

Testing hypotheses about social capital and irrigation organization in Nicaragua

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Abstract

The 2007 Nicaraguan Water Law seeks to set up of irrigation districts. However, in contexts of poor and infant institutions, the mere reference of a policy goal in a Water Law is not sufficient to convince farmers to enter into arrangements. Currently, in Nicaragua there is evidence of farmer groups sharing and managing common irrigation systems. The analysis of these experiences might provide valuable insights for the development and institutional design of irrigation groups as defined in the new Water Law. This study compares the case of shared and individual irrigation systems in the Upper Rio Viejo Sub-basin in Nicaragua. A survey on agricultural production and social capital was administered at household level. Results suggest that cognitive social capital factors, such as subjective perceptions of the community and of peers' trustworthiness as well as past successful collective experience, stimulates a positive attitude for participation and contribution to the community. In this respect, farmers' community background, in particular past experiences with collective action, might be useful before implementing policy programs such as irrigation formalization.

Keywords: Social capital; irrigation; Nicaragua

1. Introduction

The Dublin Statement (1992) on Water and Sustainable Development put forward four guiding principles for an integrated water resources management. Based on grounds of increased efficiency, equity and democratization, the second principle establishes that "Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels". Therein, it is often suggested that small-scale, local common-pool resources are best managed at the community-level as resource users, compared to bureaucrats, have better information and incentives for managing these resources more efficiently (Araral, 2009). This argument involves very often a certain degree of collective action. In this respect, a large body of literature on natural resources management has been devoted to identify the factors that influence collective action in the commons, the conditions under which cooperation is maintained and how social-ecological systems deal with disturbances (Anderies *et al.*, 2004).

This study examines the case of Nicaragua, where the new water law, enacted in September 2007, represents the first attempt for putting into practice the principles of integrated water resources management. In this line, the new water law introduces the concept of irrigation districts and defines them as the territorial area around which farmers might be organized for better water, land and infrastructure management. However, despite at local level some serious advances for the provision of water and sanitation services through community-based organizations can be found, at the national level the new water law implementation hardly makes any progress (Novo and Garrido, 2010).

Establishing formal irrigation institutions is not a straightforward task in countries with little collaborative experience. As discussed in Meinzen-Dick (2007), over the past 50 years a wide range of institutional arrangements have been proposed as panaceas for irrigation. However, it has been found that the very same institutional design showed different outcomes as local contexts change. Overall, whether or not process as the Nicaraguan irrigation development occurs smoothly is closely linked to the structure of incentives that farmers perceive. These incentives might not only be related to economic and environmental factors, but also to the cultural and social characteristics of the resource users. In this sense, the notion of social capital is often

considered as an enabler of collective action for public goods provision (Coleman, 1990; Putnam, 1995; Pretty and Ward, 2001; Krishna, 2004; Meinzen-Dick *et al.*, 2004).

In this paper, the concepts of collective action and social capital are hypothesized to examine whether a new institutional approach, as reflected in the 2007 Nicaraguan water law, could be implemented given the specific socioeconomic, environmental and institutional features of the region. Based on a survey implemented in 8 communities in the Upper Rio Viejo Sub-basin (North Nicaragua) and including a total sample of 121 households, the research focuses specifically on collective action for irrigation purposes and explores its link to both structural and cognitive social capital. The analysis of these experiences may provide interesting insights for the development and formalization of irrigation groups as defined in the new Water Law.

2. Irrigation, collective action and social capital: a theoretical perspective

Collective action can be conceptualized in different ways, but according to Meinzen-Dick *et al.* (2004) most definitions agree on four common aspects. Thus, collective action implies the involvement of a *group of people* with a *common interest* in carrying out a *common and voluntary action*. In this sense, collective action is affected by factors related to the attributes of the resource itself, such as scarcity and size, the resource users, such as heterogeneity, age and origin of the group and proximity to markets, and to the socioeconomic and institutional context (Meinzen-Dick *et al.*, 2002; Popeete and Ostrom, 2004; Araral, 2009, among others). The definition, measurement and effects of these factors are often context-specific. In our study, we limit the definition of collective action to the study of collective irrigation systems, which in this case refer to irrigation based on common canals and/or wells.

