ORGANIZATIONAL STRATEGIES IN WATER SHORTAGE SITUATIONS: MEXICAN SELF-ADMINISTRATED IRRIGATION SYSTEMS

paper for the *eighth biennial conference of the International Association for the Study of Common Property (IASCP)*: "Constituting the Commons: Crafting Sustainable Commons in the New Millennium."

Panel entitled "Water Rights and the Institutional Dynamics of Irrigated Systems: between State, Market and Community Action". Organized by P. Mathieu and T. Ruf, Robert Hunt will be the discussant of the panel.

Jacinta Palerm Viqueira *and research team*

Colegio de Postgraduados
Estudios del Desarrollo Rural
Carr. México-Texcoco km. 35.5
Montecillo, Texcoco 56239
Estado de México, México
jpalerm@colpos.colpos.mx

ABSTRACT: Based on a nucleus of 8 in depth case studies with a common methodology (research done by the Colegio de Postgraduados research team and financed by CONACYT) and complemented with other studies that offer information about self-management capacities in the administration of irrigation systems, we have a data base of about 20 cases that comprise different Mexican regions, community and multi-community situations, that present efficacy --and inefficacy, with irrigated surfaces that go from 10 to 10,000 hectares. All of them comprise situations of non administration by the State, and one case of recent transfer of operation to the irrigators.

In Mexico not withstanding the millenary tradition of irrigation there are no (or very few) long date irrigation organizations, this is due to (1) the concentration of land and water by the haciendas, and later the break with the Mexican agrarian reform, that created a multitude of new users, (2) the large irrigation systems constructed by the State in the 20th century were from the start operated by a State bureaucracy (so called Irrigation Districts) as they were largely constructed in

non populated areas; (3) the expansion of State operation in “old” irrigated areas (1950 and 1960) and the State intervention in “organizing” the irrigators of “old” irrigated areas (1970 and 1980)

State intervention probably had a good sounding as there is a reported high rate of non use of new infrastructure (up to 75 % !). This situation is a good indicative of the difficulties of starting operation of irrigation systems where irrigation is new, in contrast to the organizational capacity in places were irrigation is traditional.

Even so, and based on our “data base” we find an impressive capacity in self-management; taking the case of strategies followed in situations of water shortage, we find a consistency in the type of organizational strategies, avoiding the alternative of physical violence and contraction of number of irrigators.

The organizational strategies to face water shortage are not formalized in written documents, but, and perhaps more important, they are agreements to which the irrigation community has arrived at.

There are two relevant aspects I wish to point out, the existence of mechanisms to re-assign irrigation water and to use irrigation water with efficacy avoiding the market (lending, preference to crops in danger, sharing between years, and others) and equity mechanisms (such as giving “complete” water to those with less land).

ORGANIZATIONAL STRATEGIES IN WATER SHORTAGE SITUATIONS: MEXICAN SELF-ADMINISTRATED IRRIGATION SYSTEMS

Jacinta Palerm Viqueira *and research team*[1]

Colegio de Postgraduados

INTRODUCTION

Our knowledge of irrigator's organizational capacity for the administration, maintenance and construction of irrigation systems is surprisingly scarce for Mexico. This knowledge seems essential when we take into account the extent of irrigated land in Mexico (about 6,000,000 hectares); the recent policy of changeover from government to self administration in the Irrigation Districts ("*transferencia*" of the "*Distritos de Riego*") that involves more than half the irrigated surface in Mexico; the self organizational situation of what in Mexico is called small irrigation (that is: not government administrated and not necessarily "smaller" in size than the Irrigation Districts); and the urgency of basin management due to increasing competition for water.

This context makes essential the study of the capacities and limits of self organization, when government presence and intervention is necessary and indispensable, and if the market is the only or the best alternative.

The systematic comparison of in depth case studies of self organization for the administration, maintenance and construction of irrigation systems seems to offer interesting and suggestive results on the subjects of knowing and analyzing self organization capacities and finding and typifying organizational responses to the same type of problems.

This presentation deals first with the methodology used for the case studies; second a summary of the Mexican background in self organizational capacities for irrigation systems, third our research findings dealing with the organizational response to water distribution in scarcity situations, and finally an appreciation of what happens when there is no organizational response.

Our research findings are based on a nucleus of 8 in depth case studies with a common methodology and complemented with other studies that offer information about self-management capacities in the administration of irrigation systems, we have a data base of about 20 cases that comprise different Mexican regions, community and multi-community situations, that present efficacy --and inefficacy[2], with irrigated surfaces that go from 10 to 10,000 hectares. All of them comprise situations of non administration by the State, and one case of recent transfer of operation to the irrigators. (see table 1, most of the case studies in Martínez and Palerm 1997, Palerm and Martínez 2000).

Our main point here is using the cases of capable and efficacious self organizations to explore the organizational response to water distribution in scarcity situations The comparative exploration of the "typical" organizational responses should allow, in principle, to predict what may occur and to favor strategies that are successful.

METHODOLOGY

In 1997 we (the Colegio de Postgraduados research team) begun research on in depth case studies of the existing organization for irrigation systems not government administrated. We received financial support for the project from CONACYT.

The methodology for the case studies (Palerm, Martínez and Escobedo 2000), greatly influenced by Hunt (1988), emphasized:

(a) Consistency in the concepts of "irrigation system", "size" of irrigation system, and "organizational level".

(b) A description of the organization through certain tasks or activities, that is: maintenance, water distribution, conflict resolution, monitoring or vigilance[3], and the water authority in charge; as well as ongoing or history of construction and rehabilitation of infrastructure, in the different organizational levels, including government presence or intervention in all these tasks.

Making the concepts operative.

IRRIGATION SYSTEM.

I. Hunt's (1988 pp. 340) definition of a canal irrigation system as "composed of (1) a facility (gate, offtake) which takes water from a natural channel and moves it away from its natural downhill course and (2) the subsequent control works (canals, gates, fields) that guide the water flowing on the surface to the agricultural plants until that water either soaks into the earth or flows on the surface out of the control works" is useful as a starting point, but as Hunt remarks in the same essay there is a problem when a series of irrigation systems form a continuous irrigated area (as in Valencia, Spain), or when one irrigation system has more than one head facility (as in the 12-Go in Japan).

In our case studies we have found few cases than conform to the definition, even small community systems (see table 1). A few examples:

In a community named Tochimilco, perched on the side of an --now active-- volcano, the Popocatepetl, there are a series of springs than irrigate the community's land, each spring belongs to one *barrio*[4], in some cases to two *barrios*, each with is own organization. In the case of two springs belonging to two different *barrios*, they share the same canal to bring the water towards the community, and then each *barrio* takes its own spring water. Is this one discrete irrigation system or two? Looking solely at physical infrastructure it seems to be one, looking at social organization each *barrio* "owns" a spring and makes arrangements to share one canal.

