

Comparative History of Irrigation Water Management, from the Sixteenth to Twentieth Centuries: Spain, Mexico, Chile, Mendoza (Argentina) and Peru.

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Abstract

How much does the decision for centralized or self managed water institutions depend or reflect the size and complexity of irrigation systems. This is an exploratory paper to address this issue.

Hispanic countries share a common legal framework, State intervention has always been strong, for example for water rights, and early (1563) pan-Hispanic legislation indicates the appointment of water judges and procedure for appeals on water judge decisions.

Differences in colonial and XIXth c water management between Peru and New Spain may be based on size and complexity of irrigation systems. In New Spain the main conflict was river water distribution, irrigation systems were small and usually controlled by one peasant community or one hacienda. In the Peruvian coastal valleys irrigation systems were larger and water distribution was critical. Colonial and XIXth c. Peru has a much more developed legislation and by-laws for water management than New Spain. Mexico, in the XIXth and XXth c continued its tradition of self management with State mandated by-laws, save for Irrigation Districts. Peru, after a brief experiment with Spanish style self management in the early XXth c went back to state appointed water managers.

However Mendoza and Chile, in the XIXth have a clearly diverging evolution. In Mendoza, there is a clear continuity from colonial water judges, to the XIXth c Water Court to the Department of Irrigation, only end distribution for around 500 hectares was self managed. Whereas Chile went from colonial water judges to *ad hoc* appointed water judges in the XIXth to self management in the XXth c ---seemingly based on the XIXth c experience with the Maipo canal system. There are no clear differences between Mendoza and Chile save XIXth c experiences, Mendoza with centralization and Chile with the private undertaking of the Maipo canal system.

key words: *irrigation water management, river water distribution management, history, centralized management, self-management*

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Introduction

The debate on the hydraulic hypothesis (the impact of large scale irrigation water works on society) (Wittfogel, 1957) has led to the study of the relationship between **hydraulic infrastructure** and society. Analysis of management and governance of **hydraulic infrastructure** has comprised irrigation systems, hydraulic networks, command area of reservoir dams (for example, Hunt, 1988, 1994; Cressier, 1995; Price, 1994; Maass et al, 1978; Vaidyanathan, 1999). In theory, **management of irrigation systems is unified**; acephalous systems are rare and have been described only for very small systems (Hunt, 1988; Mabry, 2007; Wade, 1988); and in the same vein, **lack of institutions** or lack of overarching institutions **has been linked to violence and infrastructure deterioration** (Millon, 1962; Fernea, 1970; Ostrom, 1990).

It is for **irrigation systems** and not for river water distribution that **management is said to be unified**. There are, however, case studies on complex management of river water, such as that of Bali (Lansing, 1991), that have been held up as examples of decentralized management (Mabry, 2000; Erickson, 2006). Restrictions for self-management have been discussed, for example, irrigation system size (Hunt, 1988), scalar stress due to number of irrigators (Mabry, 2000; Marcus and Stanish, 2006), and type of management (bureaucratic and non-bureaucratic) (Palerm, 2006, forthcoming; Vaidyanathan, 1999; Mabry, 1996). It has also been argued that existence of multi-community or larger **self-governed institutions** for water management is **closely linked with a stable and long-term national or regional legal framework** for self-governed institutions (Sengupta, 2002; also see Ostrom, 1990). Thus, India lacks a legal framework whereas the US, Spain, the Philippines, and Japan have legal frameworks and strong self-governed institutions (Sengupta, 2002; Gimenez and Palerm, 2007).

This paper explores differences in irrigation system management under the same legal framework. Hispanic America, between the sixteenth and early nineteenth centuries, as part of the Spanish Empire, had a common legal framework. The law provided for the appointment of water judges: “We order that *judges* for water distribution be appointed by the *Audiencia*, if this is not the customary practice, then shall the Viceroy or President, City and Cabildo appoint ...” (*Recopilación de Leyes de los Reynos de las Indias 1681*: libro 3, título 2, ley 63; see also Margadant, 1989; Dougnac, 1994). The same legal framework was seemingly also in use in Spain from the *reconquista* until the 1866 and 1879 water laws; the Spanish Empire-wide figure of *water judge* as per Glick (1970: 200-201) probably derived from the Arab “qadi of water”.

The Spanish case

Spain currently has some 3 million hectares under irrigation; two thirds of this area depends on surface water, of which 1,200,000 ha. are based on old irrigation systems and 1,000,000 ha. are based on post-1950 irrigation systems. The Spanish literature makes a distinction between the management capacity of the *comunidades de regantes* (water user associations) of the old and new irrigation systems. Old or traditional *comunidades de regantes*, composed of smallholders, are said to be more capable. The remaining third of the irrigated surface area employs groundwater, which only since the

1985 water law belongs to the public domain (Perez Picazo, n.d.). Water management, based on the *comunidades de regantes*' management of irrigation systems, complements a government river basin authority (*confederación hidrográfica*). .

Spain has a centuries-old tradition of irrigator organizations, greatly enhanced due to the fact that since the *reconquista*, the Crown specifically promoted and officially recognized irrigator organizations. Later, with the 1866 and 1879 water laws, a generalized, legal framework provided for irrigator organizations (the *comunidades de regantes*). At the same time, existing irrigator organizations were legally recognized, thereby allowing continuity of the traditional organizations (Giménez and Palerm, 2007).

