

**Table:** Results for Reduced Models (non-monitoring governance variables omitted)

| ***Independent Variables*** | ***Model 1b Forest Cover*** | ***Model 4b TM Forest Change*** | ***Model 2b Forest Diversity*** | ***Model 3b Forest Density*** |
|---|---|---|---|---|
| | *OLS* | *OLS* | *Logit* | *Logit* |
| Community Monitoring | 9.05*** | -0.01 | 0.71** | 0.47 |
| | (2.31) | (0.02) | (0.31) | (0.27) |
| De jure Property Rights | 12.58*** | -0.02 | 0.74 | -0.27 |
| | (2.97) | (0.03) | (0.44) | (0.39) |
| Forest Area | 0.00** | -0.00 | -0.00 | 0.00 |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Indigenous Proportion | 0.11 | -0.00 | 0.01 | -0.02 |
| | (0.06) | (0.00) | (0.01) | (0.02) |
| Population Pressure on Forests | -0.04*** | -0.00 | -0.00 | -0.00 |
| | (0.01) | (0.00) | (0.00) | (0.00) |
| Literacy Rate | -0.06 | -0.00 | -0.00 | 0.01 |
| | (0.07) | (0.00) | (0.01) | (0.01) |

| | | | | |
|---|---|---|---|---|
| Households with Degraded Soils | -8.60* | 0.07** | 0.64 | 0.77 |
| | (4.05) | (0.03) | (0.55) | (0.47) |
| Distance to Primary Road | -0.04 | -0.00*** | 0.00 | -0.00 |
| | (0.14) | (0.01) | (0.01) | (0.01) |
| Constant | 18.99*** | 0.18** | -2.85*** | -2.55*** |
| | (5.68) | (0.07) | (0.73) | (0.78) |
| F | 13.12 | 2.23 | - | - |
| Wald $chi^2$ | - | - | 24.01 | 11.81 |
| Prob > F | 0.00 | 0.03 | - | - |
| Prob > $chi^2$ | - | - | 0.00 | 0.00 |
| $R^2$ | 0.31 | 0.05 | - | - |
| Pseudo $R^2$ | - | - | 0.10 | 0.08 |
| Observations | 200 | 165 | 200 | 200 |

*Note: Columns list coefficients with standard errors in parenthesis.*

*Two-tailed hypothesis tests: **= p<0.05; ***=p<0.01*