Challenges in getting off the ground the new Nicaraguan Water Law: from farmer groups to formalized irrigation districts?

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Abstract

The Nicaraguan Water Law was passed in September 2007. While all new Water Laws need time to be implemented, the progress in Nicaragua is meager. Nicaragua's water sector, especially in rural areas, is highly informal and primarily based on small water supply systems and on local informal water institutions. The new Water Law foresees setting up irrigation districts to improve water management in the agricultural sector. Despite the lack of formal users' organizations, there is evidence of farmer groups sharing and managing common irrigation systems without any formal bonds or statutes. The objective of this research is to assess the challenges in the formalization process of the agricultural water sector in a developing country, such as Nicaragua. Since major water-related problems have already been identified, the new Water Law still faces a number of barriers that may delay its implementation. It is essential to indentify the socioeconomic, institutional and environmental factors that structure incentives for farmers to willingly become involved in a formalization process. The theoretical framework is based on the literature on collective action and social capital. The empirical focus is given by 5 focus groups and 98 surveys hold in the Upper Rio Viejo Sub-basin in North Nicaragua. The study focuses on (i) the problems related to agricultural production that farmers face, (ii) how they are organized for irrigation, (iii) how they perceive public organizations and (iv) the pros and cons of formalizing in irrigation districts. The study attempts to contribute to the Water Law implementation by analyzing both the impact of the Water Law in agricultural water managed areas and the cooperative behavior of the different farmer groups considered in the Upper Rio Viejo Sub-basin.

Keywords: water institutions, water law implementation, Nicaragua, irrigation districts, social capital.

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1. INTRODUCTION

The new Nicaraguan Water Law, enacted in September 2007, has established a new regulatory framework and management perspective for national water resources. In line with the Dublin Principles, both Nicaraguan Water Law and Water Policy recognize the integrated water resource management approach (IWRM). However, for the time being, barely any of these principles has been translated into real practice.

According to Shah (2007), a country's water institutions and the formalization degree of its water economy are intrinsically related. Despite approving well-intentioned new water laws, addressing issues of water resources regulation and management, change on the ground cannot be usually taken for granted. Previous research shows that in the Nicaraguan case three major factors are delaying this process (Novo and Garrido 2010). First, the "yet to be seen" Law potential for solving water conflicts that are rooted both on equity issues (small vs. big farmers) and on consumptive versus non-consumptive uses (irrigation vs hydropower). Second, the complexity of the reform, coupled with a large number of both sectoral regulations and water actors, seems an excessive burden for the current affairs of the Nicaraguan State. Third, the role of power and conflict of interest reflected on the presence in the parliament of sugar-cane mills, rice and coffee interests which hinder the appointment of managers in the newly created institutions.

At the national level the new Water Law implementation hardly makes any progress. At local level, where most conflicts arise and competences and cooperation for water resources management take place, serious advances toward better water resources access and management can be found. For instance, more than 5,000 Water Supply and Sanitation Committees (*Comités de Agua Potable,* CAPS) operate in Nicaragua. These are community-based organizations whose objective is to provide water and sanitation services to the rural population. In addition, some River Basin Committees have already been set up, serving as consultation forums where both representatives from communities, civil organizations and government, among others, discuss about issues related to territorial development and planning within the basin (Castellón and Prins 2009).

As in many other countries agriculture is one of the largest direct consumers and polluters of water resources and, therefore, it deserves particular attention. 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. Currently in Nicaragua, despite the lack of formal water users' organizations, there is evidence of farmers groups sharing and managing common irrigation systems. The analysis of these experiences may provide interesting insights for the development and formalization of irrigation groups as defined in the new Water Law.

Establishing formal irrigation institutions is not a straightforward task in countries with little collaborative experience in the rural areas. Whether or not the process occurs smoothly is closely linked to the structure of incentives that farmers perceive. Incentives might not only be related to economic and environmental factors, but also

to the social organization. In this sense, the notion of social capital has been considered as an enabler of collective action by lowering transaction costs (Pretty and Ward 2001). In addition to social capital, Meinzen-Dick et al. (2004) recognize the importance of considering the role of certain key agents, for example local leaders, as facilitators of collective action. Krishna (2004) points out that agency capability multiplies the positive effects of social capital, in particular, in weak institutional contexts.