Seemingly, the legal framework for Hispanic America was also in use in Spain between the *reconquista* and the nineteenth century water laws. For example, in Guadi, water mayors (*alcaldes de aguas*) were authorized by the monarchs in 1494; in Granada, water judges (*jueces de aguas*) and a water court (*juzgado privativo de aguas*) date from 1501, where the king authorised by-laws in 1535 (Diego, 1984; González and Espinar, 2005); and the Spanish federation of water user associations (FENACORE) currently reports associations called *juzgado privativo de aguas* (water court) and *alcaldía juzgado de aguas* (water mayor court). Glick (1970) proposed that these institutions derived from the Arab "qadi of water". He further stated (p. 200-201), "There seem to have been, thus, two models for the medieval Christian organization of irrigation administration: a cellular one, based on irrigation communities with their own elected officials, and a centralized one, in which irrigation administration was a branch of a higher jurisdiction, typically that of the town."

The late XIX century Spanish water laws made establishment of a *comunidad de regantes* **mandatory** when an irrigation tract shared a river off-take and had 20 or more users. In addition, the water laws (art.282 of the 1866 law and art. 242 of the 1879 law) also provided for other, **non- mandatory**, self-governed institutions "...along a river course ... one or more central or common syndicates may be constituted by mutual agreement, in order to defend rights and to conserve and promote common interests. These will be made up of representatives from the interested *comunidades*." A good example of a mutual agreement syndicate is provided by the case of the six sister ditches of the Jucar River, which between them irrigate 45,000 hectares. The sister ditches of the Jucar have agreements for water distribution in drought years and also jointly negotiate with the Jucar River *confederación hidrográfica* (Palerm forthcoming; Pimentel Equihua, 2004).

The establishment of river basin authorities (*confederación hidrográfica*) began in the 1920s. Although these initially had a strong participatory character, this was soon lost; only towards the second half of the XXth century has user participation been slowly reintroduced (Perez Picazo,n/d). The latest water legislation (TRLA, 2001) renewed the continuity of the irrigator organizations and improved the participatory character of the *confederaciones hidrográficas*.

The Chilean case

In Chile, water administration is fundamentally in the hands of water user organizations, as much in the case of irrigation systems as in the case of rivers. The total surface under irrigation in Chile consists of 1,800,000 ha. Self-management capacity is

impressive, with irrigation systems of 50,000 ha (Laja) and 30,000 ha (Maipo), as well as smaller irrigation systems. This is perhaps even more surprising when one considers that the expansion of irrigated agriculture occurred during the XIXth century (Astaburuaga, 2004). The success of Chilean self-management is not based, as in Spain, on centuries-old traditional irrigation organizations. Turrall (1995), rather, asserts that self-management capabilities have to do with the homogeneous and commercial agriculture sized land tenure. Thus, it is important to note that the 1970s land reform has apparently had some impact on the water user associations (Peña, n.d.).

In Chile during the colonial era, as in all the Hispanic American regions, the law provided for the appointment of water judges: "We order that *judges* for water distribution be appointed by the *Audiencia*, if this is not the customary practice, then shall the Viceroy or President, City and Cabildo appoint ..." (*Recopilación de Leyes de los Reynos de las Indias 1681*: libro 3, título 2, ley 63; see also Margadant, 1989; Dougnac, 1994). In Santiago, Chile, from the time of the city's foundation until independence, *water judges* and building experts (*alarifes*) were appointed with specific water related responsibilities (*Actas de Cabildos*, Guarda, 1978; Barrios Arana, 2000; see also Vergara, 1998). For example, in 1768, owing to extreme water distribution difficulties, the colonial government intervened and appointed a water judge in order to avoid "the stubborn tenacity and violence among owners," and placed armed guards at the water off-takes to ensure a more just water distribution and thus prevent excesses (Donoso, 2003: 42).

In addition to colonial water legislation, the special case of the Maipo [Irrigation] Society was to have strong influence on the development of Chilean water legislation. The first by-laws of the Maipo Society date from 1827 and 1831. In 1832, the President of the Republic approved the Maipo Society's Association Act. This Presidential decree also states that "...court justice tribunals should take notice of the commitments that the Maipo canal shareholders have pledged amongst themselves and not judge on controversies that may arise among them; as shareholders have solemnly renounced to go before courts of law and have assumed the obligation to define their rights amongst themselves." (Obando, 2005) Thus, disputes between shareholders could not be taken outside the Maipo Society.

The 1832 decree was the first case in Chile when the legal personality of a water user association was recognized, and it also gave complete authority to the Maipo Society to judge on its internal issues (a capacity, which in Chile is designated as *arbitro arbitrador*, arbitrating arbitrator), thus providing a degree of judicial autonomy which would only be matched in the Valencia *huerta*, (Spain) until the 1985 water law (Giménez and Palerm 2007).

During the XIX century when considerable expansion of irrigated agriculture took place, as well as during the late XIXth century drought (Figuerola, 1993), new water legislation was enacted. Water distribution issues amongst irrigators were taken before a judge, the judge then appointed a water judge (*juez de aguas*), when irrigators shared the same river water off-take, or a river judge (*juez de río*), when the irrigators only shared the same river water (Donoso, 2003; Diagnóstico, 1999; Puig, 1998; Figuerola 1993; Vergara, 1998). Currently, in the state of Montana in the United States a similar strategy is employed (Montana Code Annotated 2007).

