CHAPTER V

CONJOINT ANALYSIS OF COOPERATION AND CONSERVATION OF THE LOCAL COMMONS

a. Introduction

This chapter presents results derived from the survey collected at the same three villages where the field experiments were conducted for this study. Using the conjoint analysis technique, we have been able to study how the public and private benefits and costs of the conservation of a local commons may affect the household's willingness to cooperate in a project aimed at providing multiple products and services from the sustainable use of a local commons. Further, we have attempted to estimate an implicit economic value for some of the public good types of benefits, such as biodiversity conservation and water provision from such ecosystems.

In general the results support the argument that in average individuals are willing to contribute at least partially to the provision of a public good, despite the free-riding equilibrium prediction; not only did individuals show a willingness to cooperate and sacrifice income so that others even outside the community benefit, but they also showed a willingness to cooperate more when others do so as well. The individuals surveyed do manifest a positive social value for benefits such as the existence of a variety of species, or the improvement of the water provision for them and their neighbors even if their provision involves the reduction of personal income. We found that the respondents would be willing to contribute in cash and labor and to cooperate by refraining from extracting the local commons so that they and their community would benefit from conservation. Such willingness to cooperate however could be affected not only by the expected benefits and costs from the project but also by the existing and proposed institutional setting --namely, the type of manager involved and the level of cooperation by neighbors. The results show that among the state solutions the National Parks system was preferred, but they showed a significant positive marginal utility when the proposed manager was a community-based organization. Further, they would be more likely to cooperate if a greater fraction of their neighbors do comply and cooperate with the proposed conservation project.

Several implications can emerge from the results with regard to policy design and the involvement of communities in the solution of these dilemmas. However, the results also suggest that there are differences across the three villages that would imply the need for more customized projects according to the particular ecological, economic and institutional conditions prevailing. In the case of Colombia, such results would be highly compatible with the new decentralized institutional setting currently in place and arising from the new constitution of 1991 and its subsequent environmental legislation.

b. The local commons dilemma

The dilemma of the local commons arises from the group externality created when the optimization of resource extraction by individuals creates a socially inefficient level of extraction and lowers the possibilities of the ecosystem to provide multiple goods and services for current and future generations. Tropical ecosystems are

characterized by a high ecological diversity and fragility, but also by being able to provide multiple benefits for plant, animal and human species. Ecosystems provide food, fiber, and energy for species. They regulate natural processes such as water cycles, erosion control and nutrients recycling. And they provide non-use benefits to humans in recreational, spiritual and cultural values. As we move from material to non-material goods and services, the level of publicness in the their provision creates a dilemma for beneficiaries and state institutions interested in preserving these ecosystems. If institutions do not correct for the externalities arising from self-interest, these ecosystems may be threatened, creating economic social losses[1].

i. Three local commons providing multiple products and services

The three case studies selected for the field work are typical cases of local ecosystems that provide multiple benefits in products and services for the community and even for others outside the village. In all three locations chosen for the study (Encino, Nuqui and Quindio) what we will denote as the "local commons"[2] (LC) corresponds to an area of natural vegetation adjacent to the village and from which villagers extract with certain regularity resources for food, fiber and energy uses. These three areas, according to experts, host significant levels of biodiversity and are in fact within or next to areas under the national park system. Further, the ecological areas chosen include certain ecosystemic functions such as hydrological regulation, erosion control and nutrient recycling at different levels. The *de jure* property rights and management for the three local commons areas may vary but the *de facto* situation is basically equivalent.

In the case of Encino, located in the eastern Andean region, our LC was a natural area of around 400 hectares under tropical cloud forests which lies between the village and a natural national park. Legally, the area was recently purchased by a non-profit organization for conservation purposes, but is seen regularly as part of the natural park and no clear boundaries are defined or enforced. Besides, the foundation barely enforces the property rights via exclusion in the same way that the national government in the region refrains from excluding users from the park, unless there are significantly damaging activities. Most of the extraction involves firewood, hunting, medicinal plants and small sporadic logging for household purposes. Also, an important number of water springs are located or go through this area, and most villagers are conscious of the relation between vegetation and water availability.

In the second case located in the Pacific coast, Nuqui, the tropical rain area is composed of mangrove forest adjacent to the village and from which they extract firewood, household use logging and fishing for self-consumption of mollusks. Most villagers recognize the importance of maintaining the mangrove forest for controlling

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[1] In the first chapter of this dissertation it has been shown how individual rationality in the absence of institutional arrangements that coordinate actions creates a socially inefficient outcome.

[2] The label of *local commons* or its equivalent *common-pool resource* for these areas corresponds to the physical conditions and the *de facto* institutional setting around the current use and extraction of resources from these natural areas. This creates the basic conditions of partial excludability (difficulty in excluding individuals from extracting resources, and subtractability or nonrivalry in which resources once extracted are not available for others), which makes this neither a pure private or pure public goods provision problem.

erosion in the boundaries of the village and its role in providing nutrients for the fishing population and diversity. Legally the mangrove area considered is under the national state property and in some instances land entitlement processes are under way for some portions. But once again such property rights are weakly enforced and basically everyone in Nuqui has access to the resources if it involves small scale and mostly household consumption uses.

In our third case, Quindio, we chose a natural area called "El Roble", located between two municipalities (Circasia and Filandia) in the central Andean coffee region of Quindio. This area of about 300 hectares of cloud forest is owned by the regional state environmental agency and by some private owners although extraction of firewood, small logging, hunting and fibers is allowed. This area is part of the upper watershed that naturally regulates the water sources for irrigation and human consumption in much of the region and the surveyed households acknowledged its importance for hydrological purposes.

To sum up, the population from which the subjects for these experiments were drawn is of rural households that live in areas that depend on local forests for wood, fiber and food products. In each location, exploitation of local forests affects another aspect of their livelihoods adversely: water quality in Encino and Quindio, and fish populations in Nuqui. The survey questionnaire asked respondents to mention three most important reasons or benefits that justify conserving this area. In most cases people responded with a combination of direct use products they extract and non-consumptive benefits they perceive ranging from it being a water source to spiritual or cultural values derived from the commons. Not all respondents knew exactly who the legal owner and manager of the area was, and in some cases, notably in Nuqui, a significant portion of them answered that it was the community who managed or even owned the LC.

To give a better idea of the ecological, economic and institutional features of the three cases selected we summarized a set of variables from the survey data and presented their means in the Appendix N. Some of them show differences across the villages and give a better idea of the perceptions and composition of the populations from these samples.

