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Teasing Apart the Details: How Social Learning can Affect Collective Action in the Bolivian Amazon

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Abstract Social learning is hypothesized to result in shared knowledge and skills, trust, self-efficacy, and democratic decision-making for collective action. This paper uses a multi-method approach, including ethnography and non-parametric and multivariate statistics, to test this hypothesis and describe what specific process characteristics can predict social learning outcomes. Data are based on two communities, each with a subset of members participating in social learning processes for communal timber management and collective Brazil nut marketing in the Bolivian Amazon. Those who participated in the social learning process had significantly more knowledge about communal forest management, gained more skills, were more active in specific management activities, and had more intentions to work collectively than those who did not. The development of trust during the process, the equal involvement of all who participated, and the presentation of various ideas were most predictive of these outcome variables.

Keywords Social learning · Community forest management · Bolivia · Amazon

Introduction

Our understanding of collective action in communal forests has benefitted from decades of research on common pool resources (cf., Poteete *et al.* 2010). Collective action can be influenced by macro-situational factors, such as government policies, international markets, and tenure rights, as well as micro-situational factors, such as clear boundaries of land area and clear definitions of rightful land users (Moran 2006; Poteete *et al.* 2010). Other micro-situational variables include, but are not limited to, resource users having opportunities for open communication, procedures for making their own rules, regular monitoring of the resource and the users, graduated sanctions, conflict resolution mechanisms, and a balance between benefits and costs (Ostrom 1990, 2010). In fact, most micro-situational factors have the potential of enhancing or decreasing trust, which appears to be the greatest predictor of cooperation (Khodyakov 2007; Poteete *et al.* 2010).

Though much has been learned about the micro-situational factors that enable collective action in communal forests, little has been defined about the ability of extension projects to enhance these factors (see Biedenweg 2012, for conceptual framework). Extension projects were originally designed to disseminate technical knowledge about agricultural practices and develop skills among individual farmers (Berg 1993). More recently, they have focused on improving the capacity of communities and individuals to engage in a variety of communal and individual land uses such as agriculture, agroforestry, and communal timber management. Theories that inform extension have evolved from prescribing an emphasis on technical skills, appropriate when desired activities were entirely individual, to incorporating diverse local participation, conflict management, and collaborative decision making (Berg 1993; Chambers 1986), focusing on a trust-building process as well as skills that are essential for promoting collective action in community-based natural resource management (Monroe *et al.* 2007).

One common recommendation for increasing the effectiveness of communal forest management is the facilitation of social learning (Leewis and Pyburn 2002; Mostert *et al.* 2007; Pahl-Wostl and Hare 2004; Rist *et al.* 2003; Schusler *et al.* 2003; Webler *et al.* 1995; Wollenberg *et al.* 2001). Social learning frameworks incorporate learning theories from psychology, collaborative action theories from sociology and political science, and management principles from

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organizational learning to consider how group learning can result in knowledge generation, trust, and collective action (Schusler *et al.* 2003). From psychology, for example, Social Learning Theory explains how people learn new behaviors and their consequences from observing others and prescribes that learners should thus be exposed to a variety of people in order to break down stereotypes, develop realistic expectations, and increase alternative behavior options (Bandura 1977; Ormrod 2003). Whether learners choose to engage in these new behaviors is partly dependent on their belief in their ability to successfully complete the action (self-efficacy) in addition to the perceived risks and benefits of the behavior. A social constructivist perspective adds that when diverse peers work together to construct meaning, they spread the learning task across multiple minds and draw upon their collective knowledge bases (Ormrod 2003). The resulting knowledge of the issue should thus be more complete. Lastly, management principles from organizational learning indicate that groups should approach management as an adaptive learning process in which members of the organization implement an idea, monitor its success, and modify management based on the new information obtained (Senge 2006). Relying on social learning theories differs from traditional, pre-defined technical training by focusing on working with a group of stakeholders over time to develop a management strategy that best fits their unique interests and is more likely to be sustainable.

Attention to the process of social learning is at the core of several recommendations for extension methodologies. Keen *et al.* (2005) propose that the social learning process should incorporate participation, reflection, integration, negotiation, and a systems orientation. Other researchers add that facilitation is needed over an extended period of time to ensure the above factors in addition to a democratic structure to decision making, open communication, an egalitarian atmosphere, unrestrained thinking, and constructive conflict (Muro and Jeffrey 2008; Schusler *et al.* 2003). In essence, assuming that diverse participants are involved, that ideas are shared openly, reflected upon, and integrated into new knowledge, that conflicts are managed through negotiation, and that there is a democratic structure that allows participants to influence the learning process, social learning should result in measurable outcomes such as technical knowledge and skills, understanding of risks and benefits, self-efficacy, trust among participants, and engagement in collective action, in addition to greater procedural satisfaction that could increase the sustainability of collective action. The list of procedural requirements for social learning is long, and relative benefit of each is still unclear.

This paper examines whether the facilitation of social learning in extension projects can influence collective action, and which of the hypothesized procedural characteristics are most important for determining social learning outcomes by addressing three questions: 1) Does participation in a social learning process correlate to the predicted outcomes that are important for collective action? 2) How can outcome variables be predicted by specific characteristics of the project? 3) Can a mixed method approach that uses both ethnography and multivariate statistics respond to these questions? Social learning outcomes and perspectives of the social learning project were measured among participants and non-participants in two Bolivian communities with different socioeconomic structures where social learning projects for community forest management (CFM) were implemented.

Regional Context

The department of Pando, Bolivia, maintains 95 % forest cover and a population density of less than nine individuals per hectare organized into over 200 communities (Beekma *et al.* 1996; INRA 2008; Marsik *et al.* 2011). Residents engage in a variety of profitable forest uses, such as Brazil nut (*Bertholletia excelsa*) extraction, forestry, and small scale agriculture and cattle ranching. The most ubiquitous and economically important activity is Brazil nut extraction, though communal timber management is the primary focus of much policy and external support. Until recently, these activities were practiced largely by individual households within autonomous communities rather than communally.

A 1996 agrarian reform law and a subsequent decree granted communities in Pando land titles equivalent to 500 ha per family which had to be managed in accordance with forestry laws and national agrarian policies (Cronkleton *et al.* 2010). These policies required forest-based communities to employ forest management skills aligned with state-approved management plans signed by all community members in order to extract timber and Brazil nuts from communal forests. At the same time, private loggers were eager to gain access to communal timber. Such drivers provoked an external interest in organizing communities to collectively manage and market their timber and Brazil nut resources (de Jong *et al.* 2006).