In 1908, Chilean Law Number 2139 gave a legal framework to water user associations (*asociaciones de canalistas*, ditch associations) that shared the same river water off-take. The Maipo Canal Society lawyer used the Maipo by-laws as the basis for the new legislation, which granted legal personality as well as the judicial capacity of *arbitrating arbitrator* to the *asociaciones de canalistas* (Diagnóstico, 1999; Obando, 2005). “This law transferred to the associations all responsibility for the distribution of water pertaining to the association, and removed from the courts the hearing and sentencing of disputes pertaining to these waters, either between members or between members and the association’s board of directors. The boards of directors were granted the authority to hear and sentence as *arbitrating arbitrator*” (Diagnostico,1999: 19).

In March 1949 the *Confederación de Canalistas de Chile* (Chilean Ditch Federation) was formed (Sepulveda et al., 1996); whereas in Spain the *Federación Nacional de Comunidades de Regantes* (National Federation of Irrigator Communities) was founded in 1955.

The 1951 Chilean Water Code legislation used as a basis the XIXth century legislation concerning the appointment of *river judges*, as well as the Chilean experience of creating organizations with legal personality. Thus, the legislation concerning *juntas de vigilancia* (river water user associations) granted legal personality as well as the judicial capacity of *arbitrating arbitrator* to the *juntas de vigilancia*. To this day, the person in charge of water distribution is frequently termed the *river judge* (Diagnóstico, 1999; Obando, 2005).

Currently in Chile, there are *asociaciones de canalistas* and *juntas de vigilancia* as well as *comunidades de aguas*; the latter have the same characteristics as the *asociaciones de canalistas*, but lack legal personality (Diagnóstico, 1999). Evidenced by one case study, differences reside not only on legal personality but also in the fact that the *comunidades de aguas* are user associations of a secondary ditch within an *asociación de canalistas* (Sepulveda et al., 1996). .

The Mendoza province case

The Mendoza water management model is particularly interesting as it presents impressive continuity with the institution of the colonial water mayor (*alcalde de aguas*) as well as for, since 1884, centralizing water management in a single institution, even though management is organized by river basin. The government office *Departamento General de Irrigación* currently manages water for the irrigation of 350,000 ha. This centralized management should perhaps come as no surprise, taking into account that the XVIth century Zanjón Canal had a width of 60, 40 and 20 *varas* (a *vara* is more or less equivalent to a yard) and currently under the name Cacique Guaymallen Canal irrigates 30,000 ha. (Cano, 1941: 271; Rodriguez et al, 2006).

Whereas river and primary canal management manifests a striking continuity, water user associations, the *inspecciones de cauce*, for the management of secondary canals exhibits a significant discontinuity. This is due to the mid XXth century displacement of the self-managed *inspecciones de cauce* by increased centralisation, as well as the more recent policy for revitalising self-management, based on combining or unifying several *inspecciones de cauce* in one larger association, which at least on paper implied the disappearance of the old traditional *inspecciones de cauce* (Torres, 2006;

Bustos, 1997; Mosovisch, 1999; AsIC, Chambouleyron et al, s/f; Diaz Araujo and Bertranou, 2004; Maccari, 2004; Gennari and Eisenclas, 2006; Ruiz, 2007).

Weakness of the *inspecciones de cauce* autonomy may be related to the fact that Mendoza irrigated land tenure since the late XIXth century is characterized by small holders (Bustos, 1997 and pers. comm. 2008).

The city of Mendoza was founded in the late XVIth century, overlying pre-Hispanic irrigation systems. Since the first years of the founding of the city of Mendoza, around 1566, use and care of irrigation water courses was a function of the City Council (*cabildo de la ciudad*). In 1603/1606, the Water Mayor office was instituted, with full authority over water distribution; and a few years later, additional functionaries with irrigation water duties were appointed (Gonzalez, 2006; *Periodo colonial*, 2005; Mendoza Portal Educativo, n.d.).

After Independence, under the Republic in 1815, an alderman water judge (*regidor juez de aguas*) was appointed. In 1833, the Water Court office (*Juzgado de Aguas*) was established, apparently with the same functions as the alderman water judge. In 1844, the *Reglamento General de Aguas* or *Reglamento para el Juzgado de Aguas* (Water Regulation or Water Court Regulation) was enacted (Cano, 1941; Diaz Araujo and Bertranou, 2004; Mendoza Portal Educativo, n.d.). The *Juzgado General de Aguas* (Chief Water Court) is,

“an institution of a rather undefined nature, because even if at times it assumes judicial functions, surely in order to settle disputes amongst irrigators, [it] has as its basic function the management and distribution of water as revealed by the existence of a ditch rider (*tomero*)” (Coria, 2000).

In addition to the Water Court regulation, there are other water regulations, specific to certain towns and ditches, government issued as well, such as that of 1842 for the Acequia Real o del Estado (the Royal or State ditch), currently termed the Jarillar ditch; that of 1852 for the case El Retamo ditch; and the 1837 water regulation for the city Villa de San Martin (Cano; 1941, Araujo and Bertranou, 2004).