Social capital is often considered an intangible action asset that facilitates collective action and self-organization (Meinzen-Dick *et al.*, 2004; Bodin and Crona, 2008). Putnam (1995) refers to social capital as the “features of social organizations such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit”. However, the specific reasons explaining why social capital facilitates collective action are still under scrutiny. In this respect, Ishihara and Pascual (2009) make use of the concepts of ‘common knowledge’, defined as the capacity to represent individuals’ preferences as the community preferences, and ‘symbolic power’, which is related to the question of whose preferences are represented, for explaining how social capital may foster collective action. It is also worth noting that despite social capital being regarded intrinsically positive, Pretty and Ward (2001) highlight the fact that not all forms of social capital imply higher social welfare. For instance, Adhikari and Goldey (2010) argue that rule-breaking with impunity and elites’ capturing of resources affect collective action and the sustainability of community based organizations. In this respect, social capital may reinforce and sustain inequality, as well as forms of networks with negative social outcomes.

Overall, Pretty and Ward (2001) identify four key aspects related to social capital: trust, reciprocity and exchanges, common rules, norms and sanctions and connectedness, networks and groups. These four aspects are often inter-connected. As found by Krishna (2004), responses related to group membership, trust, solidarity and reciprocity are highly correlated. In addition, as acknowledged in Pretty (2003), higher social capital is also related to higher levels of economic and social well-being. Grootaert and Narayan (2004), in their study in Bolivia, recognize the contribution of local social capital to household welfare, in particular, for the poor.

Irrigation districts in developed countries have a strong support from government agencies, involving financial support, technical advice and law enforcement. In developing countries none of these can be summoned at ease to establish irrigation districts. As committing to formal collective arrangements entails personal and financial costs, in contexts of poor and infant institutions, the mere reference of a policy goal in a Water Law is a poor bait for dubious farmers to enter into arrangements. Farmers pondering whether to invest in participating and formalizing in irrigation districts must be convinced that the benefits will be greater than the ones obtained by individual action. As argued in Marshall (2004), trust and cooperation are pivotal factors in providing collective goods. Thus, in answering how much cooperation one should expect from one another is intrinsically linked to whether trust and mutual assurance are established in a group (Marshall, 2004).

Societies with poor cooperation habits do not engender in individuals wishes to trust others and cooperate. Nor do societies with long histories of political conflicts and strife. Therefore, efforts to create grass-roots collective entities must be focused on groups and individuals that have shown some inclination to cooperate and have had positive experiences from cooperation. As suggested by Fujie *et al.* (2005), willingness to cooperate is greater in individuals who have cooperated in the past, and have obtained rewards from that cooperation. Furthermore,

cooperating in any somewhat irreversible arrangement – as such would result from sharing irrigation infrastructures with a group of neighboring farmers – increases the risk of conflict, disputes and financial losses. It can be surmised that the personal experience on related community areas and the expectations they build as regards peer assistance under difficulties and conflicts are also two prerequisites for growing willingness to participate in collective organizations.

3. Methods

3.1. Measuring social capital and irrigation management

In order to understand the relations between irrigation management and social capital we have used a mixed-method research approach, which involves the collection of both qualitative and quantitative data, providing a richer pool of data for the analysis. The use of both qualitative and quantitative methods can reduce the disadvantages of certain methods and enhance the quality of the research by providing complementary information and insights (Teddlie and Tashakkori, 2003).

Focus groups were held with community members, and a survey on social capital and agricultural production were administered in the Upper Rio Viejo Sub-basin, which is located in the Jinotega department in central Nicaragua. According to the Community Level Human Development Report (HDRN, 2002), Jinotega ranks 16th out of 17 departments. The Upper Rio Viejo sub-basin includes six major municipalities, covering 360 km². Our study focuses in two of them where irrigated horticultural production is mostly located. The region is located along the Central America drought corridor. Thus, whereas in the Atlantic coast annual rainfall averages 2500 mm, in this region rainfall levels are usually under 1200 mm annually with marked seasonal variability (INETER, 2010).