Of the 39 communities with approved annual management plans in 2006 and 2007, 14 received resource management support from non-governmental extension organizations to design and implement forest management plans, though only seven of these relationships were active in 2008 (Cuevas, pers. comm.). The NGO provided each community at least 1 year of support to learn the bureaucratic process of filing resource management plans as well as technical skills, such as developing a forest census, negotiating a contract with a timber and/or Brazil nut buyer, monitoring the timber extraction process, and maintaining a communal organization (Biedenweg 2012). The general

model for community forest management in Pando was the establishment of a community forestry committee that engaged directly with the NGO to undertake these activities. This study focuses on the experience of two of these seven communities.

Site Selection and Description

We selected two communities with approved timber management plans that were working with different CFM projects based on interviews with project directors, extension agents, and community leaders who described these two social learning environments as being the most active and successful attempts at fostering collective action for timber management in Pando. This site description is the outcome of over 50 open-ended interviews during 5 months of working alongside extension agents and 4 weeks of living in the communities.

The two communities, hereafter known as Villa and Rio, had the same tenure arrangements, policies and forest structure. They also had many of the characteristics essential for communal resource management: a defined user base, a defined territory, approved communal statutes for resource use and conflict management, and long histories as communal groups. They differed, however, in some important socio-political characteristics (Table 1) as well as specific interactions with the extension NGOs (Table 2).

First, the population in Rio was almost five times that of Villa though the communities were similar in years of existence (Table 1). In 2008, Rio was a younger community in terms of the average age of residents and the average number of years current residents had lived in the community. The land area under title and under timber management was almost twice as much in Rio and had slightly larger quantities of high value timber species, partly because of the greater land area, but also due to a timber concession whose land rights had superimposed the area belonging to Villa until 2005. This difference in forest value disappears when considered per capita, however. Of the land under title, more was dedicated to agriculture in Villa than Rio. This was partially due to a greater reliance on salaried work in Rio, leaving little time to tend to fields. In Villa, the primary land uses were agriculture and Brazil nut extraction for the lower classes and cattle ranching for the elite. In both communities, the majority of research participants said that agriculture was their most important land use, followed by Brazil nut harvesting and either timber (Rio) or cattle (Villa) (Table 1). Importance did not necessarily imply highest economic return.

Rio and Villa were both Brazil nut estates that evolved into independent communities (Table 1). Social structures in Brazil nut estates were based on large landholders maintaining laborers in a permanent dept-peonage system: as laborers' days were filled with collecting Brazil nuts, rubber, and other forest products, they were impelled to purchase food and basic livelihood items from the landholder at inflated costs (Stoian 2005; Stoian and Henkemans 2000). In Rio, the owner of the estate was no longer alive nor did the vestiges of the estate social structure dominate. In Villa, the sons of the estate owner remained the communal elite, held all leadership roles, and maintained the paternalistic social structures with the exception that residents were not financially in their debt. This difference plays out in many

Table 1 Socioeconomic and land use characteristics of Rio and Villa

	Rio	Villa
Population (#HH)	76	16
Origin of population	Pando and Beni	Pando and Brazil
Age of community	54 year (7 officially titled)	38 year (8 officially titled)
Land area (Ha)	25,000	12,765
Land area for timber (Ha)	16,300	9,538
High value species left	Average	Low
Primary economic activities	Brazil nut, salaried labor and timber	Ag, Brazil nut and cattle
Land use history	Brazil nut estate	Brazil nut estate
Current social structure	Relatively egalitarian	Bimodal
Communal decision making	Monthly required meetings	Monthly required meetings
Norms for access and use	Within statutes	Within statutes
Leadership	Young community activists	Older elite
Current timber mgmt	Standing logs sold	Standing logs sold
Financial benefit from timber (per HH per year)	1500B = 214USD	2000B = 285USD
Current Brazil nut management	Individuals sell to intermediaries	Elite associated to sell directly to factory, lower class sells to intermediary or elite

Table 2 Social learning context for Rio and Villa

	Rio	Villa
Committee composition	10 activists	4 elite
Length of interaction	8 years, 4 specific to forestry	2 years
External organization	Sustainable land use NGO	Forestry NGO
Extension agent strengths	Forestry, law	Forestry, administration
Location of NGO offices	1 h by motorcycle	45 min by bus or car
Where learning took place	Primarily within community	Primarily in nearby city
Social learning content	Creating management plan, negotiating with timber company, monitoring extraction process, training in directional felling	Creating management plan, negotiating with timber company, monitoring extraction process, training in directional felling; Administration capacity (bookkeeping)
Learning methods	Experiential practice of skills with small group discussions	Experiential practice of skills with small group discussions
Participation by other community members	Regular participation in census activities	None
Sharing of information to larger community	Monthly meetings	Monthly meetings

aspects of the communities' structures. While Rio was a more homogenous community economically and educationally, Villa was bimodal, with 50 % of the community having many years' worth of savings and the other 50 % arriving to the community with nothing. This trend was also true for the number of years community members had attended school. In Rio, most people had attended school for 8 or 9 years, whereas in Villa the poorest group studied between 5 and 7 years while the wealthiest group studied between 10 and 13 years. Finally, while Rio had many external contacts, they were generally within civil society, such as local NGOs and social movements, while Villa's primary contacts included one of the region's largest Brazil nut processing plants and an international finance organization.

Formally, the organizational structure of both communities was similar due to their creation of a communal Organización Territorial de Base (OTB) and general assembly whose function is to represent the community in local government (as described in Cronkleton *et al.* 2009) (Table 1). Both communities made decisions about resource access and addressed conflicts in monthly communal meetings that required the participation of every household. The leadership in each community, however, was clearly different. The leaders of Rio were grassroots activists who had been engaged in campesino causes for years and upheld the democratic ideal. In Villa, the leaders were the elite descendants of the estate owner and generally made decisions in a more autocratic manner, holding community meetings to inform rather than discuss. As a result, Rio residents expressed more trust among community members and in their leaders. In Villa, members of both classes expressed a lack of trust in each other.

Rio began developing their first annual timber management plans in 2001, though they had successfully obtained contracts for only two due to internal politics and disagreements with external buyers. Villa began their timber management process in 2006, had successfully signed contracts for two annual plans, and was working on the third as of 2009. Both communities managed their timber similarly. The forestry committees (see below) completed a timber census, prepared and negotiated timber contracts, and monitored extraction practices with the help of their extension agents. Both sold standing trees, though both had trained sawyers who planned to add timber felling to the list of communal management activities, and both distributed $214–$285 per year to all legal households as their allotted income from timber sales (Table 1).