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". Nevertheless, as argued by Ishihara and Pascual (2009), the definition of social capital in terms of trust, norms and networks seems insufficient to tie social capital to collective action and economic development. Critics highlight the reverse causal relation between institutional performance and social capital, being the latter enabled by the former (Bodin and Crona 2008). However, for the purpose of this study, the analysis of social organization in terms of organizations, networks, previous collective action, solidarity, trust, cooperation and mechanisms for conflict resolution seems relevant for assessing the differences among farmers and the likelihood of cooperation given these differences.

This research attempts to analyze whether a new institutional approach, as reflected in the 2007 Water Law and 2001 Water Policy, could be implemented given the specific socioeconomic, institutional and environmental features of the region. For this purpose, the research focuses on collective actions for irrigation and explores its link to both structural and cognitive social capital. A mixed-method research approach combining focus groups and a survey is used for the assessment of the formalization process of the agricultural water sector in Nicaragua.

2. IRRIGATION, COLLECTIVE ACTION AND SOCIAL CAPITAL: A THEORETICAL PERSPECTIVE

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. Thus, 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.

Krishna and Shrader (1999) distinguish two levels of social capital. The macro level relates to the institutional environment, in which organizations operate, and might be defined in terms of economic development, political stability and demographic trends, among others (Ostrom 2009). The micro level focuses mainly on structural and cognitive social capital at individual or group level. Up to now, most studies have focused on this latter level.

Meinzen-Dick et al. (2004) highlight four common aspects in the definitions of collective action. 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.

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). 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. Thus, social capital may reinforce and sustain inequality, as well as forms of networks with negative social outcomes.

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. Persuading neighbor farmers of the technical and economic advantage of formal water users' organizations is almost the only means of raising interest to embark on these alien and unknown institutions. Committing to formal collective arrangements entails personal and financial costs. In contexts of poor and enfant 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.

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 Fujiie 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.

Related to cooperation experience and conflict risks, whether a household has some assets and how important they are in per capita terms would also be another factor influencing farmers' willingness to co-share irrigation equipment in formalized irrigation organizations.

3. COMBINING FOCUS GROUPS AND SURVEY METHODS FOR THE ANALYSIS

Mixed-method research involves the collection of both qualitative and quantitative data and provides 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). Both quantitative and qualitative methods have been widely used separately for the study of collective action (Meinzen-Dick et al. 2004), but not so often combined for the study of irrigation and social capital.

In the following section, qualitative and quantitative methods applied in this study are briefly described. The area of study in the Jinotega region in Nicaragua, the Upper Rio Viejo Sub-basin (see Figure 1), corresponds to the intervention area of the TERRENA program, a development program that aims to contribute to the reduction of social, economic and environmental vulnerability in impoverished areas through access to safe drinking water, sanitation services and water resource management strategies. According to the Community Level Human Development Report (HDRN, 2002), this area is one of the poorest in Nicaragua, ranking 16th out of 17 departments.

Figure 1. Map of Nicaragua River Basins

Source: INETER (2009)

The Upper Rio Viejo sub-basin includes six major municipalities, covering 360 km^2. However, our study focuses in two of the municipalities 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, increasing up to 5000 mm in the southwest part, in this region rainfall levels are usually under 1200 mm annually and might even fall to 500 mm in a dry year

(INETER 2010). The seasonal variability between the dry and the wet period is also marked.

3.1. Focus groups: Discussing irrigation, the Law and its effects

Five focus groups were gathered in the Upper Rio Viejo Sub-basin in April 2010. 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. Two municipalities were included in the study, since both concentrate most irrigated crops in the sub-basin. An average of 12 farmers were invited to participate in each focus group. The objective of the groups was to gather 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.