In the valley of Tehuacán, we have some 10,000 or more hectares of irrigated land, the irrigation sources are a multitude of springs, *qanats*, pumping from deep wells and some river water, no one source has a defined command area: an active water market and a complex web of canals makes it feasible to place the irrigation water in a variety of places, thereby making impossible to know where the irrigation water will go. Is this multi-source and canal network one system or a multitude of interlocking systems?; we can add to this that ownership of water rights, of canals and of land is in different hands including individuals, *ejidos* and old time communities, and that access to all three (water, land and canals) depends on ownership, sharecropping (*mediería*) arrangements, and renting (including payment of canal use).

In, the now extinct, San Juan Teotihuacan system the water sources for the irrigation system included spring water (actually various springs) and also a river that besides --formerly-- draining the spring water, drains torrential waters during the rainy season. Some of the canals carried water directly from the springs, others had off takes from the river --where part of the spring water was deliberately spilt. Is this one irrigation system with two water sources? Does having an off take from a natural channel (the river) make it a different system ?

In the Nexapa river, we find, at least from colonial times (and mentions that this was "*desde los tiempos de la gentilidad*", that is prehispanic), a series of off takes to irrigate land along the river, in the late XIXth c., a canal and a tunnel were constructed for the purpose of taking water from the Atoyac river and spilling it into the Nexapa river; nowadays some 12 irrigation systems that take water from the Nexapa to irrigate some 10,000 hectares have an organization to give maintenance to the canal and the tunnel that bring water from the Atoyac to the Nexapa river and to share the available water. Is this one irrigation system or several with one organization?

In the Cuautla river, one organization covers some 10,000 hectares irrigated with water taken from the river at various points along its course; from a stream that feeds into the Cuautla river; and also from a series of springs that perhaps formerly drained into the Cuautla river, these have their own canals, that is they so not share the same water or the same infrastructure, but they do share the same, government created, organization (or association). Also one off take in this part of the Cuautla river section belongs to another organization (the Tenango canal association). Can the Cuautla river association be called a consortium of irrigation systems --even if they do not share water, and how do we fit in the Tenango association offtake ?

These examples are not exception, but rather the norm.

II. Most difficult was the lack of interlocking between an irrigation system and an organization, an organization could be larger than an "irrigation system" (for example the Cuautla river case) or it could also be smaller (for example the Tehuacán irrigation network is managed and owned by a multitude of organizations, the Tochimilco irrigation system or maybe systems are managed by the *barrio*'s organizations).

III. Also problematic is the place of reservoirs in irrigation systems[5].

Reservoirs play a very important role in Mexican irrigation systems.

In northern Mexico (for example La Laguna) large dams regulate river flow, the decision to open and close the dam gates and how much water to use in one irrigation period directly impacts agriculture, lack of secondary reservoirs means that decision taking at dam level and diversion of water flow though the several very large canals to reach the individual plots is paramount. There is no flexibility in water turn access, an irrigation plan is formulated and closely followed for the, in a good year, 80,000 hectares. Type of crop and irrigation calendars must be closely adhered to. This worked well when the cotton crop had a good price, but nowadays with low cotton prices and no flexibility in irrigation turns there is little chance to innovate. Hydraulic engineers do not see as a solution secondary reservoirs but larger capitalist farmers (100 hectares and more) are investing in secondary reservoirs to allow flexible irrigating of horticulture crops (Palerm Viqueira 1998).

In central Mexico small reservoirs, filled with diverted water from rivers and springs, have a very important presence, they allow catchment of torrential water and redistribution through the, not always constant, rainy season; they allow water saving for the winter dry season; they allow an irrigation system to overcome peak irrigation requirements for certain crops (like maize), they allow out of turn irrigation for punctual crop requirements (for example Palerm Viqueira 1993, Rodríguez Meza 1998, Fortanelli 1997, Cabrera y Martínez 1997, Eling y Sánchez 2000).

IV. To make the concepts operative *and* systematic or consistent --in the case of defining irrigation systems Cressier's (1995 pp. 268-268, 270-271) concept and examples of irrigation networks helped us somewhat.

In the case of why and how to include reservoirs as a part of an irrigation system

Price's (1994) emphasis on the place of large reservoirs or dams as part of irrigation systems as well as Hunt's reply (1994) was illuminating; and, more particularly, Vaidyanathan's (1985, 1999) concept of technical centralization in big irrigation systems, and how, maybe, this links with social organization centralization; also the role of secondary reservoirs as a technical and social decentralization.

V. The operative conclusion was to make a precise description of water sources for use in irrigation and their natural course as well as the physical structures to conduct the irrigation water, and existing reservoirs; the relationship between the course of irrigation water through natural and man made structures and the organization(s) for its management[6] seen through the activities or tasks mentioned above (maintenance, water distribution, conflict resolution, monitoring or vigilance) taking notice of different organizational levels.

SIZE OF IRRIGATION SYSTEM

This has also been a headache, should we take the area dominated by an organization, or that of a "discrete" irrigation system. The data on irrigated surface is mostly linked to organizations, though not all organizations have an official recognition (some are larger and some smaller than officially or government recognized organizations).

The irrigated surface data is also uncertain due to discrepancies in official data, complicated by water rights where it is the land that has a "right" to be irrigated --and may get no water or be partially irrigated; there is also the case of land with a right to be irrigated and the amount of water is specified --that water right in volume may or may not bear on reality.

Other measurement problems, for example, are that from one system to another we find strong variations in the amount of irrigation water --enough to ensure a rainy season maize crop or enough for flower and vegetable crops; and water measurements of spring and river flow are not available, inexistent and in any case depend on the time of the year and the year itself, as Mexican rivers strongly depend on rainy season torrential water[7].

We have some hope that this measurement data will become more readily available and perhaps more trustworthy with the ongoing Mexican government registration program of organizations and their water rights.

ORGANIZATIONAL LEVEL.

The concept of organizational level corresponds to the management of parts of the irrigation system or "irrigation network" (following Cressier 1995), a community organizational level corresponds for example from the off take for the community water tank and the canal irrigation network from the water tank to the fields; while a multi community organization level corresponds from the off take that brings water to two or more communities, the general canal shared by the communities; a next level of organization may be a number of communities that share the same dam from which two or more general canals begin; and so on. The basic idea was and is to avoid stopping at community level and to search for existing organizations or non-organization but that should be in place as the non administration by the government or self organizations makes for upstream / downstream conflict. Ostrom's (1990) concept of nested organizations was very useful. We have also avoided a either / or self organization or government administration (or charter)[8].