Though the timber management processes were similar, the collection and sale of Brazil nut differed between the communities (Table 1). In both, households either hired workers or independently collected Brazil nuts along paths historically allotted to them. The sale of these nuts was entirely individual through external intermediaries in Rio. In Villa, the elite collectively purchased nuts from other community members, though some in the lower class preferred to sell directly to external intermediaries. In 2008, several residents in Villa attempted to pool their products to sell a larger quantity directly to the factory. Due to a drastic drop in market prices and the inability of the factory to purchase such a quantity at the specified time, this deal was left incomplete and is still remembered as a failed attempt by those who witnessed the collective action.

Social Learning Processes

Extension projects in Pando that facilitated social learning varied little in their social learning components and methods (Biedenweg 2012). In all cases, a social learning group (the

forestry committee and their respective extension agents) engaged over a period of time to practice, reflect, and negotiate timber and Brazil nut management and marketing within the confines of the law. The effectiveness of extension agents as facilitators for open dialogue varied based on the experience of each individual agent. Most were foresters or economists by training and were more comfortable with technical training but even so generally succeeded at facilitating social learning environments that encouraged sharing diverse perspectives, practicing new skills, open communication, and relatively unrestrained thinking about resource management. The most successful agents regularly visited communities over an extended period (several years ideally), developing genuine friendships by sharing meals and accommodations, and hosting various training sessions and workshops in which they learned from community members' local expertise and community members learned from their technical skills.

In Rio and Villa, the social learning processes differed primarily in the social status of the forestry committee members, the length of time the community had worked with the extension NGO, other participants in CFM activities, and the location of the social learning activities (Table 2). In Rio, there were 10 members of the forestry committee; in Villa, there were four. Members of both committees were either elected or were volunteers. In Rio, this resulted in a core group of young activists who had a reputation for getting things accomplished for the community. In Villa, it led to the elite maintaining leadership roles that were little appreciated by the rest of the community. Although Villa's forestry committee did not represent the entirety of the community, we consider it a social learning group because they met the criteria of internally learning from each other, democratic decision making, and working together to practice and learn from collective timber management and Brazil nut sales. The limitations of this arrangement are considered in the discussion below.

The extension NGO in Rio had been working on community agroforestry and timber and Brazil nut projects since the late 1990s. Their methods included regular visits (often monthly) to attend community meetings, meet with community leaders, or to conduct specific training. They hired a community technician to act as the liaison with the community for the agroforestry project and to represent the community at inter-community workshops. With the timber and Brazil nut project, they worked directly with the community forestry committee, attending meetings and preparing training sessions as well as helping negotiate political issues surrounding the development of timber management and sale plans. Agents generally treated the forestry committee as partners rather than clients, promoting an equal foundation for knowledge sharing. Most importantly, they developed a long-standing trust with many community members, choosing to stay overnight and share meals after events. The extension NGO in Villa had only recently developed a relationship based on a community forestry project, though they too maintained regular meetings with the forestry committee, responded to requests for training sessions and technical support, and assisted in negotiating the politics of the creation of timber management and sales plans. They also developed strong bonds with the forestry committee, spending significant amounts of time with them when they visited the nearby city and staying overnight in the community on a couple occasions. They were less interactive with other members of the community, however, furthering distrust between the two communal groups in Villa.

In both communities, the forestry committees were given an open invitation to the extension offices. For Villa, this was where all non-field-based activities took place (Table 2). The committee prepared documents, learned database management, negotiated with timber companies, and made major decisions while in the city with the extension agents. Their trips to the field, accompanied by extension agents, were only to complete the timber census and monitor felling by timber companies. For Rio, most activities took place within the community and the extension agents visited on the forestry committee's request. This made the process more transparent and enabled participation by many community members outside the forestry committee in CFM activities, particularly the tree census for the management plan. In Villa, only the elite committee members participated in all activities.

Although the primary social learning groups were the forestry committees and their respective extension agents, both communities held monthly communal meetings that extended knowledge about CFM beyond the core forestry committee. However, decision-making was extended to non-committee members only in Rio. In Villa decisions were presented to the community by the forestry committee with little opportunity for or consideration of feedback. One non-elite community member from Villa commented, "There is a lack of participation when decisions are made." In Rio, however, important decisions were usually made democratically during the day-long communal meetings that required the presence of a representative from every household.

Understanding the social learning context also requires knowing the intentions of the social learning facilitators. Both extension NGOs anticipated co-generating knowledge, with the understanding, however, that extension agents had the unique technical expertise required to fulfill government regulations. They also intended to employ methods for gaining trust with the community and for ensuring the community's ownership of the process. They did not, however, intend to modify the community's internal relationships and social structure. They respected the community's existing bylaws and norms for decision making and assisted in conflict management only when the conflict was between

the community and an external actor. They thus had no intention to enhance trust among community members, one of the prescribed components of social learning for natural resource management.

Quantitative Research Methods

Data Collection

Methods for understanding if and how participation in social learning could influence outcomes necessary for collective action were designed based on our research in Rio and Villa, their respective social learning environments, and our understanding of the social learning literature (e.g., Muro and Jeffrey 2008; Schusler *et al.* 2003). We evaluated the perceived presence of 10 project characteristics hypothesized to influence social learning for collective action and eight outcomes considered important for collective action (Fig. 1). Outcome variables were separated into two types, those resulting in knowledge, self-efficacy, and behavioral impacts and those resulting in procedural satisfaction. Project characteristics included: participants' perception that everyone's ideas were considered, interests of all community members were considered, participation was open to all who desired, actual participation was equitable when working in the project, all concerns were respected, facilitators demonstrated interest in individual participation, participants took individual opinions into account, there was conflict management, good information was presented, and the process improved trust. Knowledge, self-efficacy, and behavior outcomes included ability to define and describe CFM and sustainable forest management (SFM); the perception of risks and benefits of collectively managing timber and marketing Brazil nut; self-efficacy in collective timber extraction and Brazil nut marketing; and participation in collective activities (creating a timber management plan, negotiating a timber contract, monitoring timber extraction, and organizing to sell Brazil nuts). Procedural satisfaction variables included trust in the facilitators and their information, satisfaction with the decisions made during the project, and satisfaction with the decision-making process.

Data were collected through semi-structured interviews and observations over 2-week visits in each community, pre- and post-interview interactions within the communities, and discussions with community members at the extension offices. Interviews were conducted with an interview guide incorporating 40 questions and a cognitive mapping exercise to measure recognition of CFM and SFM, trust in community and the extension agents, descriptors of the process and the extension agents, opinion of the project, perception of the risks, benefits, and self-efficacy to engage in communal management activities, participation in communal timber management and Brazil nut marketing, commitment to the activities in the future, and existing and desired alternate land uses within the communal lands. Likert-style questions for self-efficacy, risks, and benefits of communal timber were not part of the original interview protocol first implemented in Villa. Based on qualitative discussions with Villa residents, however, we recognized the benefit of quantifying these variables and thus implemented them in Rio. As a result, quantitative results for communal timber risks, benefits, and self-efficacy are only for Rio. Interviews averaged an hour and a half and were led by the lead researcher with detailed responses noted by a Bolivian assistant.