Five focus groups were assembled in the Upper Rio Viejo Sub-basin in April 2010 with the objective of collecting information on: (i) the problems related to agricultural production that farmers face; (ii) their knowledge about the new Water Law and its effects; (iii) how they perceive public organizations; and (iv) whether there is any potential for organizing in irrigation districts, as defined in the 2007 Water Law. Participants were selected from the sub-basin based on the information provided by key informants, mostly community leaders and representatives from credit and savings cooperatives.

Focus groups provided key information for survey design, which was based on the 2005 Nicaragua Living Standards Measurement Study Survey (LSMS), on the World Bank Social Capital Accounting Tool (SOCAT) and on a comprehensive literature review (Krishna and Uphoff, 1999; Grotaert and Narayan, 2004; Krishna, 2004 and Meinzen-Dick *et al.*, 2002). Sample selection included all participants in the focus groups plus all other irrigators located along the sub-basin.

The survey was administered in July 2010 and March 2011, on a sample of 121 interviewees. The survey included 65 questions and was divided into three parts. The first part gathers general household information. The second part focuses on agricultural production features and includes specific questions related to irrigated production, irrigation system and organization, land tenure system, commercialization and the major problems affecting production. The third part is devoted to social capital, distinguishing between structural and cognitive social capital. Relevant variables included in this part are related to the characteristics and density of organizations, networks, previous collective action, solidarity, trust, cooperation and conflict resolution mechanisms. It is worth noting that while focus group gather information at community level, the survey focuses at household and individual level.

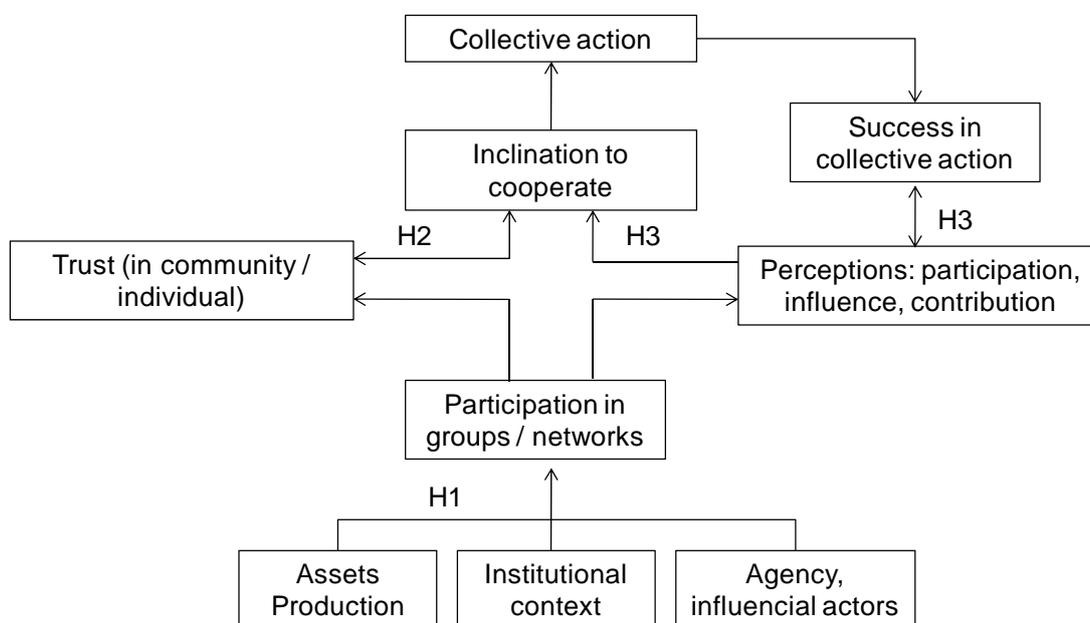
Group participation is considered at the household level by estimating a participation intensity index, in terms of participation per capita in each group of potential participation in the region of study. In addition, major features of group members are addressed in the survey, including whether group members belonged to the same community, family or political party. Another aspect taken into account is how decisions are taken within the group on a scale from top-down decisions to group consensus. With respect to networks, two issues are considered. On the one hand, how people would act when a pest infests all crops in the community. On the other hand, who would take the role of the leader and what are the major leader attributes. Since past collective experience might be linked to future collective action expectations and performance, this study takes into account how often community members have come together to apply for community development projects to the government and to political leaders, and whether they have been successful.