The multiplicity of products and services recognized by people surveyed in our three cases brings us to the very nature of the collective action dilemma involved in biodiversity conservation, and to the methodological design of the conjoint analysis instrument. When benefits from a project are public in the sense that is difficult to exclude individuals that do not contribute to them, the project may not be undertaken due to free-riding incentives. And when those benefits may also affect individuals who would be very costly to contract with, perhaps because they live outside the community or, it may be impossible as in the case where they are not born yet, the risk of a socially inefficient level of conservation increases. In the case of products extracted from the LC, exclusion and extraction level controls are more feasible because these goods are private, but in the case of other services like species hosting, nutrient or water regulation, coordination of individual actions and social efficiency become more challenging. The extreme level of pure public benefits arises for instance with the existence value of species or the natural landscape. In this case it is impossible to exclude beneficiaries and contributions to a project of conservation might be less likely. These types of benefits compose a "total economic value" derived from conservation of natural capital which is usually classified in direct, indirect and option values. The following table presents these with the most frequent examples mentioned by

respondents for the three villages.

Table 5.1. Examples of benefits from the three Local Commons (Extracted from survey responses)

Categories			Types of economic benefits	Encino (Examples)	Nuqui (Examples)	Quindio (Examples)
Total Economic Value	Use Value	Direct Use Value	Direct use for consumption or production	-Firewood and timber -Medicinal plants -Sporadic hunting and logging -Oxigen, breathing	-Fishing and other food sources -Firewood -Logging	-Fibers for handcrafts -Firewood -Oxigen
		Indirect Use Value	Indirect benefits (Use without consumption)	-Water conservation -Erosion control -Habitat for animals -Ecotourism	-Source of food for fish and mollusks -Erosion control -Habitat for animals -Ecotourism	-Water regulation -Erosion control -Habitat for animals -Recreation
	Non Use Value	Option Value[3]	Potential future benefits already identified	-Andean Biodiversity -Future ecotourism	-Mangroves biodiversity	-Cloud forest diversity
		Existence Value	Benefits from mere ecosystems existence	-A regional treasure (pride)		-Landscape, tradition
		Bequest Value	Future potential benefits still not identified			

Notice that as we go down the table it is more difficult to exclude people from benefitting from the conservation of the local commons. On the other hand, as we go up in the table the problem of subtractibility increases, i.e. the goods are less public and more private. This has the problem that as the extraction level increases for direct use benefits, the capacity of the LC to provide the less private (non-use value) goods or services decreases, thus affecting social welfare.

ii. The zero-contribution prediction and the problem of free-riding

[3] Different authors locate the "option value" as either use or non-use values. For the current generations, the option value is a non-use value, but it represents potential future use values for future generations, in the case of accounting for the present value of benefits perceived by future generations.

The tragedy of the commons predicts that in the absence of clearly defined individual property rights and effective institutions to enforce them, the publicness of the benefits provided by these local ecosystems would discourage these villagers from voluntarily refraining from over-extracting resources and limiting themselves to socially efficient levels. In the same lines this group externality would also discourage them from voluntarily contributing in kind, labor or cash to a project aimed at providing benefits such as biodiversity conservation or better water availability. The incentives to free-ride are clear. In a self-regarding population the equilibrium would bring contributions (cooperation) to a socially inefficient level with extraction at unsustainable rates.

This creates the first local commons dilemma discussed in the first chapter. However, we mentioned a second dilemma, that of the global externalities derived from biodiversity. The incentives not to cooperate in conservation are as clear when considering the potential beneficiaries of biodiversity conservation outside these three villages. Their difficulty in intervening in the local problem, but their interest because of the economic losses they would suffer if biodiversity is not preserved, creates a further challenge. They also face the incentive to free-ride due to the publicness in the provision of the public good. Individuals outside could benefit even more by not contributing, for instance with donations to tropical rain forest initiatives, and yet see that such initiatives reducing the pressure on such ecosystems increase their option and bequest values shown in the table above.

As discussed in the introduction solving these local and global dilemmas is a great challenge to conservation of biodiversity and local commons in general. Further, the solution of the global dilemma requires the local one to be solved given the interdependence of the multiple products and services expressed in the use and non-use values. Assuming that privatization is unnfeasible due to problems of ecological indivisibility and high transaction costs, we can look at two other forms of institutions: state and community governance.

In the more common case of the state governance, one can define a set of rules that exclude or regulate users in their levels and types of extraction of resources from the local commons. Such solution could also involve mandating users or society in general to contribute through a tax for the implementation of a conservation project that benefits all in the form of a public good[4]. In either case society faces complex issues when one introduces the problems of enforcement, compliance and monitoring involved in environmental regulation. Problems of rent seeking, moral hazard, principal-agent relationships and information costs in general generate social losses and impose complications. Further, political conflicts or fiscal constraints in developing countries often inhibit the possibility of intervening and solving the collective action dilemma in the use of local commons through command and control or economic incentives.

In the case of community governance forms, there is evidence that people can organize projects that face the collective action dilemma despite the material incentives not to do so. The literature in common-pool resource management is replete with examples in which groups have been able to devise and sustain forms of self-regulation in the use of a resource that suffers from problems of excludability and nonrivalry

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[4] The second chapter on the problems of regulating the use of local commons and local environmental control discusses in more detail other effects that external intervention may create due to incomplete information and transaction costs.

(Ostrom, 1990; Ostrom, Gardner and Walker, 1994). The other chapters in this dissertation based on the field experiments conducted in these three villages discuss in detail such literature and the evidence that cooperation can emerge endogenously within groups. This does not imply that non-cooperation can result as a result of individuals free-riding on the provision of the public good by others.

In either case the state or community solutions bring problems of transaction costs arising from the private information that users or regulators have and the externality involved in extraction.

c. Are people willing to cooperate in conservation when there are incentives not to?

A project of conservation of a LC therefore involves several components. One is the type of manager of the LC who would enforce the set of rules for a socially optimal level of use by individuals. A second component concerns the types of benefits that users are interested in receiving from both extraction (use values) and conservation (non-use values). A third involves the nature of the private costs, including opportunity costs, from the standpoint of the users. A final component concers the aggregate level of compliance and cooperation by the rest of the individuals necessary for the success of the conservation project. The central question of our conjoint exercise is therefore to study the willingness to cooperate by an individual and how it is affected by different levels or types of ecological, economic and institutional factors governing the local commons.

d. Why the Conjoint Analysis method

Through the conjoint approach we can study individuals' preferences regarding a "product" or a "project" that involves a bundle of characteristics and how these characteristics (attributes) each affect the decision. By varying the levels of the attributes and constructing a set of scenarios or projects for the respondent to react to, we can study the preferences towards the project and the marginal change from each attribute. Further, we can study the trade-offs among the attributes and eventually estimate implicit prices for some of the attributes that do not have a market price. In our case the attributes of our conservation project involve the benefits and costs as well as the institutional conditions for its implementation.

