Irrigation institutions typology and water governance through horizontal agreements [previous title in working paper "The Social Fabric of Agreements Between Communities and Institutions of Irrigation for Water Management"] Reference Number: 608a

Jacinta Palerm-Viqueira

jpalerm@colpos.mx

http://www.geocities.com/jacinta_palerm

Colegio de Postgraduados, Mexico

Introduction

Research on the existence and capacities of self-governance organizations for the management of irrigation systems has seen important advances in recent years. There are a growing number of case studies, greater systematization of case study analyses and, as a result, a greater capacity to realize comparative analysis and establish typologies. But concepts such as self governance, and bureaucratic and non bureaucratic management are still vague, as well as their implications. Also, research attention has centered on irrigation system institutions, with little attention of interactions between institutions, or with other water user institutions.

In this paper, on the one hand we will review concepts such as self-governance, bureaucratic and non bureaucratic management, as well as doubts on the benefits of bureaucratic management and centralized self governance illustrated with data from a in depth case study. On the other hand, we will review cases in which irrigation institutions establish horizontal agreements between themselves, without creating a new institution or organizational tier.

Irrigation institutions typology: self governance and bureaucratic and non bureaucratic management

The evidence from case studies allows us to propose that institutions for the administration of irrigation systems, can be typified, (a) by *governance* type, that is governance by the irrigators themselves ("self-governance"[1]) or by the State; (b) by *management* type, non bureaucratic or

bureaucratic, that is, when the irrigators themselves carry out the fundamental tasks on the basis of a body of accumulated local knowledge, filling all of the necessary positions from among their ranks the management type is non bureaucratic ---and might be properly called "self-management"; and when the fundamental tasks are done by hired specialized or professional staff the management type is bureaucratic. (Palerm-Viqueira, 2000; 2001 a; 2001 b; 2002).

It is likely that the capacity for non-bureaucratic management may be limited by the size of the system; but there are non-bureaucratic organizations that operate systems that are as large as 10,000 hectares, that is *medium-sized systems*. The *irrigation system size*, is measured as irrigated surface: *small* a few hundred ha. to 2,000 - 3,000 ha., *medium* 3,000 to 15,000 ha, and *large*, 20,000 - 50,000 - 100,000 and more. (Palerm-Viqueira, 2000; 2001 a; 2001 b; 2002).

The typical organizational design of non bureaucratic management is in organizational levels or tiers of organization, and these are related to the operational levels of the irrigation system. This organizational design has been described and analyzed in explicit terms by Pradhan (1989), Yoder (1994 a, b) and Ostrom(1990) and is also one of Ostrom's organizational principles for sustainable institutions.

Although this organizational design is also found in bureaucratic management of irrigation systems, it is probably mandatory for the non bureaucratic management of the larger irrigation systems were land tenure is characterized by small scale farms, due to the number of people involved. The predominance of small scale farmers in an irrigation system means a multitude of irrigators even in small systems, more so in medium sized irrigation systems; a system with an irrigated surface of 10,000 ha. can have some 4,000 irrigators.

Organizational tiers of bureaucratic and non bureaucratic management as well as different governance type tiers can also be found. For the management of storage reservoirs and for river administration, as well as for large irrigation systems, the organization for the lower operational levels, such as the field irrigation ditches or the irrigation system itself can be non-bureaucratic, but the higher up one moves in the operational levels the use of technical staff is the norm, thus a bureaucratic management. Governance of the larger infrastructure such as storage reservoirs is usually reserved to government (State) institutions with few cases of co-governance or

participation of irrigators' organizations (Maass *et al.*, 1978; Price, 1994; Pimentel-Equihua, 2004; Salcedo, 2004; Freeman *et al.*; Palerm-Viqueira *et al.*, 2000).

The evidence also indicates that the cases of non-bureaucratic management are apparently associated with a pattern of land tenure of peasant smallholders or small scale farmers (Palerm-Viqueira, 2000; 2001 a; 2001 b; 2002). For example, in Mexico, the few large scale farmers in irrigation systems with a prevailing peasant land tenure and a non bureaucratic management opt for hiring a local person to fulfill their obligations in operational tasks instead of investing their own labour[2].