In relation to cognitive social capital, most attention is given to measuring solidarity, trust, cooperation and conflict resolution at the community level. Thus, solidarity is considered in terms of monetary support in case of a large and unexpected economic loss. In addition, we measured trust in people both in monetary terms, i.e. willingness to lend to or borrow money from people from the same community, and in personal responsibilities, i.e. for managing their properties in case they have to leave the community for a while. In this way, both bonding and bridging trust is considered. Linking trust is taken into account indirectly in the measure of previous collective action, as well as in the focus groups questions. Regarding cooperation, the survey considers two aspects. On the one hand, individuals' preference for land sharing instead of individual properties and, the other hand, the valuation of community members' contribution to development projects. Conflict resolution mechanisms are explored at two levels, depending on the conflict intensity and procedures.

3.2. Hypotheses

This research seeks to test a number of hypotheses regarding collective action at community level. For this purpose, the study focuses on the link between structural and cognitive social capital variables, as summarized in figure 1.

Figure 1. Conceptual framework for analyzing the link between structural and cognitive social capital factors



Note: H1, H2 and H3 refer hypotheses.

Source: Own elaboration

These hypotheses are:

1. Households' capital, measured in terms of total land and land per capita, increases incentives for participation in collective entities such as cooperatives. The reasoning would suggest that, as households' stakes are higher, there is more interest in entering into formal arrangements. One would expect little capacity or willingness to participate in households with little per capita assets, because there is little to be gained from such social investment to the extent there would be little financial leverage in the households' economy (Bowles, 1998). But one would also expect that households' owning large assets would gain little from cooperation, because individualistic strategies would pay-off better than complex collective endeavors (Sandler, 1992).

2. Trust and inclination to cooperate grow with past experience sharing irrigation systems. This follows from the fact that those households with positive collaborative experience would exhibit more willingness to collaborate,

because they have had the chance to experiment with actual collaboration schemes and, to some extent, build and reinforce mutual assurance within the group.

3. Past collective experience increases individuals' willingness to participate in collective entities. Therefore, successful collective experience is expected to be positively related to both valuation of participation and contribution to the community.

3.3. Model estimation for valuation of participation

In order to test how structural and cognitive social capital variables influence perception of participation within the community, an ordered logit model of multiple regression was used. The general specification of an ordered logit model is:

$$y_i^* = \beta' x_i + \varepsilon_i$$

Where i is the observation, y_i^* a latent variable, x_i the set of explanatory variables, β a vector of unknown parameters, and ε_i a random error term. Although y_i^* is unobserved, what can be observed is:

$$\begin{aligned} y &= 1 \text{ if } y^* \leq 0, \\ &= 2 \text{ if } 1 < y^* < \mu_1, \\ &= 3 \text{ if } \mu_1 < y^* < \mu_2, \\ &= J \text{ if } \mu_{J-1} \leq y^* \end{aligned}$$

The μ 's are unknown parameters to be estimated with β . The parameters of the ordered logit model are obtained by maximum-likelihood estimation.

In our study, the ordered logit model is applied to modeling interviewees' perceptions regarding participation in community projects. Thus, the latent variable is a categorical variable that measures valuation of participation on a 5-point scale. Negative and positive poles were designated as "very low" and "very high", respectively. Explanatory variables, x , comprise both structural and cognitive factors associated to social capital and respond to the conceptual framework presented in figure 1. Model variables are summarized in table 1.

Three explanatory variables were included to explore responses on collective action. These variables are (a) valuation of personal influence in the community, (b) frequency with which community has met to pursue development projects and (c) intensity of household participation in credit and savings cooperatives. Both valuation of influence and collective action frequency are categorical variables that range on a scale from 1(none) to 4 (high) and from 1(never) to 4 (often), respectively. Intensity of household participation in cooperatives is estimated by aggregating the product between the dichotomous variable called participation and the degree of involvement, rated on a 5-point scale, at household level. It is expected that the greater an individual values influence in the community, frequency of collective action and participation in groups, the higher will be his/her valuation of participation. Consequently, these variables are expected to show a positive association with the dependent variable.