We see at least two major advantages of the conjoint technique when studying the case of local commons conservation programs in developing countries. First it may overcome some of the methodological concerns in the more frequently used method of contingent valuation (See Stevens et.al., 1999), that of strategic biases in the response, and particularly the problem of income constraints in poor regions to elicit a willingness to pay for receiving environmental benefits. Secondly, by introducing the concept of a 'bundle' of attributes we can study how the different types of benefits (use, non-use, option, existence) affect the preferences of an individual towards a conservation project, and also study her preferences regarding the institutional setting including the best organizational solution and the collective action problem of aggregate cooperation by neighbors. However, there remains a controversy between Contingent and Conjoint valuation techniques as they seem to yield statistically different estimates of values for people's willingness to pay for an environmental benefit.

The conjoint technique is widely used in marketing studies of private goods, and

more recently in the study of public goods problems such as environmental and natural resource problems (Mackenzie, 1990, 1993; Stevens et.al, 1999). Unfortunately, this method seems not to have been applied in developing countries settings where it could be highly promising. For instance, using the contingent method in societies with low levels of integration to markets, low cash income and only partially monetized, the hypothetical question of a willingness to pay in cash could suffer from strategic bias[5].

We adapted the conjoint method to our study in the following way. First, we confront the respondent with several options or alternatives, each of which presents a set of attributes. The attributes for each alternative reflect the benefits and costs of each alternative. The benefits usually are based on attributes that the markets do not reflect such as environmental quality or ecological conditions of a species or an ecosystem and are of a different type from private goods to public ones. The cost attributes reflects the level of income that would be given up by the respondent in compensation for the benefits described by the attributes. Such income or welfare is represented not only by a monetary contribution but also by the opportunity cost of reducing the extraction of the resource, and by a contribution in unpaid labor for the project. The respondents react to different scenarios of projects in terms of a subjective ranking, in a scale of 1 to 10. The scenarios constructed also included different types of managers and owners for the LC, and an assumption about the fraction of neighbors contributing to each scenario.

In this way, the individual will rank and rate a set of projects according to her implicit values and marginal rates of substitution among the ecological benefits, the institutional conditions (manager, neighbors' cooperation) and the individual reduction in income from the opportunity costs, labor and cash contributions.

A preferences model. In its basic formulation the conjoint analysis uses a simple preferences model where i's utility $V(.)$ is derived from N attributes of the product, project or bundle (Mackenzie, 1990, 1993). Implementing each project involves a private cost C_i for i, and the N attributes involve the benefits which might include public good externalities. Thus, $V_i = V(X_{1i}, X_{2i}, X_{3i}..., C_i)$, where, X_{ni} represents the level of the n^{th} attribute. By varying the levels of X and C and gathering the preferences of a large sample of individuals who face different combinations of these costs and attributes we can use regression analysis to estimate the marginal effects of these attributes on the level of acceptance for individuals. Each estimated coefficient then reflects the marginal utility of a unit change in each of attributes. And by setting $dV=0$, we can obtain an equilibrium condition where the average individual is indifferent, that is where the marginal rate of substitution between any two attributes would be $(dV/dX_j)/(dV/dX_k)$. Further, we can estimate also the marginal rate of substitution between a unit change in one attribute and a unit change in cost yielding a proxy for the willingness to pay for a unit increase in one of the, say, environmental attributes, by calculating the ratio - $(dVd/X_j)/(dV/dC_i)$.

e. The survey instrument and field work

After pre-testing a survey with individuals from the same villages a final

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[5] For a contingent valuation study where non-monetary units were used to estimate economic values for environmental goods see Shyamsundar and Kramer (1996) where they estimated the willingness to accept compensation (in bags of rice) for the opportunity costs of not using land recently transferred to a national park conservation regime in Madagascar.

instrument emerged and was applied to 200 respondents (household members) in each of the three villages. Three field practitioners were trained and hired for such purpose. They were members of these communities and had a proportionally higher level of education and experience with natural resource issues in their localities. The survey was conducted during the second semester of 1998 and January of 1999. The selection of the two hundred households in each of the villages was made as random as possible, but assuring that enough households were interviewed from different levels of farm size, different closeness to the forested area and types of economic activity. Most households were rural, although some lived in the small urban center of the village.

i. The interview

The interview lasted on average less than one hour and was conducted to an adult member of the household. The complete interview had five sections, as follows (the complete survey questionnaire is included in Appendix V and translated in Appendix W):

Introduction: The surveyor reads an introduction and gathers basic information about date, time and place of the interview.

Part A: Questions about the respondents' perceptions about their "local commons" for that village, which would be the same for all 200 respondents. It includes questions about her views of its ecological importance, their dependence and state of natural resource uses and problems.

Part B: In this section the surveyor reveals a basic commons dilemma to the respondent and proceeds to present seven cards (projects), starting with the Status Quo (SQ), which presented seven different scenarios made of different values for attributes regarding a proposed manager, benefits in terms of biodiversity and water conservation and costs in terms of reduction of extraction, labor and cash contribution as well as an assumed fraction of neighbors agreeing and contributing to the project. The respondent would then rate from 1 to 10 the seven cards including the Status Quo ("do nothing") scenario.

Part C: Additional information about the household such as demographic and economic characteristics of the family.

Part D: Questions about the village social capital, the institutional setting of the village, membership in organizations, neighbors' cooperation, and actual labor contributions to projects.

ii. The conjoint cards

In a conjoint analysis the researcher creates "cards" that represent scenarios or "projects" that the respondent reacts to. Each card shows a set of attributes that represent the benefits and costs as well other characteristics for which the respondent may have some preferences. The respondent treats the card as a bundle and compares it to other cards. By comparing the trade-offs across them the respondent is able to rank or rate them and manifest her preferences. When aggregating the sample of respondents

one can then infer some kind of average marginal values for the attributes of the cards.

The cards presented in Part B of the interview as the scenarios or projects were also pre-tested with different groups prior to the field work to improve the comprehension by respondents who were in general people with very basic education, in some cases having difficulty in reading and writing. Both the survey and the cards exercise were read entirely by the surveyor. Visual aids were included in the cards such as drawings representing the types of benefits and costs and the magnitude of the level of the attribute. Colors were also used, green for benefits, and red for costs or sacrifices. Each card (See Appendix X) was made of seven rows or frames representing the attributes:

i) the proposed manager: state, community and private ones;
ii) the level of expected biodiversity after a number of years;
iii) the level of expected water after the same number of years;
iv) the allowed level of resource extraction for the household;
v) the required contribution in labor contribution to the project for the first year;
vi) the required cash contribution for the first year of the project; and
vii) the assumed fraction of cooperating neighbors that would accept and contribute to such project.