The typical water management structure of the XIXth century consisted of a government appointed water judge, supported by a water lieutenant(s) (*teniente de aguas*) and ditch riders (*tomeros*). The water lieutenant acted as the water judge's assistant and the *tomeros* were charged with supervising and operating the systems. The duties and tasks of the *tomero general* (chief ditch rider) and the *teniente general de aguas* (chief water lieutenant) were regulated in Mendoza between 1822-1840 (Gonzalez, 2006). However, concerning the secondary canals (locally called *hijuelas*), the irrigators themselves appointed a water judge and employed their own ditch riders.

The 1884 Water Law replaced the *Juzgado General de Aguas* (Chief Water Court) with the Chief Water Department (*Departamento General de Aguas*), which in 1895 changed to the Chief Irrigation Department (*Departamento General de Irrigación*), headed by the Chief Superintendent of Water. Apparently, 1884 also marks the end of the aforementioned local water regulations, so that water management in the province of Mendoza is completely centralized in the Chief Water Department. However, having river basin sub-delegations ensured decentralisation but “only in a *bureaucratic sense*”

(Cano, 1941; Díaz Araujo and Bertranou, 2004). During that same year the 1884 Water Law also established the *inspecciones de cauce*, an irrigation water user association made up of irrigators who shared the same secondary canals. The *inspecciones de cauce* were created, “*ministerio legis*”, that is by the sole imperative of the law (Pinto, 2006; Maccari, 2004). The legislation of Mendoza province emphasizes the autarchy of the *inspecciones de cauce*. For example, the 1916 Mendoza province Constitution states:

“Article 187- the irrigation laws that the Legislative body may dictate should in no circumstance deprive the interested parties of canals, *hijuelas* and drains, of the faculty to elect their own authorities and administer their rents, without prejudice to the control by the superior irrigation authorities.”

In recent studies emphasis has been placed on the self-governance and autarchic character of the *inspecciones de cauce*, as well as on the mid XXth century process of centralization with the corresponding displacement of the *inspecciones de cauce* (Torres, 2006; Bustos, 1997; Mosovisch, 1999; AsIC; Ruiz, 2007). However, the emphasis on the autarchic character of the *inspecciones de cauce* and the supposedly participatory character they granted to overall water management seems exaggerated, considering that the average irrigated area of a given *inspección de cauce* -- based on Torres (2006) and Chambouleyron et al. (n.d.)-- consisted of 500 ha. or even less.

In the 1980s, a policy for “revitalising” the *inspecciones de cauce* was initiated, based on their “**unification**”, with the objective of achieving “economies of scale” and professionalization. Some years later, in 2006, the policy consisted of the **association** of the *inspecciones de cauce*. With this most recent policy each *inspección de cauce* maintains its specificity. The **unified** and the **associated** *inspecciones de cauce* manage irrigation water for 10,000 to 15,000 ha. (Chambouleyron et al., n.d.; Diaz Araujo and Bertreanou, 2004; Maccari 2004; Torres, 2006; Gennari and Eisenclas, 2006; AsIC; Ruiz, 2007).

The Peruvian case

Peru currently has 1,200,000 irrigated ha. While in Chile and Mendoza the irrigated surface area expanded, in Peru the coastal irrigated surface area served by large irrigation systems declined between the XVIth and XIXth centuries; and these only recovered their pre-Hispanic extension in the XXth century (840,000 ha.); the irrigated areas of the *sierra* (highlands) are estimated at 246,000 ha. Information on water management for Peru is impressively rich.

The large irrigation systems of the coastal valleys have had, since colonial times, government appointed managers and, simultaneously, significant irrigator participation. The valley water was managed as a unit and was, thus, similar to river basin management. Current policy is for management to be turned over to the water user associations in a process of state downsizing (GPER, 1993). In striking contrast to the large coastal irrigation systems, the small irrigation systems of the *sierra* are self-managed.

Indian peasant communities deserve special mention for their self-management capabilities. Most ethnographic work has concerned the *sierra* Indian communities;

however, coastal Indian communities also display considerable self-management capabilities. Ore (2005), for example, describes Indian communities' participation in the maintenance work and surveillance of a large coastal irrigation system, as well as the work on extending the main canal, by means of the coordinated efforts and labour investment of the Indian communities in the early XXth century. However, the Indian communities self-management capabilities were curbed when the 1969 Water Law withheld recognition of the traditional Indian community authorities. The 1969 Water Law has been harshly criticized for its negative impact on the coastal and sierra traditional community organization (Gelles, 1984; Ore, 2005; GPER, 1993; Boelens, 2003; Boelens et al, 2005).

In Peru, early water legislation of note included Viceroy Toledo's 1577 water ordinances for Lima, which mandated that water judges be in charge of water distribution and a 1631 Royal Decree which ordered the Lima City Council (*Cabildo*) not appoint hacienda owners as water judges (Dougnac, 1994). A similar situation is found throughout colonial Peru. For example, the 1566 "Ordinances concerning Caciques and Indian nobles" or "Ordinances concerning Indians" dictated by Doctor Gonzalez de Cuenca in the town of Jayanca says, "I have appointed the mayors, the aldermen (*regidores*) and the water judge and have ordered what care should be taken for the election of said officials, the use and exercise of said offices and have made ordinances that you the *cacique* and the mayors and aldermen and other officials must follow in the exercise of said offices" (Gomez Cumpa, 2002).