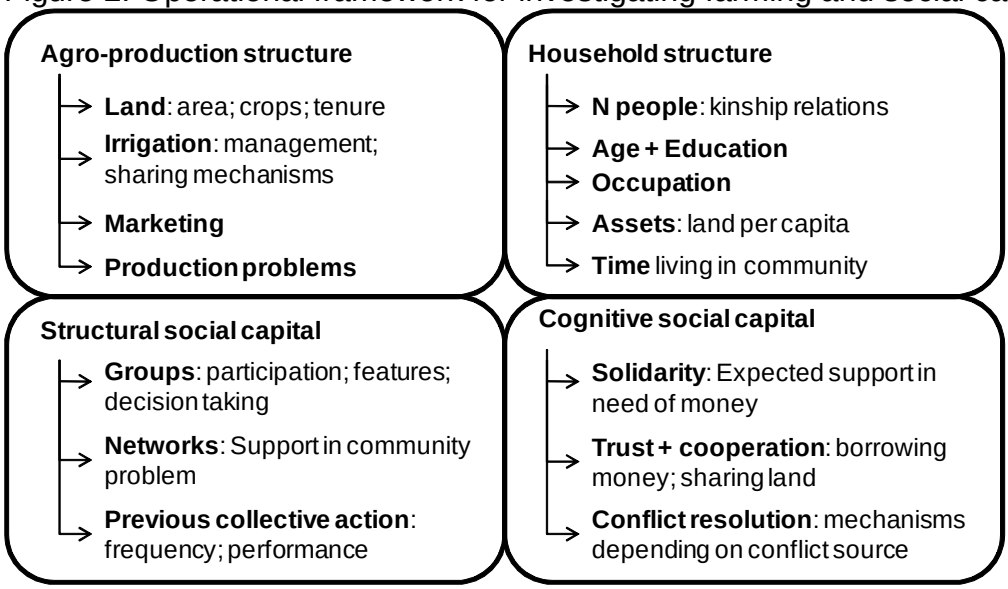
Sessions were conducted by a moderator who asked the questions and a co-moderator who took notes from the discussion. Each session lasted for about an hour and was recorded on a single tape recorder. Preliminary results from focus groups' analysis also informed the survey design. Since focus groups discussions reveal mostly context specific information they are also a good primary source for a more accurate survey design adapted to the region institutional and socioeconomic setting.

3.2. Survey: Investigating farming and social capital

This part of the study is based on a survey administered in 8 communities of two municipalities (La Concordia and San Rafael del Norte) of the department of Jinotega during June and July 2010. The unit of analysis defined was the household. We considered a household to be made up of all individuals who depend on a common expense for feeding. Sample selection included the participants in the focus groups and all other individuals located along the sub-basin and who irrigate crops. The total sample included 98 household heads.

Survey design 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, among others). The survey included 64 questions and was divided into three parts. The first part gathers general household information. The second part focuses on the 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 and cooperation and conflict resolution mechanisms. The operational framework developed for the purpose of this study is represented in Figure 2.

Figure 2. Operational framework for investigating farming and social capital



Source: Own elaboration

Regarding structural social capital, it is worth noting that group participation is considered at the household level by estimating a participation intensity index, in terms of participation per capita, in each group. 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. for lending to and borrowing 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 are considered. Linking trust is taken into account indirectly in the measure of previous collective action, as well as in the focus groups questions. Conflict resolution mechanisms are explored at two levels, depending on the conflict intensity and procedures.

3.3. Hypotheses and estimation models

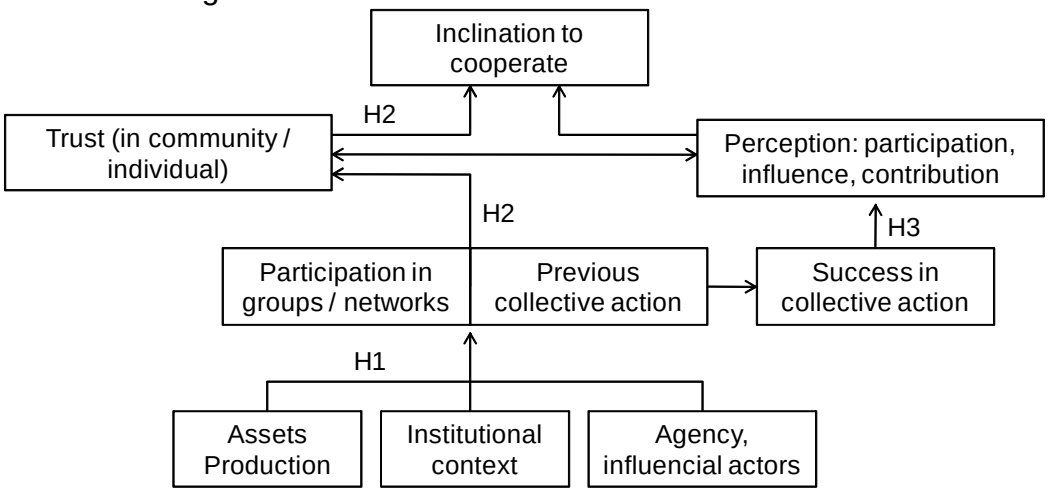
This study attempts to assess the formalization process of the irrigation sector in Nicaragua by analyzing the link between agriculture, social and institutional organization. Figure 3 summarizes the conceptual framework of this study that posits a number of testable hypotheses. These hypotheses are:

1. Household's per capita capital, measured in terms of 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. However, per capita household assets is a more powerful influence on motivation to cooperate than just household total assets because it provides a relative measure of households'. One would expect little capacity or willingness to cooperate 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 household's economy. 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.

