

National legislative framework for water user associations out of sync with traditional institutions.

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Abstract

The central question is how does the existence, change and continuity of a national legislation framework for irrigators' institutions facilitate or block an effective self governance.

The 1992 Mexican water law called for changes in water user associations that are slowly being implemented, these changes have to do with re-drawing the boundaries of the water user association (usually, but not always, smaller), with displacement of village community authority and with an institutional vacuum at river or even canal level. Field work on several case studies has shown that, in spite of the changes, irrigators seem to maintain the traditional management.

From the government perspective, notwithstanding that water management is said to be a national priority, there is little interest in strengthening traditional institutions; government field operatives rather insist on the peasants' failure to comply with the new legislation. However, in Mexico, traditional institutions seem to be capable of circumventing government directives that would impinge on effective irrigation water management.

Effective institutional design (and a corresponding national legislation framework) has to start by recognizing the users' existing institutions and their capacity to build on these institutions; as well as recognizing the costs of ignoring traditional organizations.

Keywords: Irrigation District, turn-over, water user organizations, operation, distribution, equity

INTRODUCTION

The case study of the Tepetitlan Irrigation System is of special interest, with 9,721 irrigated hectares has built a successful non bureaucratic organization. Bryan Burns suggested a case study of new/ surprising/ successful adaptations and not a case study of failure. In the Tepetitlan Irrigation System the irrigation water users --Mazahua Indians, refused a turnover that called for a bureaucratic type administration. After many negotiations with the Mexican National Water Commission (Comision Nacional del Agua) they were successful in their refusal. The Indian communities involved are now building an organization from the bottom up and, as far as we were able to measure, water distribution is better than before turnover.

The Tepetitlan irrigation system, located in the estado de Mexico, in the upper basin of the Rio Lerma-Santiago, consists of a storage and diversion dam that gives rise to three

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main canals that irrigate 9.721 hectares. The system, save 1 1964 extension , was built by the *haciendas*. In 1920s and 1930s the irrigated lands of the hacienda were distributed to beneficiaries of the agrarian reform. In 1934, the National Agrarian Commission proposed organizing the users in a *junta de aguas*. In the late 1940s, the Tepetitlan irrigation system began operations as an Irrigation District and, with other irrigation systems, become the 033 Irrigation District. Before community authorities (*comisariados ejidales*) were responsible for water distribution within their communities and disputes between communities were reported to the National Agrarian Commission. The National Agrarian Commission sent a functionary to put order in the irrigated area, sometimes threatening to send army troops to make sure that the water flow was not blocked between communities. Around 1936 the administrator of the Tepetitlán-Enyege *haciendas*, that had held on to some 211 hectares of irrigated land, had the keys to open and close the dam (Vargas y Guzmán, 2003 11, Montes and Palerm, 2009, AHA-AS, C. 2441, Exp 34397, f. 4-5; File RAN, Exp 761/410, f. 328).

The operation of Tepetitlan irrigation system, before turnover, was in the hand of the State Irrigation District bureaucracy. However, at community level, community authorities (*comisariados ejidales* and *jueces de agua*) played an important but subordinate role. Maintenance of the irrigation canals was done by the irrigators themselves, however the Irrigation District authorities set the dates and tasks. (Interview with Mr. Juan Cabiedes. Canal-worker from 1964 to 1997. Date of Interview 14 September 2009).

The turn-over process initiates in 1993. However, users, Mazahua Indian communities, refused to adopt a bureaucratic model of administration for the turn-over mainly due to the high cost. The irrigation system was turned-over, after a long process of resistance to hikes in water service charges, as a *unidad de riego*. In the new *unidad de riego* and due to a conflict between irrigators, largely instigated by the National Water Commission, the irrigators have, since 2000, two water user committees (Montes and Palerm, 2009).

Our analysis sought to establish whether there was a deterioration or improvement in water distribution after turn-over, as the absence of an operation with hired staff and the existence of two water user committees seemed to be the easiest answer to an apparent deterioration in water distribution.

Based on preliminary field work assessment the dynamics of water distribution were confusing. On the main canals water was distributed to the communities by either water user committee. The official irrigation schedule was said to have delays because the upstream communities did not close their gates thereby allowing water to flow towards the downstream communities. The irrigators gave different preferential irrigation dates depending on soil type and ploughing technology.

METHODOLOGY

To determinate changes in water distribution the community cropping patterns and intensity of community organization for water distribution, before and after turn-over, was typified. Communities were selected by their upstream/ downstream position. This would give information on the existence of unequal water distribution and would allow us to establish whether inequalities in water distribution were typical or recent.

A strategy of indirect information on the water distribution was used, not only because the dynamics of water distribution was confusing, but also because of the tension due to the existence of the two water user committees.

The case of communities with access to water from tanks (*jagüeyes*) was not considered in the sample, although a case was included as it had access to surface water drawn directly from the dam.