Because of the low population in Villa, all household heads present during the 2-week visit were interviewed (n=12). In Rio, households were randomly selected until roughly 30 % of the community was interviewed (22 interviews). The number of responses used for hypothesis testing varied due to missing data for some of the characteristics. Interviewees included those who had participated in the social learning project as members of the forestry committee and those who had not.

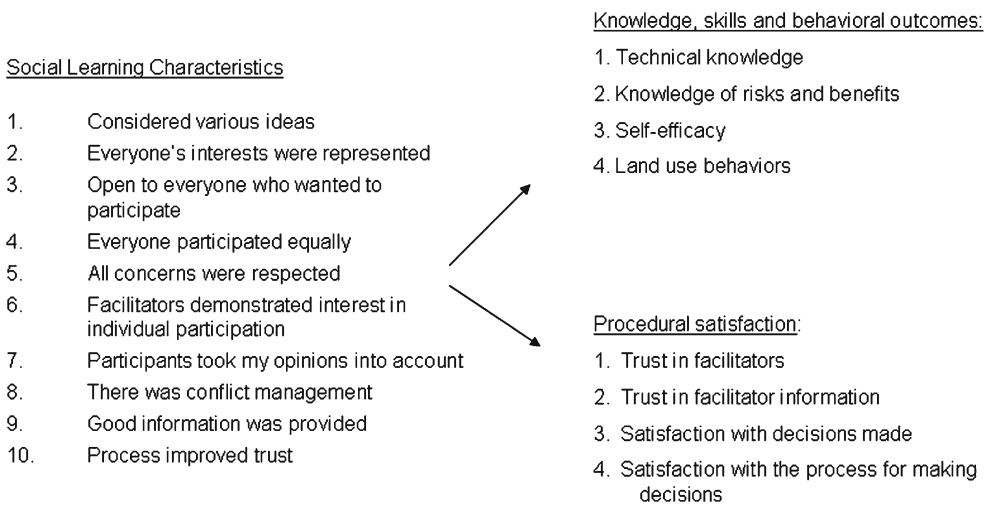

Fig. 1 Project characteristics and outcomes of social learning measured in this study

Data Analysis

Responses to open-ended questions were transcribed and coded in NVivo based on pre-defined categories including communal history, land management practices, trust, knowledge, and opinion of the social learning project. No other important themes emerged. This information was used to describe each community's context and to provide depth to the structured interview responses. Knowledge of CFM and SFM were each coded on a scale of one to three based on the complexity of the description. Whether they expressed having learned anything was coded into a binomial yes/no response. Data for all other variables are presented based on the original three to four level Likert-style categories elicited during interviews.

The mean and standard deviation were calculated for all outcome variables and social learning characteristics. Nonparametric tests of significance were used as they are more appropriate with small sample sizes and when the assumptions of normality do not hold. Significant differences in outcomes were first tested between members and non-members of the forestry committees, the primary social learning venue, for each community using Pearson Chi-square. Differences in outcomes were then tested between communities with the same statistic, controlling for membership in the forestry committees. Significance was determined at a probability of 0.10 or lower.

Finally, a series of cumulative logit models were generated in SPSS 18 to determine which of the project characteristics could be significant predictors for each outcome variable. Cumulative logit was used because it retains information in the ordinal responses. The small N, however, resulted in high numbers of empty cells. To minimize empty cells, predictor variables were recoded from three to two categories, lumping complete disagreement with 'more or less' responses. Even with this grouping, the majority of responses were in higher categories for each variable. The complementary Log-log link was selected as the most appropriate for working with responses more frequently in higher categories (SPSS 2008).

We followed established criteria for selecting the most parsimonious model with significant model fit, that satisfied the assumptions of parallel lines, and had relatively high Pearson Chi-square and Pseudo R^2 values (Agresti 1996; Chen and Hughes 2004). The first models for each variable incorporated all nine project characteristics as predictor variables, eliminating the management of conflicts because the majority of respondents said it was irrelevant. Reduced models were created for comparison until one model for each outcome filled the above criteria. Not every outcome was significantly predicted by the presence of project characteristics.

Results

We first present findings about the presence of each social learning characteristic in each community followed by the perceived overall outcomes of the social learning projects in each community for each level of participation. These findings respond to our first question, 'Does participation in a social learning project correlate to hypothesized outcome variables that are important for collective action?' and are presented in three sections: overall perceptions of the most important outcomes; outcomes related to knowledge, self-efficacy and behaviors; and outcomes related to procedural satisfaction. Statistics are only discussed in the text for significant differences, whereas non-significant differences are referenced without statistics. Finally, the second question, 'Which characteristics of the social learning project are more important for predicting social learning outcomes?' is addressed through correlations and cumulative logit models predicting outcome variables from characteristics of the project.

Were Social Learning Characteristics Present?

Respondents were asked to evaluate their opinion of the presence of each characteristic on a three-point Likert-scale (Fig. 2). Most characteristics were rated highly and there were no significant differences in the ranking between communities. The rank order of characteristics was also mostly similar in each community. In Rio, it was perceived that everyone's interests were taken into consideration more often than other characteristics, whereas in Villa the most common perception was that good information was provided. In both communities, though more so in Villa, the forestry committee members had slightly more positive perspectives of the social learning process.

What Were the Overall Outcomes of Project?

When asked for the most important outcome of the CFM projects, respondents provided 21 different outcomes that we coded into five categories: nothing or elite capture only, the development of a management plan, general knowledge and skills gained, managing what is ours, and 'other.' Results landing in the 'other' category included learning about one's rights, learning how to care for the forest, and receiving saplings. There were significant differences in the most important outcomes of the project between communities ($\chi^2=11.76$, $p=0.02$), and between members and non-members of forestry committees ($\chi^2=12.4$, $p=0.01$). In Rio, members of the forestry committee explained that the most important outcomes were the ability to manage their own land with their new knowledge, skills, and management plan. In Villa, committee members agreed that the knowledge and