In addition to structural variables, three further variables related to cooperation were included to explore the cognitive dimension of social capital. These variables are (d) neighbors' reciprocity, (e) valuation of community members' contribution to development projects, and (f) inclination to cooperate. Thus, both reciprocity and bridging trust, which are considered central for mutual assurance (Marshall, 2004; Pretty and Ward, 2001), are defined by asking the individual to whom he/she would be willing to let his/her plot in case of temporal absence from the community. As in first instance most individuals point out to relatives, the explanatory variable included in the model refers to whether they point neighbors in second instance. This variable is hypothesized to have a positive relationship with valuation of participation, as it is expected that those individuals who place higher trust on community peers would also perceive participation higher at community level. Valuation of community members' contribution to development projects is also included as an explanatory variable to measure the degree to which respondents perceived overall contribution, either with time or money, to community projects. This variable takes values 1 or 2 when the respondent considers contribution low or high, respectively. The more individuals value contribution to the community, the more they are expected to value participation. Accordingly, it is hypothesized that this variable has a positive relationship with the dependent variable.

Inclination to cooperate is measured through the preference between ‘owning 7 ha individually’ or ‘sharing 18 ha with another member from the community’. In line with our previous hypotheses, it is expected that this variable has a positive relation with valuation of participation, as individuals are more likely to value participation higher as long as they are also more willing to cooperate with other community members.

Table 1. Model variables description (N sample = 121)

Variable	Definition	Mean	Std. Dev.
<i>Latent-variable</i>			
Valuation participation	Individuals' valuation of participation in his/her community on a 5-point scale: 1 (very low), 2 (low), 3 (medium), 4 (high), 5 (very high)	3.02	0.97
<i>Explanatory variables</i>			
Valuation influence	Valuation of personal influence to make the community a better place for living: 1(none), 2(not much), 3(some), 4 (much)	1.84	0.72
Freq. collective action	Frequency during the last year of community meetings with the objective of proposing development projects for the community: 1 (never), 2(once), 3 (twice), 4 (often)	2.36	1.13
Intens. part. coop.	Intensity of household participation in cooperatives. Scale ranges from: 0 (non-participation), 1 (not active), 2(active), 3 (very active), 4 (leader). This is sum over total household members.	3.64	4.44
Reciprocity neighbors	Whether his/her second option would be to leave their plots in charge of any neighbor in case of temporal absence from the community: 0 (no), 1 (yes)	0.26	0.44
Val. Contribution	Valuation of community contribution to development projects: 1 (none or very little), 2(some or much)	1.81	0.39
Inclination cooperate	Preference for land sharing vs. individual property. This is value as: preference for owning 7 ha on his/her own.(1), preference for owning 18 ha jointly with another member/friend from the community (2)	1.21	0.41

Source: Own elaboration

4. Results

4.1. General description of the surveyed households

In this section, we describe the major demographic and agricultural characteristics of our sample which are summarized in table 2. 116 out of the 121 individuals included in the survey cultivate their own land and 20 lack proper land titles. Nevertheless, in all cases agriculture is the major income source for the household. When considering all households jointly, size of land plots average 8 ha. A closer data observation shows that land size distribution varies by community. On the other hand, average size of irrigated parcels is equal to 2.2 ha and varies very little by community. Major irrigated crops are vegetables, in particular, tomato, onion, *chiltoma* (paprika) and cabbage.

Irrigation takes place during the dry season and, in most cases, covers the months from November to April. However, the length of the irrigation season is highly variable depending on the hydrological year and on whether phenomena such as *El Niño* or *La Niña* occur. It is worth mentioning that 111 out of 121 respondents irrigate their lands, out of which 69 share an irrigation system. Most common irrigation systems in the area are drip irrigation either by pumping water directly from the river or flooding through annually constructed irrigation canals. Canal construction and maintenance is mostly done by the farmers themselves.