Haciendas or very large scale farms also followed a different pattern. In Mexico, haciendas either had control of the whole irrigation system or had to deal with few other hacienda owners and with powerless peasant communities. Each hacienda sent its own employees to guard over the water and do maintenance work, and social arrangements between users of the same irrigation systems seem to have been largely informal (Lipsett-Rivera, 1999; Sánchez, 2001; Castañeda 2004; see also Hunt, 1988).

The evidence for the United States, where medium and large farms are typical, is that although governance is in the hands of the irrigators, management is usually bureaucratic, save where the pattern of land tenure is characterized by small scale farmers and the irrigation systems are small, such as in the *acequias* of New Mexico (Rivera, 1998) or such as in Utah, where although the formal management is bureaucratic, in fact the "hired staff" are the irrigators themselves (Maass *et al.*, 1978: 332-359). Case studies of management type of irrigation systems with a prevailing land tenure of medium or large farms would be interesting. For example in the Lemore Canal case, the elected president of the "committee" is also Chief Engineer; that is, seemingly a case of non bureaucratic management, but the available information on land tenure is insufficient to establish farm size although it does not seem to be characterized by small scale farmers (Maass *et al.* 1978: 196; Palerm-Viqueira 2001 a).

Non bureaucratic management seems to be an interesting option for small and medium sized irrigation systems, as it is linked with other characteristics. The evidence from case studies of non bureaucratic management characterized by peasant land tenure, show that these peasant institutions for water management can have a centuries old sustainability, for example the

Spanish *comunidades de regantes* (Glick, 1970; Maass *et al.*, 1978; Ostrom, 1990), or the New Mexico *acequias* (Rivera, 1998). The institutional sustainability is also linked to the social capacity towards sustainability of the irrigation works; Rivera (pers. comm.) argues that small scale irrigation systems with simple technology allows the irrigators to maintain and repair the irrigation system with their own pool of local knowledge and capacities and therefore makes the irrigation systems more sustainable. Also due consideration should be given to Worster´s proposal that technocratic management and sophisticated and expensive technology favors large farms (Worster, 1985: 202-203, 215, 248-249).

Another interesting factor linked to non bureaucratic management is that local organizational capacities in irrigation management and governance allow the use of these capacities in developing new enterprises. This has been established in Indian experiences of developing community based water resources (Agarwal *et al.*, 2001:xxvii, 41-42, 191, 297))[3] or, for New Mexico, in the link between the *acequia* tradition of non bureaucratic management and self-governance and the evolution of *sociedades mutualistas* (Rivera, pers. comm.). The social impact of developing local capacities, that can be called "empowerment" is best seen were there is an almost total absence of local organization such as in the black rural communities of South Africa, totally dependant on State provision of domestic water (N. Jha, pers. comm.).

However policies for IMT (Irrigation Management Transfer) seems to favor bureaucratic management, and attention is centered in changing the governance of the irrigation systems and not the management type. For example the World Bank turnover model case is bureaucratic; that is, although governance is in the hands of the irrigators, operation is in the hands of hired technical staff. This organizational model is a Mexican contribution and has been also used for Turkey (Palerm-Viqueira, 2000; 2001 a; 2001 b; 2002; Groenfeldt and Sun, n.d.; Groenfeldt, 1997; *The World Bank Participation Sourcebook,* n.d.; Svendsen and Nott, 1999).

In fact technical staff is thought by some IMT experts as necessary even for small and medium irrigation systems, in the case of medium sized irrigation systems because it is necessary, in the case of small irrigation systems because otherwise they are "stuck in a low-level technology trap", and IMT experts propose associating various small irrigation systems so they can pay an adequate technical staff (Intervention No. 97 by Sam H. Johnson III in *IMT*, 2002).[4]

The assumption is that the technocrats will work for the good of the irrigation system and the irrigators but, as with State institutions staffed with technocrats and charged with irrigation management, the assumption may be wishful thinking. Bureaucratic management has its own set of problems, even with self governance.

For example, the Cuautla River Water Association, had a formal organizational design based on the Mexican model: self governance and bureaucratic management, as well as following the IMT experts recommendation: the association of small irrigation systems --however water distribution was not to the satisfaction of the irrigators.

The following description is based on an in depth case study of the Cuautla River Water Association, financed by the Mexican National Water Agency (Comisión Nacional del Agua) with the commitment of making a working draft of by laws for the Cuautla River Water Association, and that such working draft should be based on a participatory methodology (Palerm-Viqueira *et al.*, 2002).