To make the scenarios somehow realistic we assumed that the changes in the ecological attributes (more water, biodiversity preserved) would be perceived in about 7 years while the labor and cash costs would have to be contributed during the first year of implementation of the project, and the opportunity cost of reducing extraction from the start of the project on.

Each surveyor had for the field work a complete set of 33 cards that were generated through an orthogonal design procedure in the SPSS-Conjoint module. Such an orthogonal design allows for selecting a small number of bundles among the large number of possible permutations of attributes and values considered in a conjoint study[6]. By eliminating cards that are redundant or collinear with others, the orthogonal design generates a small subset of cards that guarantee enough variation and that have all the possible values for all the attributes. By randomly selecting for each interview a subset of six cards we simplified further the task for the respondent and with a sample of 200 people we guaranteed that each of the 32 cards and the status quo case were selected and rated with sufficient frequency.

In the Appendix O we have included the entire set of 33 cards with their attributes, values and average ratings given by the three samples, sorted by the pooled average. Also in Appendix X we include a sample of the original cards as presented to the respondents. Notice two interesting issues from the table in Appendix O. First, the average ratings go from little over three points (Card # 26) to over nine points (Card #28). Also notice that the status quo card was not in average placed last in the rankings - except for Encino- where the vast majority rated it with very low points. However for Nuqui and Quindio, the scenario of doing nothing and leave things as they are was ranked respectively above 25 and 13 of the cards. This first surprising finding alerted us on certain issues for the analysis that will be discussed later and have to do with

[6] In our case the starting number of possible combinations would be (6 managers x 3 levels of biodiversity x 3 levels of water x 3 levels of resource extraction x 3 levels of labor x 3 levels of cash contribution x 2 levels of neighbors cooperation) = 2,916 permutations.

variations across and within villages with regard to their perceptions of the ecological and institutional settings around the conservation of the local commons. However it is interesting to note that there is a relative consistency in the average ratings given to the cards as shown in the two figures in Appendix P where we graph in card number order the 33 cards and the average rating for each of the villages. Now let us turn to the analysis of the data gathered for the 600 households surveyed.

f. The estimated model

The objective is to explain through regression analysis the variation in ratings as a function of the attributes of the cards. In other words measure the individuals' willingness to cooperate as a function of the benefits and costs of a project and the institutional setting around it. If the estimation produces statistically strong results we could then go further and explore possible economic values or implicit prices for some of the non-market attributes of the project such as biodiversity conservation and water availability.

Each of the cards represents a scenario with attributes representing the set of benefits and costs for the project and the institutional conditions of governance and level of cooperation. Each respondent rated each of seven cards including the SQ card. We will treat then each of the card-rating set as one observation yielding a potential number of 4,200 observations out of which incomplete and inconsistent surveys were purged. By estimating the model for each of the villages and pooling the samples we can also study if whether there are structural differences in the preferences across the three groups or in their marginal values of the attributes. The model to be estimated has the following general form:

RATING = f(Manager, Biodiversity, Water, Individual cost, Neighbors' cooperation), where, Individual cost = Cash contribution + Labor contribution at market wages + Opportunity cost of reducing extraction from the LC.

i. Expected signs for the attributes

MANAGER: It would be difficult to predict the signs for the types of managers considered in the cards. Maybe the significance of the coefficients would be associated with the presence or absence of each type of manager in the current situation and the feelings of each individual towards each governing institution.

BIODIVERSITY: Although the positive marginal utility of having more diversity of plants and animals seems clear, some may argue that the pure publicness of such benefits may cause a rather weak or insignificant positive coefficient. Given that it is the least excludable and non-rival of the goods and services, it might create a greater likelihood of free-riding than other benefits involved such as water.

WATER: Water availability involves a higher level of private benefits to the user and more directly affects the welfare of the household. It still involves positive externalities and may involve public goods problems, but we should expect a positive and significant sign, i.e. a marginal change in the available water should increase the rating given by the respondent to that project.

EXTRACTION: In this case we should expect a negative sign because the projects involve a required reduction in the level of extraction of resources by the household in order to produce the ecological benefits above. In a sense, however, this

could reflect the value the users put into the direct uses they make of the LC.

LABOR, CASH: As part of the private costs of the project, greater labor or cash contributions should reduce the rating, other things held constant.

COOPERATION: Two contrasting hypotheses can be formulated. From the free-riding (self-regarding preferences model) prediction in public goods dilemmas, we could expect a negative sign because the greater fraction of neighbors contributing to the project would guarantee its provision and therefore incurring private costs would not be a rational choice. However, the newer approaches of rationality, where reciprocity and other-regarding preferences enter into play, would expect a positive sign.

Table 5.2 shows the definitions for the variables used in the econometric estimation of the models that follow. Their descriptive statistics for the pooled and separated samples are in Appendix U.

ii. The values for attributes in the Status Quo case

Notice in Appendix O that the Status Quo card also involves values for these variables. In our case, however we used the values that each respondent perceived as more accurate about the state of these variables in the future in the same way as the other cards. For the manager we used the organization they believed was currently in charge of the LC management. For the biodiversity and water variables we used their prediction of what the trend was if nothing different was done. In the case of extraction change and cash contribution we can assume zero values and in the case of labor, we used their contributions during the last year. For cooperation levels we used their perceived level of cooperation among neighbors.

Table 5.2. Variables description for the estimated conjoint model.

Description	Variable	Calculation
Dependent variable:	RATING	-[from card] Directly from respondents' answers
Avg. rating for 6 cards	RATIAVG	-Average for the rating of the 6 cards shown to the respondent
1 if National Manager	MAN_NAL	-[from card] Dummy variable from the card's manager
1 if Regional Manager	MAN_REG	" "
1 if Municipal Manager	MAN_MUN	" "
1 if Community Management	MAN_COM	" "
1 if NGO Management	MAN_ONG	" "
% of biodiversity conservation	BIOCONS	-[from card] % of variety of species preserved in 7 years with the project.
% increase in water (reduction of days with no water)	WATGAIN	-[from card] % of improvement on water availability in the household thanks to the project.
$ total cost of alternative (cash, labor and reduction in extraction)	TOTACOST	-Economic cost of project adding cash contribution, labor contribution at local minimum wage rates, and opportunity cost of non extracted resources valued at local market prices.
% of neighbors agreeing	COOPERA	-[from card] assumed fraction of neighbors that would contribute to the project.
% reduction in current extraction of resources	EXTRACT	-[from card] % reduction in extraaction of resources from current extraction.
Labor contribution in days of work/year	LABOR	-Days of unpaid labor contributed during the first year of the project.
Cash contribution	MONEY	-Cash contributed during the first year of the

during first year ($thousand pesos)		project.