2. Trust and inclination to cooperate grows with past experience sharing irrigation systems. This hypothesis does not need much elaboration: those households' with positive collaborative experience would exhibit more willingness to collaborate, because they have had the chance to experiment with actual collaboration schemes.

3. As hypothesized earlier, 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.

Figure 3. Conceptual framework for analyzing the link between agriculture, social and institutional organization



Note: H1, H2 and H3 refer to hypotheses 1, 2 and 3, respectively.
Source: Own elaboration

Based on the previous hypotheses, the following model to estimate the likelihood of cooperating in the six major communities included in the study is posed:

$$\mathbf{P}(LS = \mathbf{1}|x) = \alpha + \beta_1 IS + \beta_2 SIR + \beta_3 SIRPC + \beta_4 VP + \varepsilon \quad [1]$$

LS is a binomial variable that denotes the preference to own 7ha individually or 18ha jointly. It measures the likelihood of land sharing depending on the previous experience sharing an irrigation system, as defined by the dummy variable *IS* which takes value 1 when the individual has had previous experience and 0 otherwise, the total irrigated land owned by each household, as denoted by *SIR* and measured in hectares, the total irrigated land per capita, measured in hectares per household member and indicated in *SIRPC*, and the valuation of participation within the community, measured on a scale from 1 (very low valuation) to 5 (very high valuation) in variable *VP*.

A second model includes controls for six communities, C_k. There are a total of 6 dummy community variables in this model. Once major geographical differences are controlled by coefficients δ_k, model 2 allows for testing the hypothesis of whether having previous collective experience and higher valuation of participation and household assets determines a higher preference for cooperative solutions regarding production systems.

$$\mathbf{P}(LS = 1|x) = \alpha + \beta_1 IS + \beta_2 SIR + \beta_3 SIRPC + \beta_4 VP + \sum_{k=1}^{6} \delta_k C_k + \varepsilon \qquad [2]$$

A logistic regression analysis is used to modeling the probability of choosing either an individual or shared land property alternative.

4. SAMPLE DESCRIPTION

In this section, we describe the major demographic and agricultural characteristics of our sample which are summarized in Table 1. 95 out of the 98 household heads included in the survey cultivate their own land and 17 lack 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 7 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 1.4 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 *Niño* or *Niña* occur. It is worth mentioning that 90 out of 98 respondents irrigate their lands, out of which 54 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, 70% of the sample has not completed primary education, out of which 6% have no education and 26% are literate but without schooling . In addition, 65% of households are composed by a single family, 30% by two, 3% by three and 2% by four. On average four people live in each household.

Another interesting aspect to take into account is how decision processes take place within the three most important groups for the household. These processes are defined on a scale from 1 to 3, being 1 top-down decisions and 3 a consensus. Considering all communities jointly decision-taking process average 1.5 what means that in most cases the leader or board asks members for their opinions and then decides.

Table 1. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
N = 98				
Agricultural land				
Total (ha)	7.0	15.4	0.0	98.0
Total (ha) per capita	2.0	4.8	0.0	32.7
Total irrigated (ha)	1.4	1.2	0.0	7.0
Total irrigated (ha) per capita	0.4	0.4	0.0	2.3
N people share an irrigation system	3.4	3.6	1.0	16.0
Household composition				
N people	5.0	2.0	1.0	10.0
N families	1.4	0.7	1.0	4.0
Head male /female	93 / 5			
Education of head (% sample)				
None	6%			
Literate, no schooling	26%			
Primary – incomplete	39%			
Primary – completed	15%			
Secondary – incomplete	5%			
Secondary - completed	2%			
Vocational	1%			
University / other	6%			
Participation in groups (frequency)				
None	21			
Cooperatives	58			
Religious groups	9			
Others	9			

Source: Own elaboration

5. RESULTS

5.1. Analysis of focus groups: "flowing" problems?

In the following section we present the major findings from the focus groups. As mentioned in the methodology, four issues were addressed during the sessions: (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.