This concept has been very useful not only to find more inclusive organizational levels, but also variations in organizational capacity and efficacy in different organizational levels and perhaps more surprising in different tasks. For example organization for maintenance might be good at all levels, but water distribution in water scarce situations may be good in some levels and not in others.

Finding and working with water authorities in different organizational levels and determining their sphere of authority has been an important factor in the methodology for the case studies and in determining the scope of an "organizational level".

The case studies

The case studies are based on field work information: field surveys, cognoscitive maps, observation, participant observation, interviews with water authorities and former water authorities of existing organizational levels, in some cases interviews with government hydraulic bureaucracy; and archive information (particularly the *Archivo Histórico del Agua* [the Water History Archive]). We gave preference to the larger or upper organizational levels as the community level was more researched, we have also tried to give preference to how different organizational levels interact.

Following this research methodology we have 8 case studies which, with other case studies that offer information on self organizations, make a total of some 20 case studies (see table 1).

THE MEXICAN BACKGROUND IN SELF ORGANIZATION FOR THE ADMINISTRATION, MAINTENANCE AND CONSTRUCTION OF IRRIGATION SYSTEMS

When we began the research project the very few existing case studies of multi community irrigation system's "organizations" systematically indicated a very problematic organizational situation, that is organizational incapacity (Millon *et al.* 1962, A. Palerm 1972, A. Palerm y E. Wolf 1980, Cabrera y Martínez 1997, Castañeda 1995). The hydraulic engineer's opinion also indicated a very problematic organizational situation (Palacios 1997, Martínez Saínos 1998).

In Mexico, not withstanding the millenary tradition in irrigation, none or very few long standing institutions or organizations exist due to:

(1) The concentration of land and water in the hands of the *"haciendas"* and later the rupture with the agrarian reform, with this a multitude of "new" irrigators appear (Palerm y Martínez 1997); that is historical continuity of an irrigation system and of an hydraulic space, does not mean continuity in organization (see Fernea 1963 on this point), there may be some continuity in the lower organizational levels (communities) but not in the higher ones.

(2) The big irrigation systems, the *Distritos de Riego*, have been from the beginning government administrated, because --according to Martínez Saínos 1998-- in their beginning there was no one there to receive the irrigation systems, being land colonized with the construction of the irrigation systems; also turnover was

perhaps stopped due to the intervening agrarian reform and not retaken as policy in later years (Aboites 1988, 1994).

(3) The expansion of the presence and intervention of government in the operation of irrigation systems (a) in the 1950's and 1960's the government converted *"juntas de aguas"* (self administrated under government supervision) to *"Distritos de Riego"* (government operated), and in the *"Distritos de Riego"* the government eliminated *"juntas de aguas"* (Salcedo 1999, Lobato 1999, Aboites 1999), and (b) in 1972, the then new *Ley Federal de Aguas*, proposed helping the organizational and administration capacity of small irrigation, leading to a new nomenclature: *"unidades de riego"* (irrigation units) and *"URDERALES"* (an acronym that translates as irrigation units for rural development), that sometimes ended up corresponding to a community or village that belonged to a *"junta de aguas"* (that is a multi community irrigation system), and in other cases ended up as equivalent to a *"junta de aguas"* (Palerm Viqueira y Martínez 1997).

Government intervention in the operation (the *"Distritos de Riego"*) and in the organization (the *"URDERALES"*) possibly had a good foundation when we take into account that a high index of failure is reported for new government constructed irrigation infrastructure, according to Martínez Saínos (1998) at one point in time up to 75 % of new government constructed infrastructure was not being used.

Some government field operatives had taken note and studied the enormous difficulty of initiating the operation of new irrigation systems where irrigation practices where also new, in contrast to the self organizational capacity in areas of traditional irrigation, including self organizational capacity to operate new irrigation systems that allowed an expansion of irrigated land or more water for irrigation. (see for example Escobedo 1991[9] as Master's thesis of a former field operative).

We have found suggestive evidence that pre-existing community organization, not linked to irrigation, is very useful when initiating irrigation systems (Wade 1988 was very stimulating): the traditional community organization can step in to deal with new conflicts: hoses that go through different plots have a "right of way", the owner of the plot cannot cut the hose; one person cannot have more than one hose from one spring source; and so on (Sanches Peraci 1998).

What we are calling "pre-existing knowledge" covers a broad spectrum -- knowledge of irrigated agriculture, of community level organization for irrigation, of multi community organization for irrigation, of technical operational problems to move water through the irrigation system, of organizational knowledge not linked to irrigation ... these need to be further explored.

We wish to make a point that there are probably scale problems in transferring these self organizational experiences to larger irrigation systems (50,000, 100,000 hectares or more) (Vaidyanathan 1985, Wade 1995). Notwithstanding, the scale problems probably are not due to the absence of individual irrigators knowing each other "face to face". Organizations composed of few irrigators (less than 20) for very small systems (20 hectares and less) had --and are having-- many organizational problems, personal face to face knowledge of each other was not what helped solve the problem, rather it was a change in the organizational style, towards consensus decision taking (Serrano 2000).

In our research project we are trying to determine the variables that make easier or more difficult the self organizational capacity. Four of the variables under consideration, among others, are size of the irrigation system, number of irrigators, previous knowledge and inhibitions to self organization as for example when there is government intervention in the administration, all points made above (Palerm Viqueira *et al.* 1999, 2000).

ORGANIZATIONAL STRATEGIES IN IRRIGATION WATER SCARCITY SITUATIONS

The comparative method permits us to typify a response, that --according to our "data base" (see table 1)-- seem pretty much consistent for situations of distribution of scarce irrigation water.

A common methodology for the case studies, systematic group discussions as well as work on an index for an Anthology on case studies greatly helped in putting together the following data, an additional impulse was an invitation by an hydraulic engineer[10] to expound on the [unwritten] rules of self organizational irrigation systems.

In a functioning self organization, temporal water scarcity means greater organization, that is:

-- presence and work of water authorities (called locally: *“juez de aguas*”, “*comisionado”*, “*atopile*”, and so on);

--in some cases the decision to create new posts of water authorities;

-- existence and increment of shared vigilance by water authorities and irrigators in general, particularly aimed at avoiding water spillage and water stealing, in these two cases by constant surveillance of canals, and watching the due water volumes -- for this common knowledge of “*marcas de agua*” [water marks: normal water levels in canals] is specially important;

--sanctions for wasting irrigation water, that is irrigating more than the plants need[11]; we are not certain if this particular situation is common but water lending to support critical plant requirements (see below) would mean that a situation of water wasting would not be present;

--passing from a system of taking water when one wants to, to a strict water rotation system called variously irrigation calendar (*calendario de riego*) or water distribution table (*tabla de distribución*);

---with greater water restriction: implementation of a strict sharing of available irrigation water (water prorate), where we find phenomena like;

water sharing (water prorate) during an irrigation cycle, that is the water turn that the community gets is first used to irrigated the land of only a group of users, and the next water turn will be used by another group;

water sharing (water prorate) between years, one year water will be given to one group that will have privileged access, and the next year another group of irrigators will have first access[12];

water pooling, that is two or more communities will pool their water and establish a rotation on this pooled water.