The Cuautla River Water Association, Mexico, is a recently (1992) turned over irrigation tract (*módulo de riego*) belonging to the Morelos Irrigation District. The Cuautla River Water Association is composed of 29 irrigation systems, sharing the same river but not the same infrastructure. Although the irrigated surface totals some 10 to 13 thousand ha., only four of the irrigation systems have more than a thousand hectares and only one has two thousand ha. The formal organizational design for governance is an assembly of representatives, each community has one representative even if they belong to more than one irrigation system. The assembly elects a committee (president, secretary and treasurer), and the committee is in charge of hiring the Chief Engineer (*gerente técnico*), ditch riders and office staff. Governance and management are centralized --and not decentralized in each irrigation system.

The 2001-2002 organizational diagnostic that preceded the bylaws working draft established that, dating from pre turn over days, each community (*ejido*) had self governance institutions and a non bureaucratic management for the community operational level of the irrigation systems, and that the communities sharing the same main canal of an irrigation system had a non bureaucratic system in place for maintenance. The Water Association was formally in charge through a ditch rider of water distribution in each irrigation system, but the 2001-2002

organizational diagnostic established that not every irrigation system had a ditch rider, and that even with a ditch rider water distribution was problematic. It was also established that there was grassroots movement for a multi community organizational tier in each irrigation system, that is decentralized self governance for each the irrigation system and involvement of the local users in management tasks, particularly vigilance of correct water distribution.

The tail end irrigation system on the river, the one with more water shortages (Mirador), had already established written bylaws for self governance and non bureaucratic management before the 2001-2002 organizational diagnostic; in other irrigation systems the community authorities informed the Chief Engineer of negotiated inter community water distribution agreements, or the Chief Engineer was meeting with community authorities to see if they could arrive at inter community water distribution agreements. Other smaller irrigation systems with no water shortages and that had no Water Association ditch riders, had reached a satisfactory solution for all the irrigators, such as hiring the same person to irrigate their fields, this person functioned as a *de facto* ditch rider deciding on water distribution between his clients.

The grassroots movement for a multi community organizational tier in each irrigation system, also pushed by the Chief Engineer's *de facto* negotiations with the authorities of the communities in a given irrigation system, was reinforced by our own organizational proposal (by-laws working draft) to the Cuautla River Water Association and in fact was backed both by the technical staff and by the elected committee, as it was felt by all that same irrigation system users consensus and vigilance was necessary to establish an equitable and predictable water supply for all. The desired change was from a centralized self governance and a bureaucratic management towards a decentralized self governance and non bureaucratic management.

Other more or less serious problems for the Cuautla River Water Association were lack of control by the irrigators over the monies paid by themselves to the Water Association as water service, and lack of authority to negotiate with other water users, such as the use of the river to dump municipal and industrial residual waters and new groundwater users, that were on the one hand having an impact on water quality and on the other depleting spring sources for the Cuautla river flow. Professional staff as engineers and accountants were being of no help towards monies control or evaluating and negotiating water quality and medium range water availability for the Cuautla River Water Association.

Another assumption made by IMT experts is that modernization is "good" and that technical staff will modernize; but even if we accept that modernization is "good", technical staff may have no interest in modernization, the Cuautla River Chief Engineer was making no effort towards modernization; on the other hand technical expertise can be hired on a temporary bases by non bureaucratic irrigation organizations, such as in the Nexapa case where they hired a construction company that did most of its work for the Mexico City subway system, to fix a tunnel that is an integral part of their irrigation system (Rodríguez-Meza, 1998).

Water governance through horizontal agreements

The above themes need more analysis, however in this paper we also want to call attention to another organizational design, perhaps less widespread, it can be briefly described as horizontal agreements between institutions that do not lead to the creation of a new institution or organizational tier to deal with water distribution, maintenance and monitoring.

By absence of a new organizational tier or new institution, we mean that there is no specific governance body made up by the parts that arrived at the agreement. However it not always clear if there is an institution, as many non bureaucratic and self governance organizations have non official or non State recognized institutions, thus making the institution itself "invisible"; also when water is abundant there is an appearance of absence of organization as governance, management and irrigation functionaries and staff vary in the course of a year, from one year to another and between user groups belonging to the same irrigation system (Palerm, 2001-c, 2003).