Table 2 summarizes the main responses to the questions addressed during the focus groups. It should be noted that focus groups follow the river flow from upstream to downstream within the Upper Río Viejo Sub-basin. In this respect, two aspects are worth mentioning. First, both water scarcity and groundwater potential increase as we move downstream. Second, horticulture production plays a larger role in downstream communities, being these crops more vulnerable to dryer periods than cane crops found upstream. Thus, participants in focus group 1 do not highlight water scarcity as a major problem for farming, but credit provision is mentioned, which might be linked to households' land per capita, as proposed in our hypothesis 1 and developed in the following section. On the contrary, as we move downstream, water scarcity is the major constraint for agriculture production. Most farmers rely on surface water supply for irrigation. Yet, most farmers acknowledge that groundwater potential is larger downstream, and this is confirmed by hydrological studies. Nevertheless, technology investment for making use of these groundwater resources is still very low among small and medium farmers. Participants in focus groups 3, 4 and 5 see unexploited groundwater resources as almost the only means to cope with surface water deficit.

Table 2. Major findings from focus groups analysis

Focus group	N	Agro-problems	Knowledge WL	Perception of public (local) organizations	Potential for irrigation districts
1	12	Credit provision Organization	3 attended WL information sessions	No control of irrigation by-laws implementation	Organized. Hand-made irrigation infrastructure
2	15	Water scarcity and distribution Credit provision	2 attended WL information sessions	No control of water uses and irrigation by-laws implementation	Organized, but point out the need of better organization for coping with water shortages
3	9	Water scarcity Marketing	No information on WL	Only active before elections	Based on groundwater withdrawal
4	16	Water scarcity	No information on WL	Only active before elections	Capability for co- working, but plots far from each other
5	9	Water scarcity	No information on WL	Good relations with municipality	Only mean for having water access

Upstream → River flow → Downstream

Source: Own elaboration

Only a very small proportion of focus groups' participants had attended Water Law information and consultation sessions. In addition, rules contained in the law are mostly perceived as prohibitions of traditional irrigation practices, such as the use of hand-made dams in the river. Previous Water Law analysis shows that it is to some extent biased towards regulating water for drinking and sanitation, in particular, in urban areas (Novo and Garrido 2010). Water for agriculture does not receive as much attention as water for direct human consumption. Focus groups' results

highlight the fact that positive outcomes that may stem from Law implementation regarding water for agriculture were not certainly clear for most participants.

Regarding perception of public organizations, responses reflect how participants perceive law implementation at local level, in particular, by municipalities. As focus groups were conducted in April 2010, coinciding with a critical period in terms of water availability and competition for resource use, this part of the discussion mainly focused on the role played by the local government on implementing the irrigation by-law that regulates water withdrawal from the river after January. Overall, participants agreed that local government efforts for implementing and enforcing irrigation by-laws are meager. Nevertheless, smaller farmers candidly declare that they do not comply with the by-law to the same extent larger farmers neither do. Equity and power issues may underlay laws poor enforcement in the area since larger farmers use mostly groundwater for irrigation in dryer periods and, therefore, are not affected by the irrigation by-law regulation.

The last issue addressed in the group sessions was the potential for organizing in formal irrigation districts, as defined in the law. As mentioned earlier, some farmers are already organized in informal irrigation groups within the same community in order to build, maintain and share common infrastructures for supplying water at plot level. As shown in Table 2, responses regarding potential organization varied by geographical location and water scarcity perception, which are to a large extent linked, as reflected in the problems identified related to agriculture production. Farmers located downstream, in most cases irrigating with surface water taken directly from the river, see groundwater wells as the best solution for irrigated agriculture. However, artesian wells are in most cases too costly for small farmers and, therefore, grouping is a means for having access to this water. Thus, despite irrigation districts not been formally recognized, increasing economic gains could trigger, in some cases, the development of irrigation groups.

It is, therefore, interesting to take into account whether the development of irrigation groups takes place based on relative water scarcity and without explicit government support and whether and how social capital, as defined earlier, might influence this development.

5.2. Testing hypotheses about social capital and collaboration incentives

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 that households' per capita capital stimulates participation in collective entities as credit and savings cooperatives. In this case, capital per capita is defined as the ratio between total agricultural land in hectares and number of household members. Intensity of household participation considers the degree of participation in cooperatives, defined on a scale from a leader to a non-active member position. The results, summarized in Table 3, show that the relation between participation and household assets is only relevant when considering irrigated land, both in total and per capita terms.