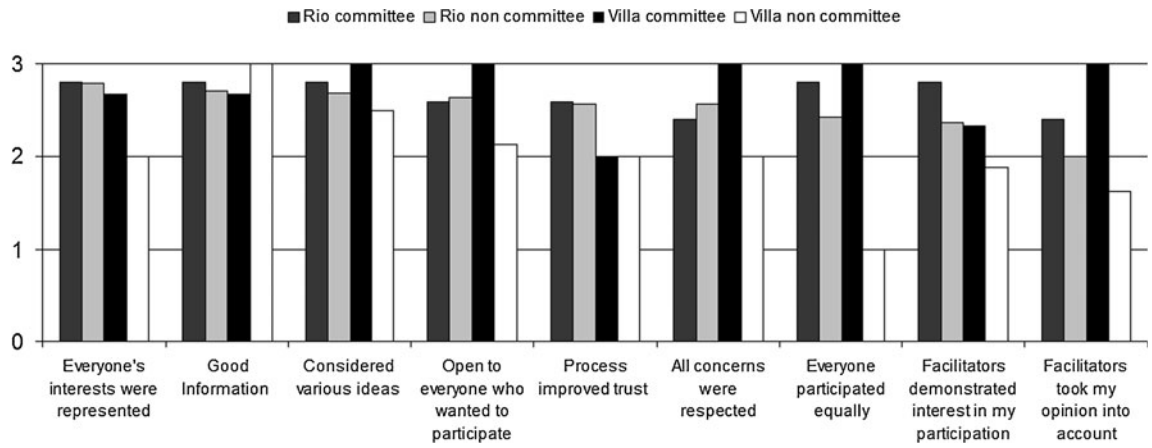

Fig. 2 Mean scores of perceived characteristics in each social learning project separated by members and non-members of the forestry committees. Scale: 1 = do not agree, 2 = more or less agree, 3 = completely agree. N=19 for Rio; N ranges from 2 to 11 for Villa

skills they gained were the most important immediate outcomes. Most non-committee members in Villa, however, recognized no important outcomes or claimed that only the elites benefitted. In Rio, more non-committee members found benefits to the project, specifically the resulting management plan and the ability to manage what was legally theirs.

Knowledge, Perception of Risks, Self-Efficacy and Behavior Outcomes

All committee members felt they had learned something from the social learning project, as did one-half and one-third of the non-committee members in Rio and Villa, respectively (Table 3). Responses to this variable were identical for committee members in both communities, and not significantly different for non-committee members (Table 4). Knowledge about CFM and SFM, however, were significantly higher for committee members in both communities (in Rio, χ^2=4.96, p=0.08 for CFM and χ^2=13.12, p=0.00 for SFM; in Villa, χ^2=.5.78, p=0.06 for CFM and χ^2=5.12, p=0.08 for SFM) (Table 3). Knowledge about CFM was also significantly higher for Rio non-committee members (χ^2=10.83, p=0.004) and knowledge of SFM was significantly higher in Rio committee members (χ^2=4.44, p=0.035) (Table 4). Knowledge of the term is a first step to engaging in CFM, as it is the term most commonly used in public policies and the marketing of projects to support communal forestry. The understanding that CFM is a form of SFM and how the two are related is something that comes with more experience. In both communities, the committee members were familiar with CFM, although those in Rio had a better grasp of SFM. Non-committee members in Villa did not understand either concept, whereas in Rio they generally had a better grasp of CFM. This implies that a basic level of knowledge is transmitted to most people in Rio, though committee and non-committee members differ in more advanced knowledge.

Some community members also learned skills essential for communal forest management. Almost half the respondents from each community, all non-committee members, described having learned nothing during open-ended questions. The remainder primarily described having learned technical skills necessary to complete a forest census and monitor extraction. Fewer participants also described learning how to manage projects (Rio and Villa) and learning to express themselves and demand rights (Villa). These outcomes were not significantly different between communities, but they were significantly different among members and non-members of the forestry committees (χ^2 =8.46, p=0.07).

Perception of risks and benefits is an important indicator for collective action and is hypothesized to be modifiable through social learning environments. Perception of more benefits than risks provides a greater incentive for collective action. If individuals assess benefits and risks on the basis of participation in social learning, their perceptions will differ from those who do not participate. Though quantitative results about timber management were only valid for Rio, qualitative responses from Villa were sufficient for comparison. Quantitative results for both communities about communal Brazil nut marketing, however, showed no significant differences between members and non-members of the forestry committees about perceived risks or benefits of timber management or Brazil nut marketing (Table 3). Qualitative results, though, showed that members of both communities regarded collective Brazil nut marketing as riskier than timber management, primarily due to the lack of trust among community members and lack of agreement on how to go about it. For timber management, on the other hand, the risks were largely explained as potential damage to Brazil nut trees and forest health, scarcity of high value

Table 3 Means, standard deviations, and statistics for differences in outcomes between committee members and non-committee members in Rio and Villa

Outcome Variable	Rio committee (N=5) Mean (SD)	Rio non-committee (N=16) Mean (SD)	Pearson χ^2, p	Villa committee (N=3) Mean (SD)	Villa non-committee (N=9) Mean (SD)	Pearson χ^2, p
Knowledge and Learning						
Whether learned or not (0,1)	1.00 (0.00)	0.50 (0.50)	4.04, p=0.04*	1.00 (0.00)	0.33 (0.71)	3.44, p=0.06*
Knowledge CFM (0–2)	1.80 (0.45)	1.13 (0.62)	4.96, p=0.08*	1.67 (0.58)	0.33 (0.71)	5.78, p=0.06*
Knowledge of SFM (0–2)	2.00 (0.00)	0.63 (0.72)	13.12, p=0.00**	1.33 (0.58)	0.38 (0.74)	5.12, p=0.08*
Risks and Benefits						
Perception of Timber risks (1–3)	1.60 (0.89)	1.36 (0.74)	0.83, p=0.66	ND	ND	NA
Perception of B-nut risks (1–3)	2.00 (0.70)	1.81 (0.91)	3.24, p=0.20	2.33 (0.58)	1.88 (0.64)	1.28, p=0.53
Perception timber benefits (1–3)	1.80 (0.84)	2.47 (0.92)	2.22, p=0.53	ND	ND	NA
Perception B-nut benefits (1–3)	2.80 (0.45)	2.31 (0.95)	2.56, p=0.46	3.00 (0.00)	2.75 (0.46)	0.92, p=0.34
Self-Efficacy						
Self-efficacy timber (1–3)	2.20 (0.84)	2.17 (1.03)	0.94, p=0.82	ND	ND	NA
Self-efficacy Brazil nut (1–3)	2.20 (0.84)	2.50 (0.65)	0.80, p=0.67	2.50 (0.71)	1.25 (0.50)	5.00, p=0.08*
Land Use Behavior						
Participation timber census (0–3)	1.40 (0.89)	0.88 (1.15)	4.10, p=0.25	2.33 (0.58)	0.00 (0.00)	12.00, p=0.00**
Participation in negotiation (0–3)	1.00 (1.41)	0.20 (0.50)	4.81, p=0.19	1.67 (1.53)	0.11 (0.33)	7.26, p=0.06*
Participation in monitoring (0–3)	1.00 (0.71)	0.00 (0.00)	15.81, p=0.00**	2.00 (0.00)	0.22 (0.67)	6.52, p=0.01**
Probability continue timber (1–3)	2.40 (0.89)	2.42 (0.67)	0.94, p=0.62	ND	ND	NA
Communal B-nut participat. (0,1)	0.00 (0.00)	0.19 (0.40)	1.09, p=0.30	1.00 (0.00)	0.22 (0.44)	5.60, p=0.02**
Talk with others about B-nut (1–4)	2.40 (0.55)	2.00 (1.16)	6.99, p=0.07*	2.33 (1.16)	1.14 (0.38)	5.92, p=0.05**
Probability collective B-nut (1–3)	2.40 (0.89)	1.75 (0.86)	2.24, p=0.33	2.67 (0.58)	1.50 (0.54)	6.97, p=0.03**
Procedural Satisfaction						
Trust extension agent (1–3)	2.80 (0.45)	2.36 (0.74)	1.58, p=0.46	2.67 (0.58)	2.43 (0.79)	0.48, p=0.79
Trust extension information (1–3)	2.60 (0.55)	2.64 (0.50)	0.03, p=0.86	2.67 (0.58)	1.67 (0.82)	2.00, p=0.22
Decisions satisfy me (1–3)	2.40 (0.89)	2.64 (0.74)	0.83, p=0.66	2.67 (0.58)	1.43 (0.79)	4.44, p=0.11
Good investment (1–3)	2.60 (0.89)	2.57 (0.76)	0.83, p=0.66	3.00 (0.00)	1.57 (0.79)	6.43, p=0.04**