Notwithstanding the above, the concept of horizontal agreements helps us to observe and analyze networks of horizontal agreements between water user associations, peasant communities and irrigators that span over medium and large irrigation tracts without creating institutions, without a schema of organizational levels and, of course, with a complete absence of bureaucracy[5]. Non bureaucratic management as well as horizontal agreements break with the technocratic model for water management.

We review a series of cases of horizontal agreements, in some cases creating networks of horizontal agreements between water user associations, peasant communities and irrigators. Most of the cases we review are based on the in depth case study of the Cuautla River Water

Association in the state of Morelos as well as case studies of other irrigation systems in Morelos. The predominance of cases from the state of Morelos perhaps has to do with the high density of irrigation systems in the state of Morelos, but I suspect it has more to do with the in depth case study of the Cuautla River Water Association and with the number of case studies done in the state by the same research group.; as this is also the case for the Tehuacan valley case --based on 4 different research studies.

In all of this cases the horizontal agreements fall outside the space of a discrete, well defined "irrigation system" (Hunt, 1988)[6]. That is, the cases refer to situations where the irrigation system tract is not well defined, the irrigation systems overlap, the irrigation system and the irrigation institution are not isomorphic or refer to river management[7].

Horizontal agreements between institutions --case review

Case 1. The Tehuacan Valley (based on Campos *et al.*, 2000)

In the Tehuacan Valley there are some 10,000 or more hectares (24,710 acres) of irrigated land. The sources of irrigation water include numerous springs, *qanats*, deep wells and some river water.. No single source has a defined command area. An active water market and a complex network of canals makes it possible to carry irrigation waters to a variety of places, so it is impossible to tell exactly where the water will go. To further complicate matters, ownership of water rights, canals and land is in different hands, including private individuals, *ejidos* and indigenous communities; and there are three means of access to them: private ownership, sharecropping arrangements (*mediería*) and rental (including payment for the use of canals). Governance institutions for *qanat*s and canal tracts are *sociedades de aguas* (water societies) composed of the individuals that have water rights, governance institutions for springs, deep wells and river water and canal tracts are *juntas de aguas* or *unidades de riego* that are community or *ejid*o based, and some communities or *ejidos* have canal tracts but no community based water rights.

The Tehuacan valley case can be analyzed, from a purely infrastructure point of view, as comprising one system or as a multitude of interlocking systems; but from a governance point of view they are clearly distinct with horizontal social arrangements making possible the water flow from water source through canals to a given plot.

Case 2. *Achololes* and *achololeras* in the irrigation systems of the Cuautla river (based on Rodríguez-Haro, 2004; Pimentel-Equihua *et al.*, 2001; Palerm-Viqueira *et al*., 2002). See Fig. 1 and 2.

The water user association of the Cuautla river comprises 29 systems, irrigating some 10,000 ha. and, from the view point of the offtakes, each canal is a discrete irrigation system; however, from the point of view of the *acholol* water it is one system, as *acholol* water flows from one system to another.

Local water users define *achololes* as "water that comes from other field plots or other community fields". *Acholol* water is the excess water that drains from a field after irrigation, is captured by drainage canals called *achololera*s and used to irrigate lower lying fields. Local water users use the term "*encadenamiento del agua*" when the *acholol* water from an irrigated plot is re-used by guiding the *acholol* to another plot to augment the irrigation water right or as sole water source. When the *acholol* water flows beyond the possibility of being used in a field , the water users of the field call this *acholol* water "*aguas muertas*" or "*achololes muertos*", that is dead water. However the *acholol* water continues its downhill course and flows directly into other canals of the irrigation systems of the Cuautla river water association or flows into the Cuautla river where it is lifted by downstream irrigation systems, also of the Cuautla river water association. During the dry season (march-may) the use of *achololes* for irrigated agriculture is critical.

The term *achololes* and the use of this water, in the form of "*encadenamiento del agua*" is present in other regions in Mexico, what is outstanding in the Cuautla case is the extent of the *acholol* water. The area covered is some 10,000 ha.