However, the most relevant and well known legislation consists of, for northern Peru, the 1699 water regulation by Antonio de Saavedra y Leiva, Superintendent Water Judge (and Dean of the Trujillo Cathedral), and, for Lima, the 1793 water regulation by Ambrosio Cerdan de Landa y Pontero, Water Judge. XIXth century and early XXth century water legislation frequently refers to these regulations and order that they be in force/in effect (for example legislation dating from 1838, 1856, 1901, 1904a, 1917 in the *Archivo Digital de la Legislación en el Perú*).

Colonial water management legislation maintains continuity into the XIXth century, not only due to the persistence of the 1699 Saavedra and 1793 Cerdan water regulations, but also because of the continued presence of water judges. In the Legislative Digital Archive of Peru (*Archivo Digital de la Legislación en el Perú*) there are multiple references to water judges and water courts (*juzgado privativo de aguas*) between 1838 and 1901 (there is also mention of a water court in 1922) (for example legislation from 1838, 1848, 1898, 1901a, 1901b, 1922 in the *Archivo Digital de la Legislación en el Perú*). In addition there is also mention to water courts in the, short lived, 1839 Peruvian Constitution; Article 114 of Title 14 'On the Judicial Authority', which states "there will be tribunals and special courts (*juzgados privativos*) for commerce, mining, tithes, water, dams and confiscations."

The XIXth century legislation is informative concerning how water management was structured, the organization of operation and maintenance, the staff employed in water distribution: water deputies, ditch riders, guards, and other staff (*diputados de aguas, tomeros, guardas, quebradores, comisarios*); and the payment of dues for activities, officials and staff. Of interest is the existence of an assembly of "interested parties": hacienda owners and smallholders (*chacareros*). Normal assembly meetings in the

presence of the water judge are set; and assembly issues concern, for example, the selection and appointment of staff, decisions on maintenance dates, discussion of rates and the apportioning of these. The assembly decisions are binding and set out in minutes.

Irrigator participation in water management also seems to date from colonial times, as user participation in decision-making is stated in Viceroy Toledo's 1577 water ordinances (Dougnac, 1994: 427-428). However, the Peruvian combination of user participation and government appointed officials for management does not appear to have been studied. The 1900-1906 memoirs of Enrique de Guimaraes, water judge of Trujillo province from 1900 to 1906, would be of interest concerning this subject (cited in Klaren, 1976).

Legislation underwent changes with the promulgation of the 1902 Water Code, a code inspired by, if not directly copied from, the Spanish 1866 Water Law, or a very similar one dating from 1879. The legislation mandates water user associations (*comunidad de regantes*). After the new legislation was implemented, there were at least two government approved *comunidad de regantes* by-laws in 1904 (*Archivo Digital de la Legislación en el Perú*). Water management by water judges was discontinued; indeed the 1902 Water Code mandated:

Art. 239 The water judge's administrative function ceases as soon as a water user association (*comunidad de regantes*) has been set up and its by-laws approved by the government.

Art. 240 Functions of officials appointed by Municipalities to attend to water conservation, management and distribution shall also cease when water user associations (*comunidad de regantes*) are set up and by-laws are government approved.

Although the *comunidades de regantes* represented a very successful model in Spain, in Peru they were a failure. Klaren (1976) attributes the failure of water management based on the *comunidades de regantes* model to land tenure polarization, as well as to increased water requirements due to the sugarcane boom. As voting shares were based on the amount of irrigated land, hacienda owners gained control over the election of the board of directors and, therefore, had control over the water manager.

The Peruvian retreat from the *comunidad de regantes* model was set in motion due to uprisings in the Lambeyeque department; and in 1911 "... a technical administration which was completely independent and removed from the interests or activities of the irrigators was implemented in the Lambeyeque department. This reform was deemed very effective; later on water distribution by government officials and engineers became generalized...." (Basadre 1968:165, see also GPER, 1993). The pertinent legislation was passed in 1917, Law Num. 2674.

The 1917 legislation called for water management to be undertaken by Technical Commissions (*Comisión Técnica*), later termed Technical Administrations (*Administración Técnica*), similar to water judge management but in the hands of engineers. The Technical Commission or Technical Administration water management went together with a policy of rationalizing watering as well as investment in new infrastructure. Charles Sutton, a US engineer is said to have played an important role in

these policies. However, changes –rationalization-- in water distribution met with strong opposition (GPER, 1993). User participation appears to maintain its continuity by means of the *comunidades de regantes* organization, as well as through the organized Indian communities.

With the agrarian reform in 1969 and new water legislation (*Ley General de Aguas*), the Technical Administration became responsible for an “Irrigation District”, a term that in Peru refers to the area of a river basin where the Technical Administration operates. The *comunidades de regantes* are replaced by *comisiones de regantes*, a water user association, composed of those irrigators who share the same river water off-take or section of an Irrigation District and by *juntas de usuarios*, a water user association composed of those irrigators sharing the same river water. Authority exercised by the Technical Administration expanded, owing to the disappearance of the haciendas as well as to lack of recognition of the traditional Indian community authorities. The Technical Administration continued to be in charge of water management in the coastal valleys until the more recent policy of state downsizing and turnover to the “organized” users.