Regarding educational data, 73% of the sample has not completed primary education, out of which 7% have no education and 23% are literate but without schooling. In addition, 69% of households are composed by a single family, 22% by two, 7% by three and 2% by four. On average five people live in each household.

Table 2. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
N = 121				
<i>Agricultural land</i>				
Total (ha)	8.2	11.1	0.0	49.0
Total (ha) per capita	2.0	3.0	0.0	16.2
Total irrigated (ha)	2.2	2.4	0.0	23.0
Total irrigated (ha) per capita	0.5	0.7	0.0	5.8
N people share an irrigation system	2.3	4.0	1.0	16.0
<i>Household composition</i>				
N people	5.0	2.1	1.0	11.0
N families	1.4	0.7	1.0	4.0
Head male /female	113 / 8			
<i>Education of head (% sample)</i>				
None	7%			
Literate, no schooling	23%			
Primary – incomplete	39%			
Primary – completed	18%			
Secondary – incomplete	7%			
Secondary - completed	2%			
Vocational	1%			
University / other	4%			

Source: Own elaboration

4.2. Testing hypothesis about social capital and collective action

The following section is a summary of the main results obtained at household and aggregated levels for the area of study in Nicaragua. Our data generation process allows for testing the hypothesis H1, that households' capital stimulates participation in collective entities as credit and savings cooperatives. In this case, capital is defined in terms of total agricultural land and per capita is defined as the ratio between total and per capita (by household member) agricultural land. Intensity of household participation considers the degree of participation in cooperative as described on the previous section. The results, summarized in table 3, show that the relation between participation and household assets is differs when considering total and irrigated land, both in absolute and relative terms.

Table 3. Relation between households' capital and participation in credit and savings cooperatives

Intensity household participation in cooperatives	Total land		Land per household member	
	Ha	Irrig. ha	Ha/cap	Irrig. ha/cap
None	10.72	2.43	2.83	0.61
Low	12.30	1.96	2.63	0.40
Moderate	14.26	2.78	4.42	0.97
High	11.97	2.97	4.13	1.13

Source: Own elaboration

Our results suggest that in order to engage in collective entities, such as cooperatives, in which economic gains represent the major incentive to participate, a certain level of assets is required. However, merely irrigating or sharing an irrigation system is not related to participation in credit and saving cooperatives, since investments in irrigated agriculture are mostly based on individual decisions and contribution to the collective irrigation system is basically in the form of labor supply. In addition, our results support previous empirical findings suggesting that both wealthier individuals and the ones with lower wealth are less likely to engage in collective entities. In the former case, because they are more likely to rely on impersonal market exchanges (Bowles, 1998) and, on the

latter case, because the cost of cooperating might be higher for people with lower wealth as it entails significant risks (Marshall, 2004).

Regarding our hypothesis H2 about trust and willingness to cooperate, the results confirm that trust and inclination to cooperate grow with past experience sharing irrigation systems. Trust is measured as the perception of confidence in the community for borrowing and lending money to community peers. It represents a personal assessment of what would be expected at community level in a situation of money need. Table 4 shows that those who share an irrigation system also place a higher trust in the community, but causality cannot be established.

Table 4. Relation between sharing an irrigation system and trust

Shares an irrigation system	Trust valuation in the community (n responses)		
	Don't trust	Trust	Total
Yes	30	39	69
No	31	21	52
Total	61	60	121

Pearson $\chi^2 = 3.09$ P = 0.079

Source: Own elaboration

The study also looks at the relation between sharing an irrigation system and inclination to cooperate. In line with Krishna (2004), this is tested by asking which alternative he/she would prefer between owning 7 ha individually or sharing 18 ha with a friend from the same community. Noteworthy, 7 ha alternative is similar to the average land plot size in the area of study. The results, presented in table 5, show that 80% of the sample would choose the first alternative and give up having access to more land under a shared production system. Nevertheless, considering those who would have chosen the alternative "owning 18 ha jointly", higher frequency is found among those who also share an irrigation system. This suggests that preferring cooperative solutions is more likely when individuals have had previous collective experiences.