These situations, of more organization, make themselves present in the following problematic situations:

--during the course of the year, in the dry season just before the start of the rainy season, that irrigators call "*de sequía*" (drought season); and/ or during the rainy season when there is a short but critical drought period (called *canícula* in Mexico),

--when during the past years existing irrigation water has been reduced due to different reasons: upstream construction of new hydraulic works, lowering of water tables that affects spring flow, and so on;

--when, for a given year or years, the quantity of irrigation water available drops due to drought (less rainfall than the usual);

--when during the past years the existing irrigation water is used to irrigate more surface;

--possibly it presents itself also when there is a change in crop patterns toward a pattern that requires a more intensive use of water, but we have no case studies on this; one of the problems here, based on the Texcoco region information[13], is that in a situation where the prevailing crop pattern is maize and open sky flower cultivation is in a process of introduction, a prevailing pattern of maize cultivation means that the whole community plants at the same time and requires irrigation at the same time thereby stretching or overwhelming the operation of the irrigation system based on spring water; whereas flowers, though needing year long irrigation and with more global requirement's of water, does not "peak" at the same time, so flower cultivation is not a problem initially, but some 40 years later with expansion of surface irrigated, changeover to a prevailing flower crop pattern and intensification of flower cultivation (from open sky to greenhouse flower growing) the rules for water appropriation and distribution have to be changed;

--we have also found these organizational difference situations when we compare communities or villages situated downstream/ upstream on the same canal and with more/ less water restriction access; the communities with more irrigation water restrictions are more organized (on this see Wade 1988)[14].

The more egalitarian solutions to water distribution in scarcity situations point to a water sharing (water prorate) that does not necessarily mean dividing the existing water among all, besides this division of existing water, we also find other modalities of water sharing such as water pooling, water turns, and water sharing (water prorate) between years are incorporated.

The above indicates that organization varies in the course of the same year, between years and between user groups belonging to the same irrigation system and the same organization.

Additionally we find decision taking of advancing the water turn and/ or loans based on critical plant requirements that may include postponing watering plants that can stand water shortage --even if reducing their yield, and favoring plants were there would be total crop loss. We find these agreements between communities, between groups of one given community and between individuals from the same community. They are based on crop observation and the decision taking involves all concerned: those that have the water, those that ask for the water and various water authorities (Pimentel Equihua 2000). Possibly certain cases of water stealing to irrigate crops at risk belong to this same pattern, the water is "returned" with or without a money fine paid to the other irrigator.

We have also found a tendency to equity in water scarcity situations, that is sharing of existing water between individual irrigators is not done on the same basis, those that have less land receive the complete water allotment those with more "irrigated land" get a water reduction in such a way that they cannot irrigate all their land (also an official government policy[15]).

The above situations of more organization, of different egalitarian water sharing (water prorate) modalities, water pooling, extraordinary water turns, water preference for crops at risk --are not written or formalized with a "superior" authority, but rather are the results of consensus agreements by all the individual irrigators involved and take place between communities or between village irrigators, and are subject to vigilance by all irrigators.

The absence of a written agreement does not mean absence of great formality in the irrigator's meetings and agreements. We are also finding some cases where agreements are notarized (a much more complicated and expensive proceeding than in the U.S.).

The agreements seem to be always made between equals, that is between representatives of irrigation groups with the same ranking authority, the presence of a water authority to negotiate an urgent water "loan" seems to take place only in the situation of water exchange between individuals (the individual irrigator using the water and the irrigator who asks for water due to crop risk) and seems to follow a logic of avoiding possible violence. The delineated organizational structure is very different from the "*Distritos de Riego*", where an individual irrigator or an irrigators group representative asks for water to a superior authority, and the authority decides and makes operative through his subordinates.

In the security of arrangements agreed upon what role does size and maybe face to face knowledge play? It appears that in the<case of efficacious organizations, the smaller organizations or the lower/smaller organizational levels corresponding to communities or "*ejidos*" that may belong to larger irrigation organizations have more possibilities of organizational responses, for example:

--we have found cases of water sharing (water prorate) agreements between years and equity arrangements only at community level and not between communities[16];

-- we have found cases of strict sharing of available irrigation water division (water prorate), extraordinary rotational water distribution (or water turns), advancing or loaning water in community and multicommunity situations. We have found water pooling only between communities (probably a strict water turns at community level fulfills, technically, the place of water pooling). In the case of associations controlling larger irrigation surfaces (10,000 hectares) continuous supervised water volume measurements (*aforos*) are incorporated; the measurement features the technician (usually a government employed engineer), the irrigator's water authorities and a variable but ever present number of curious irrigators).

OTHER RESPONSES TO WATER SCARCITY: VIOLENCE

It is possibly evident that that organization for water distribution is not needed when a crop does not require water or this water is abundant (save, in the larger systems, for technical operational reasons)

Now what happens in the situations of the dry season just before the start of the rainy season, *canícula,* drought or water reduction for whatever cause, when there is no organizational response:

-- in Fernea's description (1963) for a region in Mesopotamia, the solution is a situation of permanent violence and the protection of dams with earth forts;

--in Mitchell's (1975) description for a community in Peru, physical fights over water distribution increase (in this case the government suppressed the traditional water authorities and there was no replacement);

--in the case of an irrigation system with a long duration self organization, in Japan, in a year of extreme drought, the risk or level of violence led to police or army intervention (Millon 1962)

-- A working proposal to CNA (*Comisión Nacional del Agua,* the Mexican national water agency) on drought contingence plans incorporates the need for army or police supervision in drought situations (Velasco 2000[17]).

--in the case of two organizations that share the same water course Nexapa and Tecamachalco, by reasons of drought and water appropriation upstream, physical violence was about to erupt when it started raining and they, ironically, flooded (Rodríguez Meza 1998).

CONCLUSIONS

Most of what self organizations for administration, maintenance and construction of irrigation systems do, is not to be found in written by rules, when some kind of written rules exist; maintenance, water distribution, conflict resolution, vigilance, authorities election and other activities or tasks are traditionalized; additionally the self organizations also have the capacity to negotiate agreements between themselves to solve problems (such as the given examples of responses to water scarcity), not denying that there are also situations, as we indicated, that may collapse a long standing self organization, as well as organizations that are not capable of responding in organizational terms (non efficacious organizations).