The Mexican Case

Mexico went from estimates of an irrigated surface of 600,000 to 2,000,000 ha. in the early XXth century to an estimated 6,000,000 ha in the late XXth century. Expansion of irrigated surface took place both with the “new” Irrigation Districts (since 1926) and also with smaller irrigation projects, located outside the Irrigation Districts. About half of the current irrigated surface area belongs to Irrigation Districts, which frequently have a nucleus of old irrigation systems (Tamayo, 1958: 66, 67, 82; Orive Alba, 1970, Palacios, 1997; Palerm, 2007).

The XIXth century was characterized by almost no water legislation, whereas the XXth century witnessed an overabundance of legislation: new water laws in 1910, 1929, 1934, 1972, 1993, and 2004 as well as water law regulations in 1911, 1930, 1936 and 1994, and special Irrigation District (1926, 1946) and ground water (1945, 1958) legislation (Lanz Cárdenas, 1982). Breaks in continuity occurred with the early XXth century agrarian reform, policy changes in the 1970s, and the massive policy changes in the 1990s (Palerm, 2005).

In Mexico between the XVIth and XIX centuries peasant communities and towns had institutions for water management –water judges (*jueces de aguas*) and in Indian communities a *topil* (Meyer, 1997: 69-70); however, there were typically no overarching institutions linking haciendas, peasant communities and towns for common water management issues. Absence of institutions meant that there were no common elected officials or common hired staff. Water management was decentralized or more precisely acephalous (Lipsett-Rivera, 1999; Camacho, 1998, 2003; Castañeda, 2004, 2005; Salazar, 2000, Mazabel, 2001; Sánchez, 2001; Gómez, 2007; Romero, ms; Sandre and Sánchez, ms; Convenio, 1873; Contrato, 1899; Sentencia, 1625).

Water management in the absence of overarching institutions linking haciendas, peasant communities and towns for common water management issues was based on established [written] arrangements. During the colonial period the typical document is a *repartimiento*, a government produced text setting out water distribution (water division

and measurement structures, water turns, water storage). The *repartimiento* is the judicial outcome to a water distribution conflict and, based on the *Archivo General de la Nación* (National Archive) catalogue, all the *repartimientos* seemingly deal with river water distribution.

The lack of overarching institutions has some partial exceptions; in two cases, dating from 1625 and 1697, instructions were given that irrigators should appoint and pay a guard to supervise water distribution; and in one case the text goes on to say that, in the case that irrigators are remiss, a guard will be appointed by the local court (Mazabel, 2001; Sentencia, 1625). There is also one documented case of a stand alone (neither town nor community based) irrigation institution for the Yuriria artificial lagoon. The 1780 document refers to older ordinances (1780 and 1850 documents compiled in Sandré and Sánchez, ms; Santos, 2006).

In the XIXth century the typical document is a private [written], frequently notarized, agreement also centered on water distribution. How did this work in terms of water management? In late XIXth century accounts each hacienda sent its own employees to guard and monitor water division structures, to ensure they let pass the correct amount of water; also noticed are *ad hoc* meetings in order to coordinate maintenance, although in other cases maintenance is also defined in the horizontal [written] agreements. Conflict on water management issues were settled in court. The XIXth century case specific documents frequently refer to previous documents on water management, for example one dated 1896 refers to documents dated 1600, 1763, 1872 and 1878 which were still in force. (Castañeda, 2004, 2005; Sánchez, 2001; Gómez, 2007; Sandre and Sánchez, ms; Convenio, 1873; Contrato, 1899). Therefore, apparently, Mexico experienced continuity of water management structure between the colonial period and the XIXth century.

The first 1888 federal water legislation was preceded in several instances by state legislation. State water legislation was instituted as far as we know in the following states: Sonora (1843, 1933), Zacatecas (1862), Durango (1881), Guerrero (1898), Oaxaca (1905), Michoacán (1906), Guanajuato (1923), Nuevo León (1851, 1852, 1873, 1892, 1893), Nuevo León y Coahuila (1857, 1860, 1863) (Sandre y Sánchez, ms). However, state legislation only provided rudimentary indications, if any, concerning water management. Furthermore, no studies exist which analyse the impact of state legislation on water management.

By the late XIXth century, beginning in 1888, and throughout the XXth century federal legislation held that water distribution regulation was in the federal government's purview. The federal government's case specific regulations were similar to a colonial *repartimiento*, in the sense that they dealt with water distribution. Later water legislation would also include the specifics of the water user associations (*juntas de aguas*) charged with the implementation of the regulations (concerning water distribution and maintenance). The *juntas de aguas* acted as agents of the federal government in the implementation of their regulations (Palerm, 2005; Palerm and Rodríguez, 2005; Palerm et al, 2004; Palerm et al, ms).

The 1888 water legislation dealt with river water management. Later legislation encompassed river water as well as irrigation system management regulation. Water

law legislation (1910, 1929, 1934, and 1972) and water law regulations (1911, 1930, and 1936) retained the same institutional pattern of water user associations for management of rivers and irrigation systems. Only in the 1929 Water Law did a water user association (*asociación de usuarios*) become mandatory for users of a common off-take. The Chilean and Spanish legislation as well as the Peruvian 1902 water law made a clear differentiation between river water associations and common off-take associations and the existence of a water user association where there is an off-take in common is mandatory. In Mexico, however, the *junta de aguas* could be composed of various other *juntas de aguas*, each having its own sphere of competence. Communities and *ejidos* (agrarian reform land tenure) with legal personality had representation in the *junta de aguas* and had total authority over management of their own water and infrastructure (Palerm, 2005; Palerm and Rodríguez, 2005; Palerm et al, 2004; Palerm et al, ms).