The importance and extent of *achololes* comes most forcibly to attention during the dry season. Flow in the Cuautla river begins with two large springs, several irrigation systems use this water and excess water flows into the Cuautla river. Downstream a small dam lifts all the water in the river, at the next dam water is again present and again it is all lifted leaving the river bed dry and so on downstream. This puzzle has to do with small springs on the river bed *and with acholol water*. It is also possible that the springs on the river bed are related to subsurface drainage of irrigation water.

Quantifying *acholol* water is technically complex, but observation was made of *achololera*s draining *acholol* water into the Cuautla river, and it was possible to make a chart of *acholol* flow due to the fact that irrigators from a given irrigation system knew to what irrigation system they "gave" *achololes* and knew from what irrigation system they "received" *achololes*.

Also, due to a conflict over *acholol* water rights, it was found that *acholol* waters follow not only man made *achololera*s (drainage canals) but also follow social arrangements. In the case in point, that deals with a very small fraction of the total of *acholol* waters, the written agreements date from the 1950's, and were made between the communities that "gave" *achololes* and the communities that were asking for permission to use the *achololes* and build an *achololera* (drainage canal). An attempt was made, also in the 1950's, of registering the water use as a water right with the National Water Agency (Secretaría de Recursos Hidráulicos), but the Agency's answer was that due to the eventual and therefore non measurable characteristic of the water, it was not possible to establish a water right; though due permission was given for the drainage canal construction.

Acholol water users have their own institution for *achololera* maintenance and *acholol* water distribution, the institution for the irrigation system that "gives" the *achololes* does not participate in the institution of *acholol* water users, and these do not participate in maintenance and other tasks of the irrigation system that generates the *achololes*. It is an horizontal agreement.

Although the *acholol* water flow through *achololera*s may be seen as a prolongation of an irrigation system, from the viewpoint of the local water culture influenced by the national legal interpretation in the 1950's and from the viewpoint of governance, they are different systems.

Guillet describes something very similar for the Orbigo valley irrigated by the Duero river, Spain. Small irrigation systems generate return waters, locally called *agua perdida* (lost water) and there are horizontal agreements between irrigation systems, dating from the XVth, XVIth and XVIIIth centuries, so return water goes directly from one system to the other instead of returning the water to the river.

Something similar also in the French East Pyrenees, close to the city of Perpignan, where in a strange twist there was a long standing conflict between two irrigation systems, where the one

upstream refused to pass the return water to the lower lying irrigation system and, on purpose, directed the return water flow to the river; although other irrigation systems in the region had long standing amicable horizontal agreements for the use of return water (Pimentel-Equihua *et al.* 2001; and field trip in April 2000).

Case 3. River management. The Cuautla River Water Association and the Water Cress Producers Association (based on Avalos *et al.*, 2003; Palerm-Viqueira *et al.*, 2002)

The Cuautla river bed, close to the springs, is used for water cress production. Water cress is a semiaquatic crop and requires damming and spreading the river flow. Although the river bed is federal property, water cress producers have a special permit to use the river bed.

The Cuautla River Water Association, composed by 29 small irrigation systems, and the Water Cress Producers Association signed in 1990 an agreement whereby water cress production must cease at the beginning of the dry season.

The conflict, negotiation and agreement between the Cuautla River Water Association and the Water Cress Producer Association is based on the local conviction that the main source of irrigation water for all the downstream systems are the two large springs located upstream where the perennial flow in the Cuautla river begins, under the principle that as less water enters the upstream irrigation system, less water is drained as *achololes*. Irrigators from the tail irrigation system of the Cuautla River Water Association say that suspension of water cress production means up to a 30 % increase in irrigation water during the dry season.

In two specially dry years, 1992 and 2002, all the irrigators of the Cuautla River Water Association, by arrangement, took up their spades and in an orderly and pacific fashion went along the river bed destroying water cress crops and the infrastructure to dam and spread the river flow.

The horizontal agreement between associations as well as the effective mobilization of the irrigators to destroy the water cress crops is another evidence of the importance and extent of *acholol* water.

Case 4. River management. The Cuautla River Water Association and the Canal Tenango Water Association (based on Palerm-Viqueira *et al.* 2002; Rivas, 2000 and pers. comm.)