Results confirm the hypothesis that participation intensity increases with per capita assets. This suggests 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.

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

Intensity household participation in cooperatives	Total land		Land per capita	
	Ha	Irrig. ha	Ha/cap	Irrig. ha/cap
None	6.61	1.65	1.21	0.30
Low	10.91	1.93	1.84	0.29
Moderate	12.48	2.61	3.05	0.61
High	9.61	2.86	2.60	1.03

Source: Own elaboration

Regarding the relation between trust and willingness to cooperate, the results confirm our hypothesis 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 (response's frequency)

Shares an irrigation system	Trust valuation in the community		
	Don't trust	Trust	Total
Yes	24	30	54
No	32	12	44
Total	56	42	98

Pearson $chi^2 = 7.9$ $P = 0.005$

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 equal to the average land plot size, as shown in Table 1. 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 (response's frequency)

Shares an irrigation system	Preference to own		
	7 ha individually	18 ha jointly	Total
Yes	39	15	54
No	39	5	44
Total	78	42	98

Pearson chi^2 = 4.02 P = 0.045

Source: Own elaboration

In addition to previous collective experience, it is important to take into account whether previous collective action was successful or not. It is, thus, interesting to test whether collective action success at community level is related to both valuation of participation in the community and individual inclination to cooperate with another member from the same community. One would expect a positive correlation between collective action success and valuation of community participation, as well as higher inclination to cooperate among those individuals who had considered successful their previous collective experiences. In this sense, it should be noted that collective experiences refer to community development projects requested by community members collectively.

Table 6 shows that there is a significant relation between success of previous collective action and valuation of both participation and contribution to the community. 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. In addition, frequency with which community members have come together to apply for development projects to local government of political leaders is also linked to both previous collective action and valuation of participation. Thus, valuation of participation increases as frequency also increases and is higher in those cases where respondents valued previous action as successful, as shown in Table 7.

Table 6. Relation between success of previous collective action and both valuation of participation and contribution to the community (response's frequency)

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	4	15	17	3	47	37
No	1	20	22	16	0	12	2
	Pearson chi^2 = 12.45 P =0.014					Pearson chi^2 =4.44 P=0.035	

Source: Own elaboration

Table 7. Relation between frequency of collective action and success valuation (mean of valuation of participation on a scale from 1 to 5, standard deviation)

Success previous collective action	Frequency (during last year) with which community has met to pursue development projects			
	Never	Once	Twice	Often
Yes	-	3.5	3.3	3.8
	(-)	(0.7)	(0.7)	(0.9)
No	2.8	2.9	3.3	3
	(0.8)	(0.9)	(0.8)	(0.0)

Source: Own elaboration

With regard to the relation between individual willingness to cooperate, measured by the preference to own 7 ha individually or 18 ha jointly with another person from the community, and success of previous collective action, results reveal that, as shown in Table 8, individual decisions do not necessarily reflect past collective experiences as a community, but whether individuals trust other individuals within the community for engaging in common projects. Results also support our previous argument regarding valuation of participation in the community.

Table 8. Relation between previous collective action success and inclination to cooperate (response's frequency)

	Success previous collective action		Valuation of participation in community				
Preference to own	Yes	No	Very low	Low	Medium	High	Very high
7 ha individually	30	48	1	23	32	19	3
18 ha jointly	9	11	0	1	5	14	0
	Pearson chi^2=0.28 P=0.59		Pearson chi^2=15.85 P=0.003				

Source: Own elaboration

5.3. An estimation of the likelihood of cooperating

As previous results shown, electing a cooperative land property alternative differs depending on valuation of participation in the community and previous collective experience in managed common irrigation systems. In addition, these variables might vary also across communities. The question of whether some communities are more willingness to cooperate and to which extent issues as participation, assets and previous collective experience affect cooperation is tested using a logit regression analysis based on the data for six out of eight communities obtained from the survey developed for this study.

Table 9 summarizes the main results from the model 1 described above in equation 1. As hypothesized earlier, coefficient β_1 is significant and positive which indicates that individuals with previous collective irrigation experiences are more willing to choose the alternative "owning 18ha jointly" instead of "owning 7ha individually". Our model also hypothesized that irrigated land, both in total and per capita terms, can

have an impact on the probability of cooperation. However, while total land is positive and per capita negative, both are not significant in the model. In line with previous results, valuation of participation in the community is a positive and significant variable. Individuals who value higher community action for the request of development projects are also more willing to cooperate regarding land ownership.