*p<0.10, ** p<0.05

ND not enough data, *NA* not applicable due to ND

species, inability to sell all species, unwelcome rules imposed, corruption, lack of knowledge of relevant laws, and insufficient training. In other words, the risks for timber had less to do with interpersonal relationships and more with technical issues easier to overcome.

Despite its risks, collective Brazil nut marketing was seen as more beneficial than timber management because of the increased income cooperative members had received from bulk sales. In contrast, though all community members benefitted from timber sales, actual income was not considered very high. Although contracts with timber companies usually incorporated additional benefits to make up for this, however, such as employment, provision of new roads and often storage facilities for Brazil nuts, non-members of the forestry committee in Villa saw little benefit to timber management. As one Villa non-committee member noted: "Only the rich benefit because they receive gifts and because the [timber management] rules imply that the poor lose rights to their agricultural fields."

An increase in self-efficacy, the next hypothesized outcome of social learning and an essential predictor of behavioral change within psychology, was measured by asking people how capable they felt at engaging in communal timber management and collective Brazil nut marketing. There were no significant differences between committee and non-committee members for self-efficacy in Rio (Table 3). Though quantitative data for timber management in Villa were not available, the majority of non-committee members qualitatively responded that they were unable to engage in timber management because these activities were monopolized by the forestry committee.

Similarly, self-efficacy for collective Brazil nut marketing was significantly higher among committee members than non-members in Villa (χ^2=5.00, p=0.08) (Table 3),

Table 4 Differences in social learning outcomes between participants and non-participants in the forestry committees of Rio and Villa

Outcome Variable	Between committee members χ^2, p, (community with higher values)	Between non-committee members χ^2, p, (community with higher values)
Knowledge and Learning		
Whether learned or not	NA	0.34, p=0.56
Knowledge CFM	0.18, p=0.67	10.83, p=0.00** (Rio)
Knowledge of SFM	4.44, p=0.04** (Rio)	1.71, p=0.42
Risks and Benefits		
Perception of timber risks	NA	NA
Perception of B-nut risks	0.75, p=0.69	4.61, p=0.10
Perception of timber benefits	NA	NA
Perception B-nut benefits	0.69, p=0.41	3.46, p=0.33
Self-efficacy		
Self-efficacy timber	NA	NA
Self-efficacy Brazil nut	1.20, p=0.55	8.84, p=0.01** (Rio)
Land Use Behaviors		
Participation timber census	2.89, p=0.41	5.47, p=0.14
Participation in negotiation	0.53, p=0.77	0.61, p=0.74
Participation in monitoring	3.73, p=0.16	1.85, p=0.17
Participation in communal B-nut	8.00, p=0.01** (Villa)	0.04, p=0.84
Talk with others about B-nut	3.73, p=0.16	3.84, p=0.28
Probability collective B-nut	0.75, p=0.69	3.00, p=0.22
Procedural Satisfaction		
Trust extension agent	0.18, p=0.67	0.12, p=0.94
Trust extension information	0.04, p=0.85	8.91, p=0.01** (Rio)
Decisions satisfy me	0.75, p=0.69	8.20, p=0.02** (Rio)
Good investment	0.69, p=0.41	6.41, p=0.04** (Rio)

NA not applicable due to no variation in response rates for between community members for whether they learned or not, and no data for Villa about timber

*p<0.10, ** p<0.05

and non-committee members in Rio had significantly higher self-efficacy than non-committee members in Villa (χ^2= 8.84, p=0.01) (Table 4). This was due to the overwhelming sense that the elite, who comprised the forestry committee, controlled the Brazil nut market in Villa and were the primary Brazil nut buyers from the rest of the community. In 2007, when the elite decided to sell their respective purchases collectively, the non-elite were not invited to participate, and the limited success of the endeavor made Brazil nut marketing even less likely for those with weaker connections to external buyers. Residents of Rio had no similar experience and thus had a higher self-efficacy for collective Brazil nut marketing than timber.

In both communities, there were perceived differences in self-efficacy for communal timber vs. collective Brazil nut marketing. Based on qualitative responses in both communities, capacity for communal timber management was lower than the perceived capacity to engage in collective Brazil nut marketing because communal timber management was subject to a highly bureaucratic process and required skills most community members did not have. Collective Brazil nut marketing, on the other hand, utilized existing behaviors of individually collecting Brazil nuts, adding the collective component only at the point of sale.

Two themes from the interviews were used to explore engagement in communal resource management activities: How often individuals engaged in timber and Brazil nut activities and the probability of continuing or initiating that activity.