The Canal Tenango dam lies between two dams of the Cuautla River Water Association, but for diverse historical reasons does not belong to the Cuautla River Water Association. The agreement between them was signed in 1999, and consists in a statement of mutual recognition of water rights, of adjustment of water use in the dry season in proportion to each association's water rights and finally that the Tenango Canal will give due notice of when it will start canal maintenance so that the downstream irrigation systems of the Cuautla River Water Association may anticipate using the water of the Tenango canal.

As the preceding case it is an horizontal agreement for river management.

Case 5. Exchange of irrigation water for *jagüey* (small reservoir) use (based on Rivas, 2000 and pers. comm.)

The Tenango community had at some point in time access to water from the Amatzinac river and still has the water right, but this water is being appropriated by upstream water users on the Amatzinac river. The water from the Amatzinac river for the Tenango community was introduced into a small reservoir, but with no water, the reservoir had no use. At the same time, another community, Santa Ana has access and the due water right to water from the Cuautla river transported by the Tenango Canal, and this canal goes though the Tenango community, but Santa Ana has no reservoir. Both communities negotiated an agreement in 1986 so that Santa Ana could use the reservoir. Santa Ana, in exchange for the use of the reservoir, gave the Tenango community 20 lps of Santa Ana's water right. The Tenango community also has to do the maintenance tasks on the main canal and pay the water service fee to the Tenango Canal Water Association (*Junta de Aguas Canal Tenango, A.C.*). The first written agreement was signed by community authorities and the authorities of the Tenango Canal Water Association, and by a functionary of the National Water Agency (Secretaría de Agricultura y Recursos Hidráulicos), the agreement was ratified by community authorities in 1998 before a federal government institution (the Procuraduría Agraria).

The Tenango community reservoir used to belong to another irrigation system, that took its water from the Amatzinac river, nowadays however it is an integral part of the Tenango canal that carries water from the Cuautla river. Through the agreement between the two communities, the Tenango community began its participation in the Canal Tenango, in water right and in

maintenance work. Probably governance representation in the Canal Tenango Water Association is only through the Santa Ana community. The agreement between the Tenango and Santa communities is horizontal and no new organizational tier has been created, each community checks that other community is fulfilling the agreement terms.

Conclusions

We have shown that there are important differences between bureaucratic and non bureaucratic management, that self governance can mean centralized or decentralized governance, that lack of institutions does not necessary mean lack of governance.

On the one hand, self management or non bureaucratic management, decentralized self governance and horizontal agreements for water governance and management demonstrate the capabilities of peasant irrigators.

On the other hand, bureaucratic management, centralized self governance and large scale irrigation works and institutions may also signify the end of local knowledge systems and peasant communities empowerment.

Bibliography

Agarwal, Anil, Sunita Narain, Indira Khyrana 2001 *Making water everybody´s business. Practce and policy of water harvesting*, Centre for Sciece ad Environment, India.

Avalos, C.; J. Palerm-Viqueira 2003 "Producción del cultivo de berro y captacion de agua en la cuenca del rio Cuautla, Morelos, México", *11 International Conference on Rainwater Catchment Systems, Proceedings, August 25-29, 2003, Mexico*

Campos, Fortino; Luis Emilio Henao; Kjell Enge y Scott Whiteford 2000 "El valle de Tehuacán" (pp. 253-344) In Jacinta Palerm-Viqueira y Tomás Martínez-Saldaña (eds.) *Antología sobre pequeño riego,* vol. II: *Organizaciones autogestivas*, Colegio de Postgraduados/Plaza y Valdes, México

Castañeda, Rocío 2004 "La centralización de un sistema de distribución: el reparto de agua del río Cantarranas, Puebla, 1890-1930" *Boletín Archivo Histórico del Agua: Organizaciones*

autogestivas para el riego, (publicación de aniversario:10 años), nueva época año 9, 2004:

Freeman, D. y M. Lowdermilk 1985 "Middle organizational linkage in irrigation projects" In M. Cernea *Putting people first*, Oxford University Press.

Glick, Thomas 1970 *Irrigation and society in Medieval Valencia*, Harvard University Press, Cambridge, Mass, EEUU.

Groenfeldt, D. and P. Sun n.d. "Demand Management of Irrigation Systems Through Users' Participation", http://www.inpim.org/Library/Gro_dema.pdf. (5/3/2001).