We estimated several models according to this structure. Each of them was estimated for the pooled sample of the three villages and individually. Also we estimated the models with and without the sub-sample of ratings and attributes for the SQ cards. The models estimated are shown in equations [5.1 to 5.4]:

Model 1.1. Ratings model; using Cards (1-32); excluding SQ cards; Pooled and by Village:

RATING = f (RATIAVG, MAN_NAL, REG, MUN, COM, ONG, BIOCONS, WATGAIN, TOTACOST, COOPERA). [5.1]

Model 1.2. Ratings model; using SQ cards only; Pooled and by Village:

RATING = f (RATIAVG, MAN_NAL, REG, MUN, COM, ONG, BIOCONS, WATGAIN, TOTACOST, COOPERA). [5.2]

Model 1.3. Ratings model; using Cards (1-32) and SQ cards; Pooled and by Village:

RATING = f (RATIAVG, MAN_NAL, REG, MUN, COM, ONG, BIOCONS, WATGAIN, TOTACOST, COOPERA). [5.3]

Model 2.1. Same Model 1.1; separating costs components:

RATING = f (RATIAVG, MAN_NAL, REG, MUN, COM, ONG, BIOCONS, WATGAIN, EXTRACT, LABOR, MONEY, COOPERA). [5.4]

The OLS results are shown in the Appendices Q, R, S, T. In each table there are the estimated coefficients and their respective p-values below for significance tests. To facilitate comparisons across villages the models are shown as vertical vectors.

g. OLS results, interpretation and analysis

In general all estimated models show a level of performance that supports the hypothesis that such linear combination of attributes explains the variation in the rating (See the F-Values for each of the models at the bottom of the tables in Appendix Q, R, S, T. In all cases except for model 1.2 in Encino[7] we reject the joint hypothesis that all coefficients are zero. The sample size varies across villages and models because of missing values and unreliable observations that were omitted in each case. Recall that for each village 200 respondents gave ratings to 6 cards and one status quo card yielding a potential sample size of 1,200, 200, and 1,400 observations for models 1.1, 1.2 and 1.3 respectively in each village.

The signs for the key benefits and costs of the model are as expected and statistically significant for all of the estimated models in 1.1 and 1.3. The case of the Status Quo data did not show the same significance and sometimes the signs were not as expected and will be subject of a special section below because of its importance.

We performed Chow tests for structural changes across the three villages and in

[7] We explain this because of the very small variation in RATINGs given by respondents to the status quo card in Encino.

all cases we found that there are enough statistical differences across villages for some of the coefficients and that pooling the three samples would not be recommended statistically. Nevertheless we include such estimation for analysis and comparisons. In any case for the three villages the signs are still consistent and the structural changes are mainly on the marginal effects of each independent variable on RATING.

We have also included RATIAVG as an independent variable for performance improvement purposes, although eliminating it only reduces model efficiency without causing bias or efficiency losses in the individual estimators. The logical reason behind this is that respondents may focus on a certain portion of the (1 to 10) scale for their ratings and therefore we can reduce the error estimation by also accounting for such factors. In some of the pooled models we included dummy variables for two of the villages which would account also for some structural differences in the samples. All three of these variables were significant in the models and help the estimation efficiency.

i. Public benefits, private costs and institutional settings

The interpretation of the estimated results of the individual analysis can lead to some answers to the original questions about the dilemma of conservation of LCs that provide multiple goods and services and the institutional setting for promoting cooperation within a community. The scenarios we have designed allow us to respond to the original questions on whether individuals' preferences towards a project are affected by the type of manager proposed, the level of compliance or cooperation by others in the community, the level of direct, indirect and option value benefits from conservation, and the individual private costs involved in its implementation.

The positive and significant signs for the coefficients of BIOCONS and WATCONS (See Appendix Q) confirm that people do show positive marginal utilities for increases in the percentage of biodiversity preserved after 7 years, and for a percentage reduction in the number of days without water at the household, also after 7 years, despite the fact that the projects involve short-term reductions in income to obtain long-run public goods benefits. In this sense not only do people value the benefits of conservation including the less tangible like the variety of species, but they are also willing to contribute personally even though the benefits can be dispersed in the population.

In the case of individual or private costs, we can use the estimation results to study the costs side value in monetary units either as a whole (See Appendix Q) or separating the marginal utilities for extraction opportunity costs, labor opportunity costs and cash contributions (See Appendix T). In both cases all coefficients show negative signs and significance. The statistical robustness of these results and those of the ecological benefits will allow us to estimate the implicit prices for water and biodiversity with some confidence.

Finally we have the institutional setting which as we discussed earlier, involves a governance structure that can be state, market or communally based, and a level of cooperation or compliance necessary for avoiding the social costs of a failing collective action. We interpret from the results that individuals do care about the best manager for a conservation manager. The coefficients for the dummy variables (MAN_***), in the

pooled model, show how individuals rule out some options and elicit stronger preferences in favor of the national parks system and a community organization. For each of the village models these preferences vary slightly. These preferences may have to do with the current views about the context their LC is involved in either as a *de facto* or a *de jure* situation[8]. The National Parks systems dominates in sign and coefficient size over other state solutions and across models. This may be caused in part by the comparatively higher presence in conservation matters of the officers of the Ministry of Environment in these three villages as compared to other regional and local authorities. The regional and municipal solutions do not show positive signs but the significance level is poor and therefore it could not be argued that the respondents were in fact against them. It should be noted that although the new institutional system governing the environment gives resources and responsibilities to these two lower levels the implementation is still poor. Further, the responsibilities for conservation of forested areas with biodiversity importance remain under the national level which has a longer presence in these regions.

More interesting however, is the case of non-state solutions such as the community and a non-profit manager for the projects. The coefficient for MAN_COM showed positive and significant for most of the estimations, and further, its magnitude is in some cases significantly higher than the other governance solutions. From an orthodox position this governance structure should be less preferred as it creates higher risks for problems of free-riding and non-compliance than the market or the state, where the enforcement of property rights should be more feasible and given the public goods incentives involved. And yet the results suggest that people view this solution as attractive.