Timber

In both communities, only the committee members monitored timber extraction (χ^2=15.81, p=0.00 in Rio; χ^2=6.52, p=0.01 in Villa) and in Villa only specific committee members negotiated forest management plans (χ^2=7.26, p=0.06) (Table 3). The fact that there were no significant differences in Rio for participation in negotiation is due to the small percentage of committee members (one or two) who actually participate in the negotiation, and the fact that there were no significant differences for participation in the timber census is due to the inclusion of non-committee members

in this activity. There were no significant differences in participating in these activities between communities (Table 4). In Villa, non-members not only did not participate but also expressed no interest in participating in the future. While the average probability of continuing to participate in collective timber management was high in Rio (Table 3), respondents in both communities expressed that this decision was not entirely up to them. For non-committee members, this was often because government regulations required that everyone in the community sign annual and general management plans. For committee members, whether they would continue the project depended on maintaining the quality and quantity of valuable timber species, the willingness of buyers, and the continually shifting rules imposed upon them by national laws.

Brazil Nut

Only one resident in Rio participated in collective sales of Brazil nuts at the time of interviews, thus there were no significant differences between committee and non-committee members (Table 3). In Villa, significantly more committee than non-committee members collectively sold Brazil nuts (χ^2=5.60, p=0.02) (Table 3). This was due to the personal relationship one of the elite committee members had with the largest Brazil nut factory. Thus, the collective action was not a result of participating in the social learning project but rather the result of existing relationships among the elite members of the forestry committee better defined as a collective group of intermediaries than a collective group of community sellers. Forestry committee members in both communities, however, were more likely to talk about collectively selling Brazil nuts (χ^2=6.99, p=0.07 in Rio; χ^2=5.92, p=0.05 in Villa) (Table 3). While most residents of both communities considered the future collective sale of Brazil nuts to be only slightly likely, the committee members of Villa found it a more likely option than the non-committee members (χ^2=6.97, p=0.03) (Table 3).

Procedural Satisfaction

Trust in a facilitator, one of the hypothesized procedural satisfaction outcomes of a social learning project, can be essential for collective action. Two questions measured this: trust in the extension agents and trust in the extension agents' information. There were no significant differences in trust between committee members and non-members in either community, or between committee members in both communities (Table 3). Trust in the extension information, however, was significantly higher among non-committee members in Rio than in Villa (χ^2=8.91, p=0.01) (Table 4). This difference was likely due to the extended presence of the extension NGO in Rio and their demonstrated competence over time to the entire community. The first extension agents to present the CFM project to the entire community of Villa, in contrast, were considered dishonest and clouded the overall trust in subsequent information provided as a part of the project among non-committee members. In contrast, committee members in Villa engaged more deeply with subsequent extension agents and slowly built up trust in their information.

Satisfaction with the project was measured by asking whether respondents felt the time and money spent on the project was a worthy investment. Responses were highly correlated with responses about satisfaction with the decisions made and thus are presented jointly. The only variable that significantly differed between committee and non-committee members was the perception of the project being a good investment, which was significantly higher among committee members in Villa (χ^2=6.43, p=0.04) (Table 3). Both variables were significantly higher among non-committee members in Rio than in Villa (χ^2=8.20, p=0.02 for satisfaction with decisions and χ^2=6.41, p=0.04 for satisfaction with the project). One non-committee member in Villa expressed a pervasive opinion: "Nobody on this side [of the community] agrees [with the project]," a reference to the fact that the elite, and thus the members of the forestry committee, were also physically separated from the lower classes by living at the entrance of the community. In contrast, a non-committee member in Rio stated: "Everyone is in agreement and there is no dictatorship." Committee members in both communities, however, were highly satisfied with the project (Table 3). Overall satisfaction with the project extended beyond the core social learning group only in Rio, where participants were openly invited to partake in timber management activities and important decisions were made democratically among representatives of the entire community.

The Importance of Process

Cumulative logit models responded to the research question: How can outcome variables be predicted by specific characteristics of the project? (Table 5). Only three of the knowledge, efficacy, and behavior outcomes could be predicted based on specific characteristics of the project, whereas all procedural satisfaction variables could be significantly predicted.

The perception that the project considered various ideas significantly predicted respondents' knowledge of CFM (p=0.02) and self-efficacy to engage in communal timber management (p=0.01). In other words, those who perceived that the project incorporated various ideas were more likely to have better knowledge of CFM principles and higher perceived capacity to engage in collective timber management. Whether the group took individual opinions into account significantly predicted the individual's perception of the risks

Table 5 Cumulative logit regression models for predicting social learning outcomes from process characteristics

Outcome Variable	N	Pseudo R^2	Overall Fit χ^2, df, *P*	Pearson Goodness-of-fit χ^2, df, *P*	Threshold 1 Coefficient (SE)	Threshold 2 Coefficient (SE)	Threshold 3 Coefficient (SE)	Predictor 1 Coefficient (SE)	Predictor 2 Coefficient (SE)
Learning, Self-efficacy and Behavior Outcomes									
Knowledge of CFM			8.01, df=1	0.02, df=1,	CFM = 0	CFM = 1	NA	Various Ideas	NA
	23	0.341	*0.00***	*0.877*	−2.94 (0.90)	−0.53 (0.36)		−2.30 (1.00)**	
Perception of Brazil nut risks			11.89, df=1	0.00, df=1,	Risk = 1	Risk = 2	NA	Your Opinion	NA
	29	0.379	*0.00***	*0.984*	−1.61 (0.50)	0.01 (0.28)		−2.27 (10.94)**	
Self-efficacy of timber			6.92, df=1	0.01, df=2,	Capacity = 1	Capacity = 2	Capacity = 3	Various Ideas	NA
	18	0.348	*0.01***	*0.996*	−1.89 (0.69)	−0.36 (0.38)	0.97 (0.36)	−2.23 (0.89)**	
Procedural Satisfaction									
Trust extension agent			8.54, df=2	0.95, df=4	Trust = 1	Trust = 2	NA	Equal Part.	Trust
	21	0.675	*0.00***	*0.918*	−5.49 (2.01)	−2.78 (1.07)		−3.03 (1.19)**	−2.22 (1.17)*
Trust extension information			7.98, df=1	0.23, df=1	TrustInfo = 1	TrustInfo = 2		Equal Part.	
	21	0.394	*0.00***	*0.634*	−4.34 (1.22)	−1.80 (0.71)	NA	−2.14 (0.83)**	NA
Decisions satisfy me			16.85, df=2	2.12, df=4	Satisfaction = 1	Satisfaction = 2		Trust	Good Info
	23	0.644	*0.00***	*0.713*	−5.35 (1.92)	−3.28 (1.20)		−2.81 (1.28)**	−2.64 (1.25)**
Good investment			10.29, df=2	1.62, df=4	GoodInv = 1	GoodInv = 2	NA	Trust	Reflected all Interests
	25	0.426	*0.01***	*0.806*	−3.61 (1.12)	−2.80 (1.03)	NA	−2.00 (1.15)**	−1.31 (0.81)