The *juntas de aguas*, based on case studies research, worked well (for example see Martínez and Palerm, 1997; Palerm and Martínez, 2000). It is quite possible that the *junta de aguas* regulations were based on previous documents and local arrangements or at least government officials in charge of making the *junta de aguas* regulations had previous documents on hand. However, the agrarian reform, as well as the 1970s and 1990s changes to water user associations, termed *unidades de riego*, has made follow-up of continuity difficult.

In the 1970s, a policy favouring modernisation and new hydraulic infrastructure in peasant communities organised the recipients of this investment into *unidades de riego para el desarrollo rural* (water user associations), later shortened to *unidades de riego*. Government supervision of the *unidades de riego* was based on a county and state grid of agricultural extension offices. The communities belonging to *juntas de aguas* entered the then voluntary *unidades de riego* programme; new, small-scale infrastructure was turned over to the irrigators of one or more communities as *unidades de riego*. Finally, in the 1992 (as well as the 2004) Water Law, all reference to *juntas de aguas* is absent. In this later legislation, the federal government had sole authority over rivers, whereas previously the *junta de aguas* acted as an agent of the federal government. The fate of the *juntas de aguas* is unclear. In some cases they converted as a whole into *unidades de riego*, whereas in other cases parts and pieces of the *juntas de aguas* either became or continued as *unidades de riego*; in still other cases the *juntas de aguas* have continued to exist even though they have no legal standing (Palerm, 2005; Palerm and Rodríguez, 2005; Palerm et al, 2004; Palerm et al, ms).

The *unidades de riego* model followed the Irrigation District model, an hydraulic infrastructure built and supervised or sometimes directly managed by government officials, a model emphasizing hydraulic infrastructure management rather than water management.

The Irrigation Districts were part of the national policy for the construction of hydraulic infrastructure, which began in 1926. Mexico went from estimates of an irrigated surface of 600,000 to 2,000,000 ha. in the early XXth century to an estimated 6,000,000 ha by the late XXth century. About half of the irrigated surface area belongs to Irrigation Districts (Tamayo, 1958: 66, 67, 82; Orive Alba, 1970, Palacios, 1997).

The Irrigation Districts frequently had a nucleus of old irrigation systems. The early policy was for partial or complete turnover (with the exception of reservoir dams) to water user associations (*asociaciones de regantes* at first and later *juntas de aguas*). However, during the 1950s and 1960s there was a retreat from this policy; and with the 1972 Water Law the management of Irrigation Districts became the sole purview of the federal government, even though some water user associations persisted. More recently, during the 1990s, the government implemented a massive turnover programme. Sections of the Irrigation Districts (*módulos de riego*) were turned over to water user associations; and in the larger Irrigation Districts, main canals were later turned over to the associated *módulos de riego* (*S. de R.L.: Sociedad de Responsabilidad Limitada de Interés Público y Capital Variable*) (Palerm, 2007; Rodríguez Haros, 2007; Salcedo, 2005).

The 1992 and 2004 water legislation advocates for river basin management, however, no attempt has been made to reactivate the **river water** *juntas de aguas*, a policy which would resemble the Mendoza province policy of revitalisation of the *inspecciones de cauce*.

Conclusions

I. River water and irrigation system management: The first arresting similarity between regions is that there is no demarcation between river water management and irrigation system management. Separate, distinct institutions for irrigation system management, if they exist at all, are a late development; however, institutions for management of river water distribution have been a very important component throughout the centuries.

In Spain, irrigation system management institutions become separate and distinct from river water management by mandate, the 1866 and 1879 water laws called for irrigation system and **only** irrigation system institutions; however Spanish legislation did not mandate river water distribution institutions until the early XXth century with the formation of the *confederaciones hidrográficas*. Although the 1866 and 1879 water laws provided for the possibility of the voluntary association of several irrigation system associations, some traditional river water institutions appear to have lost official recognition. For example the Orihuela *juzgado privativo de aguas*, indicated by the fact that it was only recently officially recognized (Orihuela Digital, 2007). The XIXth legislation converted the Granada water administration which consisted of a centralized institution (the *juzgado de aguas*) into a number of *comunidades de regantes* (González and Espinar, 2005). In other cases, such as that of the Valencia *huerta*, traditional drought water distribution between irrigation systems, as well as the common water tribunal was adhered to (Maass et al, 1978; Glick, 1970).

In Chile, irrigation system management becomes differentiated at some point during the XIXth century, when water judges were appointed for irrigation systems and river judges for river water distribution; in the XXth century, legislation makes a distinction between irrigation system institutions and river water distribution institutions.

In Mendoza province, there is no distinction between irrigation system and river distribution management, first the *Juzgado de Aguas* and later the Irrigation Department

managed river water distribution and main canals. Other institutions managed the secondary canals.

In Peru, apart from the 1902 water law, valley wide, or sometimes even multi-valley wide water management by a government appointed water judge or, later, a government appointed *Technical Administration* has been the norm. In the late XXth century irrigation system and river water distribution institutions are differentiated and both types of institutions are mandatory. .