Groenfeldt, David 1997 "Transferring Irrigation Systems From The State To Users: Questions of Management, Authority, and Ownership", *96th annual meetings of the American Anthroplogical Association*. Washington, DC, http://www.inpim.org/Library/Gro_tran.pdf. (5/3/2001).

Guillet, David (ms.) 2003 "Rethinking Irrigation Efficiency: Canal Systems in Northwestern Spain".

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

Irrigation Management Transfer [*IMT*], *International E-Mail Conference (June-October 2001)*, 2002, FAO Land and Water Digital Media Series, num. 17, FAO,

Lipsett-Rivera, Sonya 1999 *To Defend Our Water with the Blood of Our Veins. The Struggle for Resources in Colonial Puebla*, Albuquerque, The University of New Mexico Press.

Maass, A. y R. L. Anderson 1978 *...and the Desert Shall Rejoice. Conflict, Growth, and Justice in Arid Environments*, The MIT Press, Estados Unidos

Ostrom, E. 1990 *Governing the commons, the evolution of institutions for collective action,* Cambridge University Press.

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.

Palerm-Viqueira, J. 2000 "Administración de sistemas de riego: tipos de autogestión", *Memorias in extenso X Congreso Nacional de Irrigación*, Chihuahua, Chihuahua.

Palerm-Viqueira, J. 2001-a "Self management of irrigation systems: a typology. The Mexican case", *2nd Conference of the International Water History Association*, (Aug. 10-12, 2001), Bergen, Norway.

Palerm-Viqueira, J. 2002 "Governance and Organizational type for the administration of Irrigation Systems" (short report), *Irrigation Management Transfer*, *International E-Mail Conference (June-October 2001)*, FAO Land and Water Digital Media Series, num. 17, FAO

Palerm-Viqueira, J. *et al.* 2002 Informe técnico "Diagnóstico organizativo de la Asociación de Usuarios del río Cuautla (Morelos)", financiado por CNA [núm convenio CNA-GDUR-CP-05/2001].

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

Palerm-Viqueira, J. 2001-b "Administración de sistemas de riego: tipos de autogestión (*nuevas noticias*)", *Memorias in extenso XI Congreso Nacional de Irrigación/ExpoAgua 2001*, Guanajuato, Guanajuato.

Palerm-Viqueira, J. 2001-c "Organizational strategies in water shortage situations: Mexican self-administrated irrigation systems" *International Journal of Water*, vol. 1, num. 3-4:285-306.

Palerm-Viqueira, J. 2003 "Regadío y origen del Estado: la investigación de casos mexicanos de administración autogestiva de sistemas hidráulicos" (pp. 321-334) en Patricia Avila (ed) *Agua, ambiente y desarrollo en México* vol II, Colegio de Michoacán.

Pimentel-Equihua, J. L 2004 “Los comuneros regantes de la Acequia Real del Río Júcar en Valencia”, *Boletín Archivo Histórico del Agua: Organizaciones autogestivas para el riego*, (publicación de aniversario:10 años), nueva época año 9, 2004.

Pimentel-Equihua, J. L.; J. Palerm-Viqueira 2001 “Problemas de medición volumétrica y derechos de aguas de riego: el caso de los achololes”, *Riego* (Organo de comunicación de la Asociación Nacional de Especialistas en Irrigación, ANEI, Año II, Núm 3, enero-abril, 2001: 24-26.

Pradhan, Prachanda 1989 *Patterns of irrigation Organization in Nepal. A comparative study of 21 farmer-managed irrigation systems*, IIMI, Sri Lanka.

Price, D. 1994 “Wittfogel's neglected hydraulic/ hydroagricultural distinction”, *Journal of Anthropological Research*, vol. 50: 187-204

Rivas, María 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.

Rivera, J. A. 1998 *Acequia culture. Water, land and community in the southwest,* University of New Mexico, Alburquerque, Estados Unidos.

Rodríguez-Haros, Benito; Claudio Avalos y Jacinta Palerm-Viqueira 2004 “Los achololes, una cultura de riego amenazada en el río Cuautla, México”, *Boletín Archivo Histórico del Agua: Organizaciones autogestivas para el riego*, (publicación de aniversario:10 años), nueva época año 9, 2004: 36-44.

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

Salcedo, Irma (ms.) 2004 Avances de investigación Distrito de Riego 011 Alto Río Lerma, México.