Table 5. Relation between sharing an irrigation system and inclination to cooperate

Shares an irrigation system	Preference to own (n responses)		
	7 ha individually	18 ha jointly	Total
Yes	50	19	69
No	46	6	52
Total	96	25	121

Pearson $\chi^2 = 3.31$ P = 0.069

Source: Own elaboration

Results reported in table 6 confirm our hypothesis that the relation between success of previous collective action and valuation of both participation and contribution to the community is significant. So, community engagement and contribution either with time or money are relevant factors for collective action success. Ultimately, both factors seem to be related to the sense of action ownership by the community members. The collective experiences refer to community development projects requested by community members collectively.

Table 6. Relation between success of previous collective action and both valuation of participation and contribution to the community (% responses)

Success previous collective action	Valuation of participation in community					Contribution to community (time and/or money)	
	Very low	Low	Medium	High	Very high	None	Some
Yes	0	7	19	20	4	6	44
No	7	22	25	16	1	17	54
Total	7	29	44	36	5	23	98

Pearson $\chi^2 = 14.62$ P = 0.006

Pearson $\chi^2 = 2.72$ P = 0.099

Source: Own elaboration

4.2. Ordered logit regression model to test structural and social capital formation

The question of how structural and cognitive social capital variables influence perception of participation in the community is tested using an ordered logit regression model. As explained earlier, participation is measure by a scale, ranging from 1 to 5. This analysis is based on the data obtained from the survey developed for this study. Table 7 summarizes the main results obtained from the model described above.

Table 7. Ordered logit regression model for valuation of participation

Variables	Expected sign	Coef.	Std.Err.
Valuation participation	n.a.	n.a.	n.a.
Valuation influence (β_1)	+	0.71**	0.25
Frequency collective action (β_2)	+	0.40**	0.17
Intensity participation coop. (β_3)	+	0.09**	0.04
Reciprocity – neighbors (β_4)	+	1.07**	0.42
Valuation contribution (β_5)	+	0.89*	0.50
Preference land shared (β_6)	+	0.73	0.47
μ_1		1.91	1.05
μ_2		4.19	1.07
μ_3		6.25	1.16
μ_4		9.23	1.31
Pseudo R ²		0.14	

p<0.10*, p<0.05**, p<0.001***

Source: Own elaboration

As hypothesized earlier, coefficient of “Valuation influence” (β_1) is significant and positive, indicating that individuals who value more their own influence in the community are also more likely to value participation higher. Our model also hypothesized that frequency of collective action can have a positive impact on the valuation of participation. In this respect, results also confirm our hypothesis. Although this is out of the scope of this study, this result might highlight the relevance of learning and trust development through collective action processes. In addition, the intensity of household participation in cooperatives has also a positive and significant impact on the valuation of participation.

Regarding cognitive variables, in all cases these variables are positive and significant. Thus, those individuals who would rely on neighbors for taking care of their plots, in case of temporal absence from the community, are also more likely to value participation higher. In this line, the more individuals value community members’ contribution to common projects, the more they also value participation. When considering the relation between the inclination to cooperate and the valuation of participation, those individuals who would prefer sharing 18 ha instead of owning 7 ha individually do also value participation higher.

Table 8 reports the effect of a change in an explanatory variable. As independent variables are both categorical and dummy variables we prefer using discrete change, which is the change in the predicted probabilities for a unit change in x_i . To understand how to interpret the table, consider the row for the “Valuation of influence”. It can be seen that for a unit increase in valuation of influence, the probability of high valuation of participation increases by 0.13. If medium valuation is considered as the yardstick for comparing the sensitivity of valuation of participation to each of the different explanatory variables found to be statistically significant, it can be observed that the sensitivity is greatest in respect of neighbors’ reciprocity. In addition, it appears that changes are more significant for low and high valuation of participation, in particular, regarding cognitive social capital variables. Thus, the absolute effect of a unit change in the frequency of collective action is nearly equal fro low and high valuations and the same for very low and very high valuation of participation.