In Mexico, the colonial *repartimientos* and XIXth century horizontal agreements focussed on river water distribution. The 1888 legislation and early XXth century legislation called for river water distribution by self-managed institutions and the early XXth century policies were for river water regulation (*reglamentación de corrientes*) with self-managed institutions in charge of implementing the government made regulations. The self-managed institutions (*juntas de aguas*) were in charge of river water distribution and irrigation system management.

Debate referring to hydraulic hypothesis has centred on a discussion of the organizational demands of hydraulic infrastructure; however, the implication here is that the organizational demands of river water distribution deserves careful attention.

In particular, greater attention should be paid to traditional river water institutions or strategies. The self-managed Bali river distribution is a case in point as well as the cultural understandings concerning river water distribution among the US Hispanic *acequias*. The strategic place of Hispanic *acequias* river water distribution culture is evident through its recent clash with the official river water distribution based on prior appropriation (Crawford, 1988; Rivera and Glick, 2003; Hicks and Peña, 2003).

II. Embeddedness of irrigation management in a larger administrative structure (except Mexico): The second common factor found particularly in the Hispanic American regions, prior to Independence from the Spanish Crown is the prevalence of a centralized model for the organization of irrigation water administration "... one, in which irrigation administration was a branch of a higher jurisdiction, typically that of the town." (Glick, 1970: 200-201). Cases where the irrigators themselves had their own elected officials are rare; one such case is that of the aforementioned irrigation institution for the Yuriria artificial lagoon (Mexico). Note should be taken that in the case of small, traditional, community-based irrigation systems; management was undertaken by the **community authorities**; interestingly in the late XIXth and early XXth century in Mexico there is a shift towards irrigators only management due to, in at least some cases, controversies between community authorities and irrigators, (Henao, 1980; Sandré and Sánchez, ms).

However, the Mexican regional case manifests some striking differences. Although communities and towns had appointed officials (*juez de aguas, topil*) in charge of water management, there was a lack of overarching institutions, linking communities, towns and haciendas. For the colonial period, the *repartimiento* dealt with river water distribution management but the evidence is unclear if this also comprised irrigation systems. In the XIXth century the horizontal agreements also focussed on river water distribution, however they also explicitly refer to irrigation systems (that is to hydraulic infrastructure such as barrages and canals as well as to maintenance work).

There are two takes on this, on the one hand, that the Mexico case is one of **acephalous management of river water distribution/ irrigation systems**. Thus, not only different from the other regional cases, but also theoretically disturbing because, as argued at the beginning of this paper, in theory the management of irrigation systems is unified; acephalous systems are not only rare but are reported only for very small systems; and the lack of institutions has also been linked to violence and infrastructure deterioration.

On the other hand, it may be worth taking a closer look at the mandate in certain *repartimientos*, concerning irrigator-appointed guards (where irrigator coordination would be required for their appointment and for the payment of guard-salary dues) as well as other evidence of irrigator coordination, such as *ad hoc* meetings for maintenance purposes. These situations may provide evidence of the existence of irrigator institutions without the underpinnings of a legal framework for self-managed irrigation institutions.

Due care should be taken with **what** is being managed. For example, horizontal agreements, are also found for use of **irrigation drainage water**; these agreements usually encompass the system that “gives” water and the system that will make use of the water. In the Orbigo valley (Spain), in the Cuautla river (Mexico) and in the French Pyrenees, very similar solutions have been arrived at (Guillet, 2006; Rodríguez-Haros, et al., 2004; Pimentel-Equihua et al., 2006).

III. Irrigation Management Transfer (mixed success): In the second half of the XIXth century and early XXth century in several of the case study regions (Spain, Chile, Peru) national legislation called for a turnover of management from government appointed water judges, that is “centralized”, to self management. The decision for turnover does not seem to be linked to systematic regional differences in irrigation system size or in the number of irrigators.

The irrigation system management turnover went smoothly in Spain and Chile; however, the 1902 management turnover was a failure in Peru. Irrigation system size or scalar stress do not seem to have played an important part, similar sized irrigation systems to those in Peru are self-managed in both Spain and Chile and the size of holdings in Spain make for irrigation systems which irrigate 20,000 ha belonging to 30,000 irrigators (Pimentel Equihua, 2004). Rather the failure of turnover in Peru may be linked to **heterogeneity** of land tenure, as well as intense growth of pressure on water resources at that period.

However, the failure of self management in Peru may also be linked to the fact that, with the 1902 water law, institutions were set up for irrigation system management but not for valley wide water distribution. This also happened in Spain, but it is possible that Peruvian coastal river water distribution is more complex.

In Mexico, the situation was different, as the creation of new self-managed institutions for river water distribution and irrigation system management replaced acephalous management. The success or failure of the new institutions is difficult to assess due to the simultaneous agrarian reform and the late XXth century changeover from *juntas de aguas* to *unidades de riego*.

IV. Legislative frameworks for water management: Legislation frameworks for water management do seem to have tremendous influence on the organization of water management. The prevalence of the “centralized” model and the lack or scarcity of cases, based on the “cellular” model, “... one, based on irrigation communities with their own elected officials” (Glick, 1970: 200-201), is perhaps related to the fact that legislation for the Indies (Hispanic America) called for **appointment** of water judges.

However due account should be given to the fact that the information itself is based on official documents. In ethnographic studies, it is not unusual to find differences between workings on paper and the actual working of water management.. More detailed ethnohistorical studies describing the actual working of water management are needed, that is details on irrigation system and river water distribution management.

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