There are several aspects that are relevant:

(a) the capacity to avoid violence in a scarce irrigation water situation;

(b) the capacity of using self organization to implement mechanisms to share scarce irrigation water;

(c) the existence of social mechanisms to re-assign irrigation water that seem to permit efficacy in the use of irrigation water avoiding the market; as, for example, water prorate, water pooling, lending, preference to crops in danger, sharing between years, and others;

(d) the existence of equity mechanisms (such as giving “complete” water to those with less land).

The organizational response is consciously related by the irrigators to avoidance of violence and procuring a water allotment with which “something” may be done. These strategies do not include a water market[18]. It might be interesting to compare these strategies with regions where self managed traditional water markets exist, like the Tehuacán valley and the outskirts of the city of San Luis Potosí (case studies in Palerm and Martínez eds. 2000), as well as cases of new water markets in Irrigation Districts[19].

Maintaining the self organization capacity of efficacious organizations; re-enforcing this capacity, creating self managed organization implies knowing the restrictions --or variables-- that affect self organizational capacity. Otherwise government intervention, instead of reinforcing and maintaining self organizational capacities may collapse existing organizations; also government retraction in those aspects and situations where its intervention or presence is necessary can equally collapse an organization (Ostrom 1999). All this means firstly recognizing that self organizational capacity is possible, and that self organizations exists.

FOOTNOTES

[1] Colegio de Postgraduados research team member's period of collaboration: **1997/ 2000** Rodríguez Meza, Martínez Saldaña, Palerm Viqueira; **1997/1998** Morán and Osorio, Sanches Peraci, Serrano, González Huerta, Zaldívar, Escobedo; **1998/ 1999** Salcedo; **1998/ 2000** Pimentel Equihua; **1999** Hernández Rodríguez; **1999/ 2000** Rivas, Almaraz; **2000** Rodríguez Pelaez, Contreras Rentería. CONACYT funding (project numbers 3242P-S9607 and 30479-S).

[2] We found Ostrom´s (1990) inclusion of cases of failure or collapse of common pool resources institutions very illuminating.

[3] Ostrom (1990, 1999) but not Hunt (1988) takes into account monitoring or vigilance tasks, which we found are very important.

[4] *Barrio* is a common geographical subdivision of communities (also cities) in Mexico, like *quartier, arrondisement* or neighborhood; not based on kinship but closely related, in the case of peasant communities, due to inheritance of land and residence rules.

[5] In the same essay Hunt speculates on the effect of reservoirs on the authority structure [:"Some of the systems in [Hunt's] table 1 have water storage facilities under their control, and some do not. The effect of storage or administrative organization in this sample is not clear, but storage is a very old phenomenon (storage works existed in medieval Ceylon and earlier still in South India). Storage would reduce variance in the amount of water available and would extend water usage in seasonal terms. But storage also encourages expansion of the area irrigated, which would in turn increase the pressure of scarcity, thereby increasing the administrative load. At this

point it is not clear that storage has visible effects upon the authority structure of canal irrigation". (Hunt 1988 pp. 348-349).

[6] On the "relationship between the course of irrigation water through natural and man made structures and the organization(s) for its management" see Palerm Viqueira *et al*. 1999, 2000, Pimentel Equihua and Palerm Viqueira 2000.

[7] In the late XIXth c and early XXth c Mexican government policy demanded metric volume measurements to confirm water rights, Bajío water users argued that this measurement was not possible due to strong variation from year to year, that the ongoing local arrangements where based on proportional access to existing water (Sánchez 2000).

[8] A typology based on the controversy surrounding Wittfogel´s "hydraulic hypothesis".

[9] Published essays Escobedo 1997-a, 1997-b.

[10] Dr. Jaime Collado, many thanks.

[11] Based on the Tochimilco case study (see table 1).

[12] In addition to the cases reviewed in table 1 also González Rodrigo 1993 pp. 60-63, Martínez Lacy 1998 personal communication on Atotonilco, Morelos.

[13] Palerm Viqueira 1993, 1995, González Rodrigo 1993, Zaldívar 1998, Lane 1994, 1997.

[14] Cuautla river case study (see table 1).

[15] Sharing of available irrigation water (water prorate) and equity considerations are also found --according to Velasco 2000-- in official government documents: SRH 1973 *Normas para la aplicación del artículo 60 de la Ley federal de Aguas*, Instructivo técnico número 30, Dirección General de Distritos de Riego, México --as Velasco 2000 states: "En los Distritos de Riego un primer criterio es hacer la distribución en forma proporcional ... el método es igualitario pero no equitativo ... Un segundo criterio basado en el aspecto de equidad es el que utiliza la curva de usuarios, proedimiento usuado en México desde muchos años atrás y que pretende garantizar que los que menos tienen (en tierra y agua) sean los menos afectados. Los principios del método están documentados y oficializados en SRH 1973" (Velasco 2000 pp. 31 y ss).

[16] But see note 15.

[17] "En las áreas más propensas a conflictos entre los usuarios, ... habrá constantemente personal de CNA para registrar niveles y gastos de los canales ... a juicio y solicitud del personal de CNA, habrá elementos del ejército, tanto para resguardar la seguridad de las obras como para evitar enfrentamientos posibles entre usuarios y técnicos de ambas unidades de riego. (....) La vigilancia ... será responsabilidad del personal de los módulos y SRL, verificada por técnicos de CNA y vigilada con el apoyo de los elementos militares." (Velasco 2000 pp. 66, 68).

[18] Surface water was and is subject to government permit, and the laws surrounding the early XXth c agrarian reform did not allow selling and renting of surface irrigation water; but lifting or "discovering" underground water (by means, for example, of *qanats* or wells) was a private venture not subject to a government permit till the 1990's change in laws, and therefore this water could be sold and/or rented.

[19] Palerm Viqueira 1998, Conteras Rentería 1999/ 2000, Fortis and Alhers 1999.

REFERENCES

Aboites Aguilar, L. 1988 *La irrigación revolucionaria. Historia del sistema nacional de riego del río Conchos, Chihuahua (1927-1938)*, SEP/CIESAS, México.

Aboites Aguilar, L. 1994 "Irrigación, desarrollo agrícola y poblamiento en el norte de Mpexico (1925-1938)" (pp 431-459) en C. Viqueira Landa and L. Torre Medina (comp) *Sistemas hidráulicos, modernización de la agricultura y migración*, Universidad Iberaomericana/El Colegio Mexiquense, México.

Aboites Aguilar, L. 1999 (febrero) comunicación personal.

Cabrera Arias, A. and T. Martínez Saldaña 1997 "El riego en Arandas: viejos y nuevos aprovechamientos hidráulicos" (pp. 301-321) en T. Martínez Saldaña and J. Palerm Viqueira (eds) *Antología sobre pequeño riego* [vol I], Colegio de Postgraduados, México.