This result can be complemented with the results for the coefficient for COOPERA. Contrary to the free-riding hypothesis and consistent with reciprocity arguments (Fehr and Tyran, 1996; Hoffman, McCabe and Smith, 1998), people seem to give higher ratings to projects where they perceive that a larger number of neighbors would contribute, comply or cooperate with the project, other things held constant. Some of the estimated models do not show enough significance, but, for the ones that did, the signs were always positive. Given that some of the coefficients were not significant, we explored further this subject as it is at the core of solving these types of dilemmas. In the survey (Question 14), we asked the number of unpaid days of labor that the household contributed in the last year for natural resources conservation in the village. And we also surveyed the individuals' perception of the fraction of cooperators among her neighbors (Question 64). A simple regression of the former as a function of the estimated fraction of cooperators, the household's wealth, and the number of community organizations the household belongs to, yields the following OLS equation with an adjusted R^2 of 0.095, and (p-values) below the estimated coefficients (Equation 5.5]:

Days Contributed	= 2.23	+ 10.477(%Cooperators) (0.0001)	- 0.039($Wealth) (0.0351)	+ 4.558(No.Orgs.Member) (0.0001)

[5.5]

[8] For instance, Nuqui presents a much higher marginal utility for a community manager and it is precisely in Nuqui where people showed the higher percentage of respondents believing that the current manager and owner of the local commons was the "community". However, the *de jure* owner and regulator of these mangroves in the national state.

People often contribute with labor to community projects, but days contributed increases for those who feel their neighbors also cooperate, as well as for those who are members of one or more community organizations which in fact are the key devices to allocate this willingness to cooperate. Further, wealth does not seem to constrain this form of cooperation and in fact in may have a negative impact[9].

Together the coefficients for MAN_COM and COOPERA suggest that not only are people willing to pay for conservation that provides benefits to them and others, but that they are more willing to do it if with others, and not necessarily under the guidance or the hand of the state. Communities do solve collective action dilemmas like these as it has been reported in the literature by Ostrom (1990; Ostrom e.t.al. 1994), and the field and experimental evidence supports the argument that they can enforce rules of use and achieve conservation, especially if the group can bring a sufficiently high fraction of cooperators.

The particular case of Nuqui can give an idea of the argument in favor of community governance. Notice the highly significant and proportionally higher coefficients for MAN_COM in the Nuqui models. This result can be complemented with other information from the survey where we asked the respondents to say who they believed was the current owner and current manager for the LC area under discussion. Recall that in the three cases the *de jure* property rights are for the state in most cases and for a non-profit nationally based in Encino. And for Nuqui, the mangroves area is supposed to be state owned and controlled. And in Nuqui we found that 58.5% beleived the owner was "*la comunidad*" and also found that 19.6% believed the area was managed by "*una organizacion de la comunidad*"[10]. Meanwhile only one respondent each in Encino and Quindio believed that the community was the owner, and none answered that a community organization was the current manager[11].

ii. The implicit prices for pure and public goods (biodiversity and water)

Another of the key potentials of the conjoint method besides studying how the attributes of the project affect the preferences of the average respondent, is the possibility of estimating the trade-offs between two attributes, which in this case would be an ecological benefit and an economic cost expressed in monetary units, yielding therefore an implicit price for one unit increase in the ecological benefit attribute. Fortunately both ecological benefits (biodiversity and water) and economic costs coefficients were found strongly significant for the pooled and for the separated models

[9] Chapters III and IV discuss in more detail how wealth may affect the way people cooperate in collective action dilemmas. In those chapters it was shown that in several instances wealth induces more individually oriented behavior in groups because of income less dependent on cooperation of others.

[10] The other options they were given were the national government, the regional environmental authority, the municipal government, a non-profit foundation, a particular individual.

[11] During the field experiments we conducted an anonymous ex-post survey to the participants and very similar results emerged when asked about who they believed was the owner and the manager of the forest from where they extracted their firewood, food and fibers.

for the three villages[12].

By dividing the coefficient of each of the variables representing the ecological benefits by the total cost variable which adds the economic private costs to the respondent (reduction in extraction, labor contribution and cash), we estimate such implicit values. The logic of this exercise (Mackenzie, 1990, 1993) is that using the estimated equation and setting the left hand side equal to zero we can solve for the price of the attribute in question, meaning that at equilibrium the marginal rate of substitution between the income and the attribute can reflect the implicit prices the individual uses for the intrinsic valuation of the trade-off at indifference. The following table shows the calculated implicit prices for the biodiversity and water components, and for the pooled and separated models. The negative results in all cases show that these would be the prices they would pay or sacrifice to obtain a 1% increase in each of the ecological benefits.

Table 5.3. Implicit prices for biodiversity and water benefits.

From model 1.1: Ratings model, Cards (1-32)				
	Pooled	**ENCINO**	**NUQUI**	**QUINDIO**
Implicit price ($pesos) for a 1% increase in BIODIVERSITY	-$342,531	-$19,469	-$866,417	-$48,100
Implicit price ($pesos) for a 1% increase in WATER	-$32,549	-$2,231	-$100,353	-$1,544
Note: Exhange rate (1998): $1,350 pesos/1$US				

The first element to notice is that the implicit prices vary across the three villages, but aspecially from the standpoint of Nuqui. One the plausible explanations is that the ecological and economic context is different, i.e. that the start point or status quo from which the respondent departs to evaluate each proposed project is different across villages. Such status quo can be in terms of the way they perceive the natural capital currently existing, or the level of dependence of each household on extracting resources and deriving benefits from the LC. For instance in Nuqui where the implicit price is quite higher, we found the highest levels of economic dependence on extracting the LC and the higher average estimated economic value of resources extracted (See Appendix N.). The implicit prices come from dividing the coefficient of the ecological variables over the coefficient of the total cost variable, and in the case of Nuqui both the denominator and numerator are significantly higher and lower respectively than the other villages. However, we can see in Appendix T where we estimate the model with the cost components separated that the coefficients for EXTRACT and LABOR are quite similar than in Encino and Quindio, but the marginal reduction in RATING because of the MONEY contribution is much smaller in Nuqui.

Furthermore it was in Nuqui that people expressed more eloquently the importance of maintaining the biodiversity of the mangroves because it was key to

[12] The only exception is the water coefficient for the Quindio case which although still positive was found not significant. We may attribute this to the fact that this region suffers the least from lack of water and either the independent variable had less variation than in the other cases, or the marginal value for this benefit is not as important as it is less scarce.

maintaining the ecological balance of the fishing population and the forest[13]. If we consider that the average annual resources extracted to have a significantly higher market in Nuqui because of their fishing activity in the mangroves, the higher implicit prices may have a logical support.

iii. The Status Quo issue

The possibility that the attributes of the "Status Quo" (SQ) situation is different across villages and even within villages imposes some interesting challenges to the application of the conjoint method. The conjoint analysis uses the SQ card so that individuals have a realistic point of reference to which they compare the other hypothetical options with different attribute values. However, not all people use firewood, not all believe the national government is the manager of a forested area, and not all face the same lack of water during a year. Therefore we attempted to have a SQ card that allowed each respondent to think of her status quo. We recorded such information through questions 9 through 14 among others. If such is the case that individuals perceive the same local commons in different ways individually, the rating they would give to the SQ card would vary significantly.