Rows present a single model per outcome variable, columns present statistics for model fit, threshold, and predictor variables

N number of valid cases submitted to model, Nagelkerke Pseudo R^2 , Likelihood Ratio χ^2 for overall model fit, *df* degrees of freedom, *SE* standard error of the coefficient, complementary log-log link

*$p<0.10$, ** $p<0.05$

P values are expressed in italics

involved in collectively marketing Brazil nuts ($p<0.01$). The models demonstrating the highest effect, however, are for procedural satisfaction variables, specifically trust in the extension agent and satisfaction with the decisions made. Trust in the extension agent was significantly predicted by perceptions of equal participation ($p=0.01$) and improved trust among participants ($p=0.06$). The project improving trust ($p=0.03$) and providing good information ($p=0.03$) were both significant predictors for satisfaction with the decisions made in the project, i.e., those who perceived the project as not having improved trust and not providing good information were less likely to be satisfied with the decisions made. Trust in the extension agents' information was also predicted by the perception of equal participation ($p=0.01$). Finally, the perception that the project was a good investment was predicted by the perception of improved trust ($p=0.08$). The inclusion of community as a covariate was insignificant and decreased the fit of the models. It can thus be determined that these models are relevant for predicting outcomes in both communities.

Discussion

Social learning can occur when participants openly share ideas, reflecting and integrating them into new knowledge through a democratic structure that allows them to influence the learning process. When social learning occurs, it is hypothesized to result in measurable outcomes such as technical knowledge and skills, understanding of risks and benefits, self-efficacy, trust among participants, and engagement in collective action. Our results suggest that social learning occurred to an extent in both the Rio and Villa forestry committees and their extension agents. Members of the core social learning groups had better knowledge of CFM principles, learned more essential CFM skills, were more involved in the collective actions of timber monitoring and contract negotiations, and were more likely to discuss collective sales of Brazil nuts than non-committee members. In Villa, committee members were also more involved in creating the tree census, perceived more benefits from timber management, and expressed greater procedural satisfaction than non-members. The fact that committee members in Villa also expressed greater self-efficacy in collective Brazil nut marketing and a higher probability of engaging in it was more a result of prior relationships among Villa elite than the social learning project.

Membership in the core social learning group did not correlate to different perceptions of risks and benefits in either community, or increased self-efficacy or greater procedural satisfaction in Rio. The first is a testament to the limitations of these particular social learning projects in addressing debilitating internal and external barriers to collective action. The latter is explained by remembering that self-efficacy and procedural satisfaction were highly rated by all respondents from Rio, which may reflect the fact that learning extended beyond the core group and into the broader community due to greater opportunities for participation.

The primary factor preventing more extensive collective action and learning in Villa was elite capture of the social learning project and lack of trust between the elite and lower classes. This lack of trust is historical but exacerbated by the presence of an extension project that worked primarily with the elites and conducted most work outside the community. The only interpersonal trust described in Villa was among the four members of the committee. The majority of the rest of the community expressed mistrust in everyone, including their own family members. Rio had greater amounts of overall participation in decision-making and trust outside the core social learning group based on historical transparent actions of the communal leaders.

These trends of trust confirm the results of decades of common pool resource research (Ostrom 2010; Poteete *et al.* 2010). Trust is an essential component to being invited and willing to participate in communal activities, mutual learning, perceiving the benefits of communal management, and being satisfied with the entire project. In Rio and Villa, even the equitably distributed financial return from timber management was not significant enough to mediate the role of trust. In Villa, where trust did not initially exist outside the social learning group and was not clearly enhanced by the social learning project, most people were unsatisfied with the timber management project even though it provided income. In such situations, extension organizations may need to build trust in their organization and within the community if their efforts to promote collective action are to succeed. While it may be beyond the interests of many extension agents to address inter-communal trust, this example shows that not doing so may only further divide the community. When there was a foundation for trust, as in Rio, the particular style of social learning employed by these extension groups seemed to be effective. The similar results among committee members in both communities are evidence that this type of social learning project was at least partially successful in fostering trust, joint learning, agreement on collective action decisions, engagement in collective action for timber management, and interest in pursuing collective Brazil nut sales.

There are still critical limitations to social learning that includes only a core group of resource users. Even the extension NGO affiliated with Rio was disappointed in the division that working primarily with leaders can create within the community and discussed different models for interaction. This NGO was also concerned, however, that macro-institutional factors such as market chains that favored private companies over communal resource managers, repressive national forest management policies, and a

hostile national political environment were still not favorable for communal forest management. The director of the NGO believed community forestry extension projects had largely contributed to empowering the timber mills that purchase, cut, and remove timber from communal property. Private timber companies were profiting disproportionately from the contracts and were unchecked by national regulations.

Conclusions

The results of this study demonstrate that extension projects for communal resource management can incorporate aspects of social learning and that the results of social learning can include knowledge acquisition and generation, self-efficacy in communal actions, participation in communal activities, and satisfaction with the entire project. Moreover, specific characteristics of the social learning project may predict procedural satisfaction. These social learning outcomes are particularly beneficial in the context of CFM because they have been proven to enhance or create factors important for collective action. However, according to Poteete *et al.* (2010) external factors and historical internal factors play a large role in the effectiveness of social learning and resulting collective action; for example, in Rio and Villa, historical mistrust, national policies and pressures from cattle ranchers and large scale agriculture. Our results also demonstrate that extension projects do not always incorporate every characteristic hypothesized to be beneficial for social learning. Many efforts to use participative and integrative methods, for example, are hampered by maladapted institutions and social arrangements that are constrained by habitual practices and historical events that have affected trust (Berg 1993; Keen *et al.* 2005).

Nonetheless, applying at least some of the proposed methods appears to positively influence learning, action, and satisfaction. Extension agents can select from the range of methods to develop a learning context most appropriate for addressing specific micro- and macro-situational barriers to collective action. Many extension projects are constrained by staff training, project timelines, the socio-political environment, deeply engrained professional habits, and participant capacities. In a 2 to 5 years project cycle where extension agents must work with a variety of communities, it is particularly difficult to design methods to stimulate social learning specific to each community, especially in developing countries with unstable political structures. In this study, a significant initial emphasis was placed on building trust and developing technical skills in Rio and Villa.

This study was an initial attempt to produce quantitative results to test social learning hypotheses. The results corroborate many hypotheses about social learning and collective action, and the triangulated methods of qualitative and quantitative analysis seem adequate to the task. Future research will need to explore a greater diversity of social learning projects across more contexts before these results can be extrapolated outside Rio and Villa.

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