Castañeda, R. 1995 *Irrigación y reforma agraria, las comunidades de riego del valle de Santa Rosalía, Chihuahua 1920-1945* CNA/ CIESAS (Comisión Nacional del Agua)/ Centro de Investigaciones y Estudios Superiores en Antropología Social), México.

Contreras Rentería, R. 1999/2000 ms "Avances de investigación La Laguna".

Cressier, P. 1995 "Hidráulica rural tradicional de origen medieval en Andalucía y Marruecos. Elementos de Análisis Práctico" (pp. 255-282) en González Alcantud and A. Malpica Cuello (coords.) *El agua. Mitos, ritos y realidades. (Coloquio Internacional. Granada 23-26 de noviembre de 1992)*, Coedición Anthropos/ Diputación Provincial de Granada/ Centro de Investigaciones Etnológicas "Ángel Ganivet", España.

Eling, H. and M. Sánchez 2000 "Presas, canales y cajas de agua: la tecnología hidráulica en El Bajío mexicano" (pp 97-132) en J. Palerm Viqueira and T. Martínez Saldaña (eds.) *Antología sobre pequeño riego*, vol. II, *Organizaciones autogestivas*, Plaza y Valdés / Colegio de Postgraduados, México.

Escobedo Castillo, J. F. 1991 *Análisis de funcionamiento de organizaciones de usuarios de obras de pequeña irrigación. El caso de San Buenaventura Tecalcingo, Puebla*, Tesis de Maestría en Ciencias, Centro de Estudios del Desarrollo Rural, Colegio de Postgraduados, México.

Escobedo Castillo, J. F. 1997-a El pequeño riego en México en T. Martínez Saldaña and J. Palerm Viqueira (eds.) *Antología sobre pequeño riego* [vol I], Colegio de Postgraduados, México.

Escobedo, F. 1997-b "Una zona de riego tradicional, el caso de San Buenaventura Tecalcingo, Puebla" (pp 273-299) en T. Martínez Saldaña and J. Palerm Viqueira (eds.) *Antología sobre pequeño riego* [vol I], Colegio de Postgraduados, México.

Fernea, R. A. 1963 "Conflict in irrigation" (pp. 76-83) en *Comparative Studies in Society and History*, VI [spanish translation:1997 "El conflicto en el regadío" (pp 170-180) en T. Martínez Saldaña and J. Palerm Viqueira (eds.) *Antología sobre pequeño riego* [vol I], Colegio de Postgraduados, México.

Fortanelli Martínez, J. 1997 "Pequeña agricultura de regadío" (pp. 366323) en T. Martínez Saldaña and J. Palerm Viqueira (eds) *Antología sobre pequeño riego* [vol I], Colegio de Postgraduados, México.

Fortis Hernández, M. and R. Alhers 1999 *Naturaleza y extensión del mercado de agua en el D. R. 017 de la Comarca Lagunera, México*, IWMI, Serie Latinoamericana, num 10, México.

González Luna, A. 1994 *Manejo de los recursos y producción agrícola en un sistema de pequeña irrigación, Caso Buenavista de Juárez, Puebla*, Tesis Maestría en Ciencias, Estrategias para el Desarrollo Agrícola Regional, Colegio de Postgraduados, México.

González Rodrigo, J. 1993 *Santa Catarina del Monte. Bosques y Hongos.* Colección Tepetlaostoc, Universidad Iberoamericana, México.

Hunt, R. 1988 "Size and the structure of authority in canal irrigation systems" (pp. 335-355) en *Anthropological Research* (antes *Southwestern Journal of Anthropology*) vol. 44, num. 4.

Hunt, R. 1994 "Reply to Price" *Journal of Anthropological Research* vol 50 1994 pp 205-211.

Lane, M. 1994 "Estudio preliminar sobre la reconstrucción del sistema de riego en la región de Texcoco en 190-30 y 1991" (pp 137-188) in C. Viqueira Landa and L. Torre Medina (eds.) *Sistemas hidráulicos, modernización de la agricultura y migración*, Universidad Iberoamericana / El Coleio Mexiquense, México.

Lane, M. 1997 *Santa María Nativitas*; Tesis Maestría, Antropología Social, Universidad Iberoamericana, México.

Lobato, A. 1999 ms interview by I. Salcedo Baca and J. L. Pimentel Equihua july 12, 1999.

Martínez Lacy, P. 1998 comunicación personal sobre Atotonilco, Morelos.

Martínez Saínos, F. 1998 ms interviews november, 1998; partially printed in Palerm Viqueira, J. e Irma Salcedo 1998 "Grande y pequeño riego en México:la política del Estado (entrevista con el ingeniero Fernando Martínez Saínos)" (pp 14-16) en *Boletín del Archivo Histórico del Agua* año 5, núm. 14, septiembre-diciembre.

Martínez Saldaña, T. and J. Palerm Viqueira (eds.) 1997 *Antología sobre pequeño riego* [vol I], Colegio de Postgraduados, México.

Millon, R. 1962 "Variations in social responses to the practice of irrigation agriculture" (pp. 56-88) en *Anthropological Papers* num. 62, R. B. Woodbury (editor) *Civilizations in Desert Lands*, University of Utah Press, Salt Lake City, Estados Unidos.[spanish translation 1997 "Variaciones en la respuesta social a la práctica de la agricultura de riego" (pp 123-169) en T. Martínez Saldaña and J. Palerm Viqueira (eds.) *Antología sobre pequeño riego* [vol I], Colegio de Postgraduados, México].

Millon, R., C. Hall, M. Díaz 1962 "Conflict in the modern Teotihuacan irrigation system" (pp. 494-524) en *Comparative Studies in Society and History* vol. 4. [spanish translation: 1997 "El conflicto en el sistema de riego del Teotihuacán moderno" (pp 71-121) en T. Martínez Saldaña and J. Palerm Viqueira (eds.) *Antología sobre pequeño riego* [vol I], Colegio de Postgraduados, México].

Mitchell, W. 1975 "Irrigation and community in the central peruvian highlands" en *American Anthropologist* 78 (1) pp. 25-44.

Morán Bravo, L. del C. y R. Osorio Gómez 1997/1998 ms "Avances de investigación: Sistemas de riego, riego por canales a partir de manantiales en Tochimilco, Pueblade Tochimilco, Puebla".

Ostrom, E. 1990 *Governing the commons: the evolution of institutions for collective action*. Workshop in political theory and policy anlaysis. Cambridge University Press, New York, Cambridge

Ostrom, E. 1999 "Principios de diseño y amenazas a las organizaciones sustentables que administran recursos comunes" paper for *VI Conferencia Electrónica y Exposición Virtual en Internet. De cara a la globalización: Organizaciones Económicas Campesinas en América Latina y el Caribe.*

Palacios, E. 1997 "Las unidades de riego o pequeña irrigación" (pp 419-433) en T. Martínez Saldaña. and J. Palerm Viqueira (eds.) *Antología sobre pequeño riego* [vol I], Colegio de Postgraduados, México.