The three following bar diagrams (Figures 5.1, 5.2, 5.3) show the distributions of the answers about the respondents' prediction about the state of biodiversity, water, and available resources in seven years -the time span for the projects also- if nothing is changed from the current state, trends and institutional setting. In the first figure the horizontal axis represents what they believed will be the fraction of remaining variety of species after the period of time. In the second one, the axis represents the predicted change in water availability from the standpoint of their current situation. And the last figure's horizontal axis represents the predicted fraction of resources that will be available after the seven years. There are differences across the villages but more importantly the picture is far from being a pessimistic one regarding the possibility of conservation from the standpoint of the respondents. This was in fact elicited in the ratings given to the Status Quo cards, except for Encino where most respondents gave it a very low rating. However, these figures do not suggest that people perceive their future comparably less promising in terms of conservation of resources in case nothing was to be done, and was expressed by higher ratings to a substantial number of cards.

[13] Based on open answers in question 8 of the survey questionnaire.

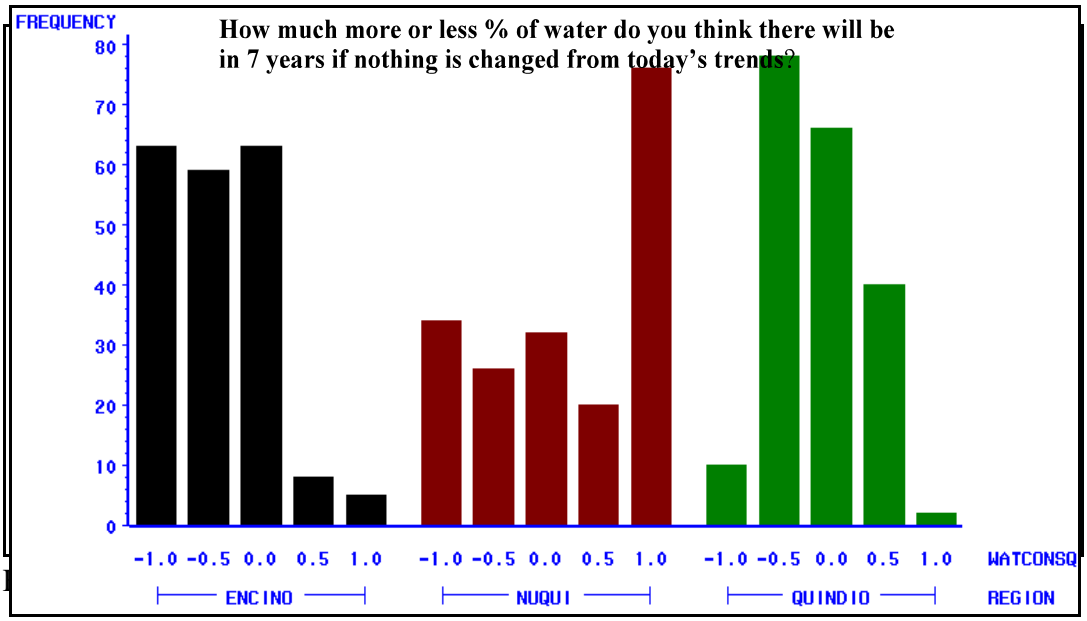

Figure 5.3. Status-Quo for water availability (results in 7 years).

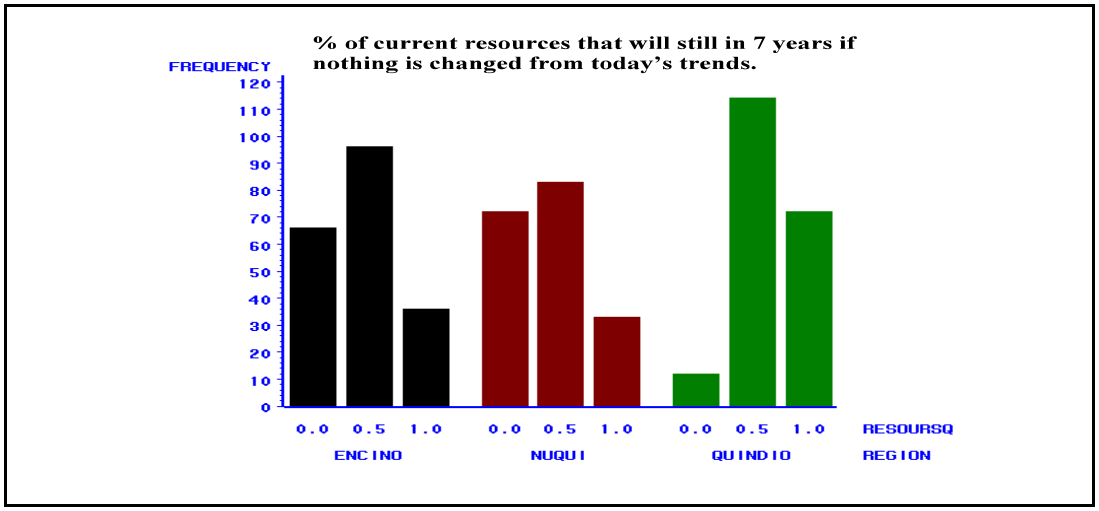

Figure 5.2.. Status-Quo for resources (results in 7 years).

h. Conclusons

With this exercise we wanted to see how the ecological, economic and institutional factors associated with an initiative for managing a local commons determined individuals' willingness to cooperate or contribute to its implementation. The benefits derived from managing a local commons sustainably are public goods in nature and therefore impose challenges regarding strategic behavior that may create inefficient outcomes. The institutional setting also affects the strategic behavior and the possibility of transaction costs and private information to induce non-cooperative behavior in the form of non-compliance with government regulations, or over extraction of the common-pool within a community. These in fact are similar to the questions that

were asked for the field experimental portion of this project, and eventually some parallels can be derived as we will discuss later, given that the field work, experiments, survey and workshops, were conducted for the same populations.

In general we have found that individuals are willing to cooperate even if it involves the provision of public goods such as the conservation of species. By cooperation in this case we mean sacrificing personal income in the form of opportunity costs and cash in the short run in order to guarantee that the local commons provides in the future (7 years) the multiple goods and services they recognize from these forested area. These marginal utilities from ecological gains and disutilities from the private costs allowed us to estimate with some confidence the implicit prices the place in the trade-offs between income and ecological benefits.