As we control for communities in model 2, the results show that geographical controls are very significant. This implies that community characteristics are also powerful explanatory factors of the cooperative behavior of individuals. In addition, in this case total irrigated land becomes significant. This indicates that higher irrigated land endowment increases the probability of preferring a cooperative option, which, in turn might be linked to individual risk perception and participation in cooperatives, as shown in Table 3.

So one can conclude that, despite community conditions play an important role in explaining the probability of cooperating, previous collective experience and total irrigation assets endowment are identified as important factors to take into account independently of site-specific settings. Thus, findings reported in Table 9 confirm our previous hypothesis discussed earlier in section 5.

Table 9. Results from logit model 1 and 2 for analyzing the probability of electing "owning 18 ha jointly" or "owning 7 ha individually"

	Model 1		Model 2	
	Coef.	Std.Err.	Coef.	Std.Err.
Irrigation sharing (β_1)	1.265*	0.692	1.334*	0.809
Irrigated land (β_2)	0.554	0.389	0.999**	0.509
Irrigated land per capita (β_3)	-0.545	1.034	-1.605	1.351
Valuation participation (β_4)	1.585**	0.503	2.056***	0.623
Namanji (δ_1)	-	-	-3.039*	1.660
Sacacli (δ_2)	-	-	-2.818*	1.694
Santa Rosa (δ_3)	-	-	-5.246**	2.491
S. Coyolito (δ_4)	-	-	-2.981*	1.740
Valerio (δ_5)	-	-	-1.587	1.670
Constant (α)	-8.329***	2.050	-7.824***	2.366
Number of observations	87		87	
p<0.10*, p<0.05**, p<0.001***				
	R^2=0.261 Correctly classified=81.61%		R^2=0.351 Correctly classified=86.21 %	

Source: Own elaboration

6. 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, 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.

Focus groups analysis reveals that only a small proportion of farmers has attended Water Law discussion and dissemination sessions and, therefore, posses very little knowledge on the Law rules and outcomes. In addition, from the participants' view, local public organizations are perceived as not being active in law enforcement. On the other hand, noncompliance with the law might be rooted in equity and power issues between small and big farmers located upstream and downstream, respectively. Water scarcity seems also to have the potential for triggering cooperation for groundwater withdrawal. Since artesian wells are in most cases too costly for small farmers, grouping seems to be the means for accessing this resource.

Downscale analysis at household level found that households' participation intensity increases with both total and per capita assets, in the form of irrigated land. This might indicate that households with some capital see benefits in participating in collective irrigation organizations, perhaps because 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. This might be related to the concept of habit (norm) used in the "old" institutional economics.

In addition, successful collective experience is positively correlated with higher valuation of participation and contribution (time and/or money) to the community. Frequency with which members in the community have come together also seems a relevant factor for successful collective experience. This might be link to the process of learning involved in collective action, which is also another factor to be considered to select communities to be prioritized in irrigation district programs.

Our analysis also reflects that individuals' willingness to cooperate on land issues does not necessarily reflect past collective experiences as a community, but whether individuals trust other individuals within the community for engaging in common projects. To a certain extent this could be explained by the type and characteristics of action in which participants engage either at community or individual level. Thus, at community level collective projects are in many cases donor-driven and supported, whereas at individual level decisions often involve higher private investment and risk exposure. In this sense, individual commitment at community level is likely lower as risks might be distributed among a larger number of individuals, while individual production decisions (such as land sharing) often involve greater investment and individual risk exposure.

Results from the logistic regressions suggest that, as we control for geographical differences, having had collective irrigation experience and larger irrigated land assets increases the probability of electing the alternative of collective ownership instead of the individual option. In addition, 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.

Formal irrigation districts require common investments and, for that reason, a minimum institutional and legal set-up. Very little experience has been accumulated in Nicaragua on irrigation districts. So farmers sometimes prefer to invest in their infrastructure, and it should not come as a surprise to see some reluctance to invest in collective organizations. There are individual risks and irreversible results associated with common as opposed to individual endeavors.

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.

7. REFERENCES

Adhikari, Krishna P., and Patricia Goldey. 2010. Social Capital and its "Downside": The Impact on Sustainability of Induced Community-Based Organizations in Nepal. *World Development* 38: 184-194.

Araral, Eduardo. 2009. What Explains Collective Action in the Commons? Theory and Evidence from the Philippines. *World Development* 37: 687-697.