Sánchez-Rodríguez, Martín 2001 *De la autonomía a la subordinación. Riego, organización social y administración de recursos hidráulicos en la cuenca del río Laja, Guanajuato, 1508-1917*, Tesis de Doctorado en Historia, El Colegio de México, Mexico.

Svendsen, Mark and Gladys Nott 1999 *Irrigation Mangement Transfer in Turkey: Process and Outcomes*, EDI Participatory Irrigation Management Case Studies Series, EDI web page (5/3/2001).

The World Bank Participation Sourcebook: Appendix II: Working Paper Summaries "Participation in the Irrigation Sector", WBI Home Page (5/3/2001).

Worster, Donald 1985 *Rivers of Empire. Water, Aridity and the Growth of the American West,* Pantheon Books, Nueva York,

Yoder, Robert 1994-a *Locally managed irrigation systems*, IIMI, Sri Lanka.

Yoder, Robert 1994-b *Organization and management by farmers in the Chhattis Mauja Irrigation System, Nepal*, IIMI, Sri Lanka.

Fig. 1 Irrigation systems Cuautla River Water Association

Fig. 2 Acholol water movement through the irrigation systems of the Cuautla River Water Association

[1] Also called "self-management", but as we wish to distinguish *governance* from *management*, so we will use the term "self-governance".

[2] This observation has come out in all case studies of the research group "Organización Social y Riego" (http://www.geocities.com/jacinta_palerm), but has not been systematically registered.

[3] For example "Another interesting dimension of community-based rain water harvesting is that it helps to generate a community spirit within the village ... and build up what economists call the 'social capital'." (Agarwal *et al*., 2001:xxvii).

[4] For example: "Too much of the IMT literature uses a one-model-fits-all approach that ignores the scale and engineering complexity of a system. Small irrigation 100-300 ha systems in countries such as Indonesia, Thailand, the Philippines, etc. have been sustained for 100s of years with village level irrigators and management by village government officials. In these cases, much of the ISF payment can be in kind and the bulk of the maintenance requirements can be carried out by volunteer labor. On the other hand, 3,000 to 20,000 ha irrigation associations in countries such as Mexico, Colombia, the Kyrgyz Republic, Albania, etc. require a higher level of management and, depending upon the degree of technical sophistication, a higher level of staffing. In these more technical irrigation systems, associations have cash costs for their staff as well as for technical maintenance activities such as dredging canals. Governance is by the board of users and management by hired or contracted staff-and ISF is paid by users to cover the costs of O&M. (...)

"A very interesting intervention (No. 75) by Charles Burt illustrates the problem of the small-scale systems. They are too small to have economies of scale and consequently they are stuck in a low-level technology trap. To increase their technical level of management they need to hire professional staff, yet they cannot do this as long as ISF is paid in kind and with volunteer labor. They also cannot justify modernizing their systems as the system is too small to bear the costs. Mexico realized very quickly that their WUAs had to be large enough to spread the fixed costs of maintaining a professional O&M staff. In recognition of this fact at present a number of small WUAs are sharing office facilities while other WUAs are combining together to reach the economies of scale needed to

maintain a professional O&M program. In other countries, federating WUAs into FOs along a secondary or tertiary supply channel is one means of maintaining small, local WUAs but also creating critical economies of scale for improved management." (Intervention No. 97 by Sam H. Johnson III, Posted 11th October 2001, http://www.fao.org/ag/agl/aglw/waterinstitutions/archive6.stm#Int97 or *IMT*, 2002).

[5] Email exchanges with David Guillet in 2003, as well as his ms: "Rethinking Irrigation Efficiency: Canal Systems in Northwestern Spain" were critical for the analysis on the social agreements over *acholol water* and coming up with the concept of horizontal agreements.

[6] "The following definition is an attempt to specify how to find the boundaries of particular irrigation systems: a canal irrigation system is composed of (1) a facility (gate, off-take) 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 such time as the water either soaks into the earth or flows over the surface out of the control works" (Hunt, 1988:339-340). However, as the author himself remarks in his essay, problems arise when a series of irrigation systems form one 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). See also Palerm-Viqueira, 2001-c.

[7] How these cases and others link to the policies for river basin management, should be explored. The Mexican *consejos de cuenca* are paying very little or no attention to local problems in terms of management or governance.