Palerm Viqueira, J. 1993 *Santa María Tecuanulco. Floricultores y Músicos*. Colección Tepetlaostoc, núm. 2, Universidad Iberoamericana, México.

Palerm Viqueira, J. 1995 "Sistemas hidráulicos y organización social: la polémica y los sistemas de riego del Acolhuacan septentrional" (pp 163-178).in *Mexican*

Studies/Estudios Mexicanos vol. 11, num. 2

Palerm Viqueira, J. 1998 ms. field notes La Laguna survey april 15, 16 and 17, 1998.Palerm Viqueira, J. and T. Martínez Saldaña (eds.) 2000 (eds.) *Antología sobre pequeño riego*, vol. II, *Organizaciones autogstivas*, Plaza y Valdés/Colegio de Postgraduados, México.

Palerm Viqueira, J. and T. Martínez Saldaña 1997 "Introducción: la investigación sobre pequeño riego en México" en T. Martínez Saldaña and J. Palerm Viqueira (eds.) *Antología sobre pequeño riego* [vol I], Colegio de Postgraduados, México.

Palerm Viqueira, J., J. G. Rodríguez Meza, Ma. E. Serrano, P. Zaldívar, I. Salcedo Baca, M.González Huerta, R. Osorio and L. del C. Morán, J. L. Pimentel Equihua 2000 "Organización autogestiva de regantes" en Patricia Avila (ed) *Agua, ambiente y desarrollo en México* vol II, Colegio de Michoacán, México [based on paper (may 6 and 7, 1998) for the *Segundo Seminario Preparatorio: El agua y su problemática socioambiental en México: uso, abuso y control de un recurso limitado*, mesa iii actores sociales, gestión y política del agua El Colegio de Michoacán, Zamora, Michoacán].

Palerm Viqueira, J., L. del C. Morán, R. Osorio, J. G. Rodríguez Meza, P. Zaldívar, Ma. E. Serrano, M. González Huerta, J. L. Pimentel Equihua, I. Salcedo Baca, A. Sanches Peraci, Ma. E. Rivas, L. Sánchez Almaraz. Ma. de L. Hernández Rodríguez 1999 "Organizaciones autogestivas para la administración de sistemas de riego" paper (march 9-11, 1999) for the *Taller Internacional Transiciones en materia de tenencia de la tierra y cambio social. Instituciones, organizaciones e innovaciones en torno a los recursos naturales, tierra, agua y bosques*, organized by CIESAS and IRD (Centro de Investigaciones y Estudios Superiores en Antropología Social/ Institut de recherche pour le développement) at the Casa Chata, México.

Palerm Viqueira, J., T. Martínez Saldaña, F. Escobedo 2000 "Modelo de investigación: organización social de sistemas de riego en México" (pp. 31-62) in Palerm Viqueira, J. and T. Martínez Saldaña (eds.) 2000 *Antología sobre pequeño riego*, vol. II, *Organizaciones autogstivas*, Plaza y Valdés/Colegio de Postgraduados, México.

Palerm, A. 1972 *Agricultura y Sociedad en Mesoamérica*, SepSetentas, México.

Palerm, A. and E. Wolf 1980 *Agricultura y Civilización en Mesoamérica*, SEP/ Diana, México.

Pimentel Equihua, J. L. 2000 "Evaluación, por los productores, según criterios objetivos de necesidad de agua para el cultivo (indicadores de stress hídrico), para el intercambio informal de agua de riego" en Palerm Viqueira *et al.* 2000 "Organización autogestiva de regantes" en Patricia Avila (ed) *Agua, ambiente y desarrollo en México* vol II, Colegio de Michoacán, México [based on paper presented 1998 (may 6 and 7) for the *Segundo Seminario Preparatorio: El agua y su problemática socioambiental en México: uso, abuso y control de un recurso limitado*, mesa iii actores sociales, gestión y política del agua El Colegio de Michoacán, Zamora, Michoacán].

Pimentel Equihua, J. L. and J. Palerm Viqueira 2000 (april 2-9) “Diseño de organizaciones autogestivas para el riego: el caso de la Asociacion de Usuarios del río Cuautla, Morelos paper for the *Congreso Internacional de Transferencia de Sistemas de Riego*, Mazatlán, Sinaloa, México coordinated by the Comisión Nacional del Agua.

Price, D. 1994 Wittfogel's neglected hydraulic/hydroagricultural distinction (pp 187-204) en *Journal of Anthropological Research* vol 50 (3) pp 187-204.

Rivas Guevara, M. E. 2000 *Organización social para el pequeño riego, barranca Amatzinac zona baja y Canal Tenango, Morelos*; Tesis Maestría en Ciencias, Estudios del Desarrollo Rural, Colegio de Postgraduados, México.

Rodríguez Meza, J. G. 1998 *La organización social de los regantes del Nexapa, Puebla*; Maestría en Ciencias, Estudios del Desarrollo Rural, Colegio de Postgraduados, México.

Salcedo Baca, I. 1999 *La organización social de los regantes del río Cuautla, Morelos*, Tesis Maestría en Ciencias, Estudios del Desarrollo Rural, Colegio de Postgraduados, México.

Sanches Peraci, A. 1998 *Organizaciones campesinas autogestivas y desarrollo rural sustentable, estudio de caso en la Sierra Juárez de Oaxaca, Municipio de San Juan Tabaa*, Tesis Maestría en Ciencias, Estudios del Desarrollo Rural, Colegio de Postgraduados, México.

Sánchez Almaraz, L. 1999/ 2000 ms “Avances de investigación Xalostoc, Tlaxcala”.

Sánchez, M. 2000 ms “Avances de Investigación De la autonomía a la subordinación. Riego, organización social y administración en la cuenca del Laja, Guanajuato”.

Serrano, M. E. 2000 “Dificultades organizativas: sondeo sobre riego a partir de pozos en dos ejidos” (pp. 63-71) in Palerm Viqueira, J. and T. Martínez Saldaña (eds.) 2000 *Antología sobre pequeño riego* vol II, *Organizaciones autogestivas*, Colegio de Postgraduados, México.

Vaidyanathan, A. 1985 “Water control institutions and agriculture: a comparative perspective” in *Indian Economic Review*. vol XX, num 1 pp 25-83 I.

Vaidyanathan, A.1999 *Water resource manaement. Institutions and irrigation development in India*, Oxford University Press.

Velasco Velasco, I. 2000 (enero) ms *Estudio de las sequías en México. Su importancia y propuesta metodológica para mitigar sus efectos.*

Wade, R. 1988 *Village Republics:economic conditions for collective action in south India* Cambridge, New York, New Rochelle, Melbourne, Sydney: Cambridge University Press.