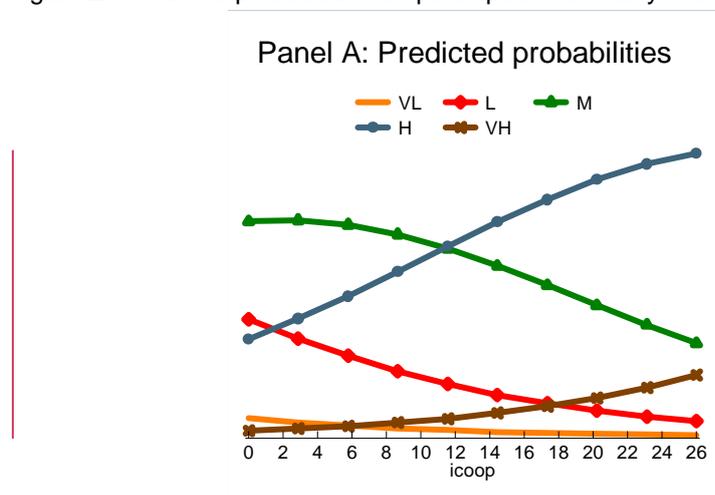
Table 8. Change in probability of valuation of participation

Due to a one unit increase in... from its mean score	The probability of...valuation of participation increases by:				
	Very low	Low	Medium	High	Very high
Valuation influence**	-0.02	-0.11	-0.02	0.13	0.01
Freq. collective action**	-0.01	-0.06	-0.01	0.07	0.01
Intensity participation coop.**	-0.002	-0.01	-0.002	0.02	0.001
Reciprocity – neighbors**	-0.02	-0.14	-0.07	0.21	0.03
Valuation contribution*	-0.03	-0.13	-0.02	0.17	0.02

Source: Own elaboration. $p < 0.10^*$, $p < 0.05^{**}$

Figure 2 shows the change in predicted probabilities when the intensity of participation in cooperatives ranges from its minimum (0) to its maximum (26) value in our sample. As it can be seen, predicted probabilities for both high and very high valuations rise with increasing participation intensity. On the opposite, medium, low and very low valuations decrease with participation intensity. These results are in line with those reported in table 7.

Figure 2. Predicted probabilities as participation intensity in cooperatives ranges from 0 (min) to 26 (max)



Source: Own elaboration

Curve slopes are higher for both high and medium valuations, which indicates that marginal changes are more relevant in these cases. On the other hand, considering both high and very high valuations, it appears that as participation intensity increases the function is concave in the former case whereas convex in the latter, which might have implications for the thresholds that may actually change perceptions in participation.

5. Conclusions

This paper looks at the incentives of farms for participating in collective irrigation entities. It asks what factors may be more favorable for creating irrigation districts in Nicaragua. The context in which the study has been carried out involves a hilly landscape with strong seasonal hydrological and rainfall regimes, one of the poorest Nicaraguan region, and groups of small and large farmers, with little or none irrigation infrastructure. The research attempts to provide clues about the communities and individuals more prepared to participate in irrigation districts, which the Nicaraguan Water Law wishes to create in the rural areas.

Our results suggest that households with some capital see benefits in participating in collective entities in which economic gains represent the major incentive. Since establishing irrigation districts will require a common investment, farmers must be convinced that by participating they can become more productive by having access to inputs that otherwise would not acquire.

Subjective perceptions of the community and of peers' trustworthiness are also found to be relevant. Trust to borrow from, or lend money to, community members seems to be larger for those farmers with some experience in sharing irrigation systems. In addition, successful collective experience stimulates valuation of participation and contribution (with time and/or money) to the community.

Results from the ordered logistic regression suggest that both structural and cognitive social capital variables have a positive impact on the valuation of participation. However, sensitivity analysis shows that, in particular, cognitive variables have a greater effect on this valuation. In line with Meinzen-Dick *et al.* (2004), our findings suggest that examining questions related to the community background, in particularly past experiences with collective action, might be useful before implementing programs with the objective of organizing irrigation into formal districts.

In sum, it is not easy to get irrigation districts off the ground in Nicaragua. For this reason, targeted communities should be carefully selected, based on the previous experience of individuals, observed communal life, and sociological factors. More research about the way communities manage their affairs would certainly add valuable information.

6. References

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