However, cooperation would increase or decrease if the institutional setting changes. By institutional setting we refer to the proposed manager of a conservation project, and the level of compliance or cooperation by the rest of neighbors. Orthodox views would predict that the governance solutions that guarantee a better correction of the externalities such as privatization or total state control should be preferred solutions. And that if the provision depended on voluntary contributions by others, the higher the number of contributors the less likely an individual would vote high for a project. However the estimation results suggest that people have a significant preference for a community governed LC and that higher number of neighbors cooperating increases one's cooperation.

Further, the balance between conservation and extraction that the sustainable development paradigm predicates over the deep ecology movement and the developmentalism, seems to be high in the preferences of the surveyed subjects. Extracting sustainably a local commons rich in biodiversity not only provides food, energy and fiber for the community but also for its future generations, and the positive implicit prices we estimated are proof of such valuation for inter-generational equity. Therefore we could suggest that direct, indirect and existence values are important components of the preferences of the rural poor and not only in the rationality of the better-off or the industrialized world. The foregone income in the short run to provide ecological services as intangible as the variety of plants and animals in the local commons seems to reflect their other-regrading preferences and show a sense of the social valuation they have for others despite the short-run economic constraints imposed by poverty.

Both inter- and intra-generational equity are key challenges for preserving local commons. The first in terms of refraining from extracting a certain amount of resources so that new generations benefit from conservation. The second, within the same generation, means preserving a resource so that others outside the community also benefit (Intra-generational equity), despite that both cases suffer from incomplete contracts and therefore involve externalities. Our respondents were asked at some point in the survey (Questions 29 and 30, See survey in Appendix V) two questions about reducing the use of a forest, and about preserving a forest for others. In both cases as in the rest of the survey, the questions referred to an "area ___" which in each of the villages corresponded to the actual place where most people extracted firewood, logging and other resources and for which there was joint access for households of that community, regardless of the property rights of the land. The first question referred to refraining from extracting part of the resources to provide benefits to others. They had to choose from three options the one they agreed the most with and the one they

disagree the most with from `extracting the same as today, extracting part of the resources to leave some for future generations, and refrain entirely from extracting and leave everything for future generations'. In the second question they had also to choose the two they agree the most and disagree the most from `preserving biodiversity for this community and their descendants, this community and other Colombians, and this community and the rest of Colombians and people from other countries'. In a sense the first question referred to test whether individuals' other-regarding preferences could solve endogenously for the first local dilemma, and the second if those other-regarding preferences could also endogenously contribute to solving the global second dilemma along this dissertation.

With regard to the problem of inter-generational equity (See Figure 5.4) respondents were on average leaning towards a balance between the right of the present generation to extract resources and the rights of future ones dependent on the current use. Notice the strong feelings against maintaining the same extraction of today's and strong feelings in favor of a trade-off between extracting today and leaving for the future. Furthermore, if we compare the two extreme options in the bottom and top questions, there were more respondents in favor of entirely refraining from extracting

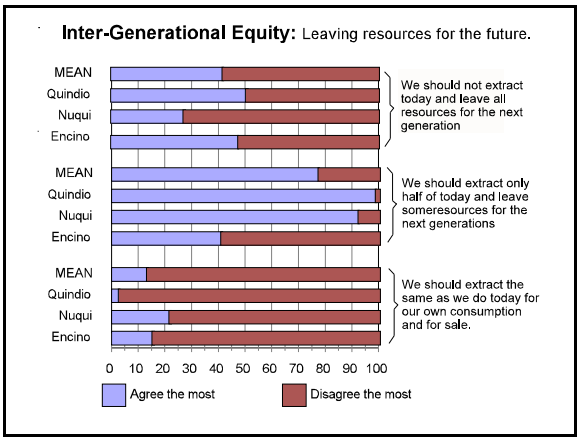

Figure 5.4. Respondents' preferences about the rights of future generations.

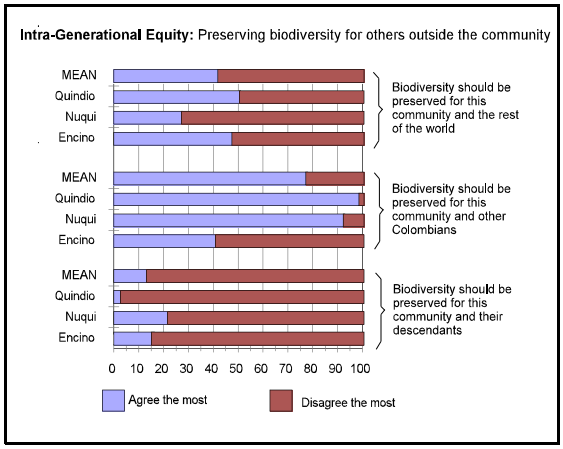

Figure 5.5. Respondents' preferences about the rights of others outside the community.

than maintaining the same extraction levels today.

In the case of the equity between community members and outsiders, see Figure 5.5, the more preferred option was to preserve biodiversity not only for the community

but for other Colombians as well. There seems to be more respondents in favor of "preserving for other Colombians" than "preserving for the rest of the world"[14], but this latter seems to be preferred to the option of "preserving only for the community" However there was a very clear disagreement with conserving for others outside the country.

In general these data support the notion that people's preferences do take into account the rights and welfare of others, including those that may not be able to contribute currently to the effort of conservation either from reducing extraction or contributing to a management project. These results are consistent with the estimated regression models in this chapter where individuals are willing to sacrifice personally in order to provide ecological benefits, even those such as biodiversity that probably have a small short-run individual benefits but are key for inter- and intra-generational equity.

i. Relations with field experiments results

A comparison of these results with those found through the field experiments in the same villages might enrich the debate about cooperation in local commons dilemmas. In the field experiments (See chapters II, III, IV) we have found that despite the material incentives to free-ride in an experimental LC dilemma, individuals were willing to make decisions that improved the group efficiency from the Nash prediction of the narrow self-regarding model. The introduction in the experiments of a "community" governance form in the form of face-to-face communication created a further improvement in social efficiency. However, the introduction of an external regulator meant to induce individual behavior changes toward Pareto improvements had a negative effect as it induced a more individual oriented strategy while the communication induced a group oriented one in the participants (See chapter II).

Other forms of institutions seemed to play a role in determining experimental cooperative behavior among these villagers. Their perceptions about the government and their perception about the others in the group did affect individual cooperation. Reciprocity and social capital within groups do create non-monetary incentives to contribute in public goods situations. Sometimes externally imposed rules may negatively affect such traits while self-governing institutions based on trust and mutual control could produce socially desirable outcomes.

[14] As in several other rural regions in Colombia the lack of strong government presence and political conflict create a nationalist sentiment which has been recently agitated by the rumors and fears that international corporations are illegally entering tropical forested areas in search for biodiversity samples, and the presence of armed groups plays a role in this respect.