Wade, R. 1995 “The ecological basis of irrigation institutions: east and south Asia” en *World Development* vol. 23, num. 12 pp 2041-2049.

Wittfogel, K. 1957 *Oriental Despotism. A comparative study of total power.* Yale University

Press, New Haven, Conn., USA.

Zaldívar Martínez, P. 1998 *Expansión urbana e intensificación agrícola en el uso del suelo y agua en la región de Texcoco, estado de México*; Master´s thesis, Estudios del Desarrollo Rural, Colegio de Postgraduados, México.

Table 1: irrigation organizations and / or hydraulic areas

Organization and/or Hydraulic area	Water source and hydraulic infrastructure	Irrigated area (hectares)	Water measurement (lps)	Num. of individual irrigators	Num. of communities	Reference
Nexapa river Org., Puebla	canal and tunnel (common infrastructure) to bring water from the Atoyac to te Nexapa river, 12 offtakes from the Nexapa river	9,145	6,245	5,411	53	Rodríguez Meza 2000 in *Antología sobre pequeño riego* vol. II *Organizaciones autogestivas*
Santo Domingo community, (part of the Nexapa river Org.)	Nexapa river by means of the general canal Santa Lucía	176	123	55	1	Ocampo Fletes 1997 en *Antología sobre pequeño riego* vol. I pp. 375,378
San Isidro Huilotepec community, (part of the Nexapa river Org.)	Nexapa river by means of the general canal Santa Lucía	108	98	54	1	ibid pp. 383, 384
Tochimilco community, Puebla	9 springs, each spring with its own canal network	850	323	943	1	Morán y Osorio 1997/ 1998
Pilantitla Org.	spring Pilatitla	746	35-40 1 hour per hectare once a month		4-6	Escobedo 1997 in *Antología sobre pequeño riego* vol. I pp. 298
San Buenaventura Tecalcingo community, Puebla	various water sources, one canal network:	? 141			1	ibid pp. 276, 277, 298
	spring Pilantitla	141	35-40 1 hour per hectare once a month			
	spring Fundo Legal	21				
	2 deep wells	72 and 43	56 and 60			
	other water sources (different canal network) 3 deep wells, (some water	123	205			

	selling to another community)					
San Juan Tabaa community, Oaxaca	Springs, water moved through hoses, sprinklers; each irrigator with own hose	65		44	1	Sanches Peraci 1998 pp. 9,19,20,24,149
Cuautla river Org., Morelos	3 springs (each spring with discrete canal network); 7 offtakes from Cuautla river (each with discrete canal network), 1 offtake from tributary of Cuautla river	10,250	7,500	4,500	30	Palerm, Pimentel and Salcedo 2000 in *Antología sobre pequeño riego* vol. II *Organizaciones autogestivas*; Pimentel and Palerm 2000
CADER Quecholac region	517 deep wells	14,727			>1	González Luna 1994 pp. 106,107,127
Buena Vista de Juárez community, Puebla (in CADER Quecholac area)	4 deep wells	168		53	1	ibid pp. 115-127
Irrigation District La Laguna	2 reservoir dams on Nazas river	(1991) 100,000 (1998 drought conditions:) 40,000				Fortis and Alhers 1999; Contreras 1999/2000
irrigation "módulo" of the La Laguna Irrigation District	1 offtake for the irrigation "módulo"	<3,000			>1	Palerm Viqueira 1998 field notes
San Juan Teotihuacan Org., edo. México	1 spring and San Juan river torrential water (canal network and use of San Juan river channel)	2,088	560		17	Millón, Hall y Díaz 1997 [1962] en *Antología sobre pequeño riego* vol. I, pp. 72-74; González Huerta 2000 en *Antología sobre pequeño riego* vol. II *Organizaciones autogestivas*
Tule river Org., Arandas, Jalisco	1 reservoir dam on Tule river, canal network	2,100 (in use) 350		(individuals with water rights:) 318	?	Cabrera and Martínez 1997 en *Antología sobre pequeño riego* vol. I, pp. 306-311

				(individuals using irrigation water:) 45		
Texcoco region, edo. de México	multisource: springs and various torrential streams (or perennial if spring water is allowed to drain into streams), interlocking system(s) through canals and streams	74 to 4,144 (data variation)(	-		>1	Zaldivar 1998 pp. 141, 142; Lane 1994 pp. 157
	deep wells (each with own canal network)	4,721 to 11,336 (data variation)				ibid pp. 141, 142
Tehuacán region, Puebla (231 water societies)	multisource: springs, deep wells, qanats; interlockiing canal network	10,966	13,841		>1	Enge, Whiteford, Henao and Campos 2000 in *Antología sobre pequeño riego* vol. II *Organizaciones autogestivas*
Tenango Canal Org., Morelos	two water sources at canal beginning: 1 spring and 1 offtake from Cuautla river	1,813	1,350	1,174	12	Rivas 2000 pp. 78-79
Amatzinac river Org., Morelos	Amatzinac river, 7 offtakes on river	743	745 (at this moment:) 200		11	Rivas 2000 pp. 99, 106, 108
Xalostoc community, Tlaxcala	1 deep well, modern sprinkler equipment	60 (in use) 15		(individuals with water rights:) 30 (individuals using irrigation water:) 10	1	Sánchez Almaraz 1999/2000 avances de investigación
La Noria community, Jalisco	3 deep wells	5 to 10 for each well	8 to 18 for each	10 to 15 for each well	1	Serrano 2000 en *Antología sobre*

			well			*pequeño riego* vol. II *Organizaciones autogestivas*
San José de las Palmas community, Jalisco	1 deep well	20	16	5	1	
La Parada (high) valley Org., San Luis Potosí	La Parada river, 1 reservoir dam, 11 offtakes from river	840		1,076	11	Fortanelli 1997 en *Antología sobre pequeño riego* vol. I, pp. 347-350
La Parada (low) valley region, San Luis Potosí	wells, underground low pressure pipes, each with own canal network	2,566		1,310	7	ibid pp. 347-350
Mezquitic canyon and downstream Org., San Luis Potosí	Mezquitic river, 1 reservoir dam, offtakes from river	1,223			8	ibid pp. 352-354
Las Enramadas Santa María canyon Org. I, San Luis Potosí	Santa María river, 1 reservoir dam	850		3,465	7	ibid pp. 358-363
Las Enramadas Santa María canyon Org. II, San Luis Potosí	Santa María river, 4 offtakes from river	583			5	ibid pp. 358-363
Las Enramadas San Maria canyon region, San Luis Potosí	Santa María river, springs and wells	>1,512.8		>3,365	>10	ibid pp. 356-363