Bodin, Örjan, and Beatrice I. Crona . 2008. Management of Natural Resources at Community Level: Exploring the Role of Social Capital and Leadership in a Rural Fishing Community. *World Development* 36: 2736-2779.

Castellón, Néstor, and Cornelis Prins. 2009. El comité ejecutivo de la subcuenca del río Jucuapa, Matagalpa, Nicaragua. Avances, alcances y aprendizajes. Turrialba, Costa Rica: CATIE.

Fujiie, Masako, Yujiro Hayami, and Masao Kikuchi. 2005. The conditions of collective action for local commons management: The case of irrigation in the Philippines. *Agricultural Economics* 33: 179-189.

Grootaert, Christiaan, and Deepa Narayan. 2004. Local Institutions, Poverty and Household Welfare in Bolivia. *World Development* 32: 1179-1198.

Human Development Report Nicaragua. 2002. El desarrollo humano en Nicaragua 2002. Las condiciones de la esperanza. Programa de Naciones Unidas para el Desarrollo (PNUD). Managua, Nicaragua. Available at http://www.undp.org.ni/files/doc/idhnicaragua2002_completo.pdf

INETER 2009. Map of Nicaragua River Basins. Instituto Nicaragüense de Estudios Territoriales. Available at http://www.ineter.gob.ni/caracterizaciongeografica/capitulo7.4.html

INETER 2010. Climate characteristics in Nicaragua. Instituto Nicaragüense de Estudios Territoriales. Available at http://www.ineter.gob.ni/Direcciones/meteorologia/clima%20nic/caracteristicasdelclima.html

Ishihara, Hiroe, Unai Pascual. 2009. Social capital in community level environmental governance: A critique. *Ecological Economics* 68: 1549-1562.

Krishna, Anirudh. 2004. Understanding, measuring and utilizing social capital: clarifying concepts and presenting a field application from India. *Agricultural Systems* 82: 291-305.

Krishna, Anirudh, and Elizabeth Shrader. 1999. Social Capital Assessment Tool. Paper presented at the Conference on Social Capital and Poverty Reduction, The World Bank, Washington, DC, June 22–24, 1999.

Krishna, Anirudh, and Norman Uphoff. 1999. Mapping and measuring social capital: A conceptual and empirical study of collective action for conserving and developing watersheds in Rajasthan, India. Social capital initiative. Working Paper no. 13. The World Bank, Washington, DC.

Novo, Paula, and Alberto Garrido. 2010. The new Nicaraguan water law in context: institutions and challenges for water management and governance. IFPRI Discussion Paper 01005. International Food Policy Research Institute, Washington, DC. Available at http://www.ifpri.org/sites/default/files/publications/ifpridp01005.pdf

Meinzen-Dick, Ruth, Raju, K.V., and Ashok Gulati. 2002. What Affects Organization and Collective Action for Managing Resources? Evidence from Canal Irrigation Systems in India. *World Development* 30: 649-666.

Meinzen-Dick, Rurth, Monica DiGregorio M, and Nancy McCarthy. 2004. Methods for studying collective action in rural development. *Agricultural Systems* 82:197-214.

Ostrom, Elinor. 2009. A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science* 325: 419-422.

Popeete, Amy R., and Elinor Ostrom. 2004. In pursuit of comparable concepts and data about collective action. *Agricultural Systems* 82: 215-232.

Pretty, Jules. 2003. Social Capital and the Collective Management of Resources. *Science* 302: 1912-1914.

Pretty, Jules, and Hugh Ward. 2001. Social Capital and the Environment. *World Development* 29: 209-227.

Putnam, Robert D. 1995. Bowling alone: America's Declining Social Capital. *Journal of Democracy* 6: 65-78.

Shah, Tushaar. 2007. Issues in Reforming Informal Water Economies of Low-income Countries: Example from India and Elsewhere. *In* Community-based Water Law and

Water Resource management Reform in Developing Countries. Barbara van Kooppen, Mark Giordano, and John Butterworth, eds. Pp. 65-95. Oxfordshire: CAB International.

Teddlie Charles, and Abbas Tashakkori A. 2003. Major Issues and Controversies in the Use of Mixed Methods in the Social and Behavioral Sciences. *In* Handbook of Mixed Methods in Social and Behavioral Research. Abbas Tashakkori, and Charles Teddlie C, eds. Pps. 3-50. USA: Sage Publications, Inc.