TURN-OVER POLICY AND THE NEW MANAGEMENT AUTHORITIES

In Mexico, for turn-over, Irrigation Districts were subdivided into sections called *módulos*; the National Water Agency would retain control over dams and other large infrastructure, including in some cases main canals (Lopez, 2000). A water user association has created for each *módulo*. Representation would be based on communities with *ejido* and private property, the representatives called *irrigation delegates* would then elect the water user committee. This newly elected water committee had to arrange the formalization of the water user association. In this case the Tepetitlan Irrigation System Water Association.

Communities and irrigation delegates

The Tepetitlan Irrigation System has 34 communities. These communities may have only *ejido*, private property or both types of land tenure. (Table no.1). However, some communities have *barrios* small settlements separated from the community. The barrios do not have formal authorities. In total, there are 46 irrigation delegates from 31 communities with *ejido* and 15 communities with private property –which, as said, overlap.

The communities with *ejido* have a water judge, *comisariado ejidal*, irrigation delegates and other authorities. The communities with private property have as authorities the municipal delegate and the water delegate. When land tenure type overlaps in one given community authorities may collaborate.

Table 1. Communities and neighborhoods from the Tepetitlan Irrigation System.

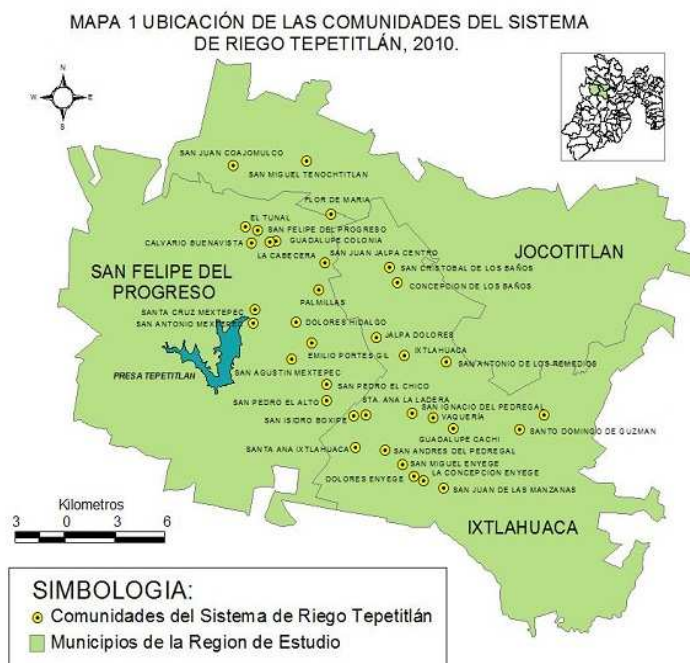
Communities	Main canal	Land tenure	Surface (ha)	Users	Average surface per irrigator (ha.)
1.Santa Cruz Mextepec	Tepetitlán	Ejido	7.25	51	0.14
2.Emilio Portes Gil, formed by the <i>barrios</i> : La Cañada Centro Tepetitlán Tungareo	Enyege Tepetitlán	Ejido	897.45	436	2.06
3.Jalpa Dolores	Tepetitlán	Ejido	6.5	12	0.54
4.Concepción de los Baños	Tepetitlán	Ejido	523.80	350	1.50
5.San Cristóbal de los Baños	Tepetitlán	Ejido	174.20	174	1.00
6.San Pedro el Chico	Enyege	Ejido	5.00	4	1.25
7.San Pedro el Alto	Enyege	Ejido	922.25	484	1.91
8.San Isidro Boxipe	Enyege	Ejido	238.80	157	1.52

9.San Ignacio del Pedregal	Enyege	Ejido	466.55	141	3.31
10.Concepción Enyege	Enyege	Ejido	133.00	88	1.51
11.Dolores Enyege	Enyege	Ejido	220.90	143	1.54
12.San Juan de las Manzanillas	Enyege	Ejido	106.80	144	0.74
13.Guadalupe Cachí	Enyege	Ejido	509.40	377	1.35
14.Emiliano Zapata	Enyege	Ejido	117.90	164	0.72
15.San Pablo de los Remedios	Enyege	Ejido	63.25	39	1.62
16.San Antonio de los Remedios	Enyege	Ejido	60.00	52	1.15
17.San Felipe del Progreso	Tunal	Ejido	157.10	57	2.76
18.San Juan Coajomulco	Tunal	Ejido	73.05	137	0.53
19.El Tunal Barrio Torrecillas	Tunal	Ejido	517.49	226	2.29
20.San Miguel Tenochtitlan	Tunal	Ejido	347.13	159	2.18
21.Vaquería	Tunal	Private property	88.89	1	0.78
22.Colonia Guadalupe	Tunal	Private property	36.53	22	1.66
23.Calvario Buenavista	Tunal	Private property	28.80	28	1.03
24.Flor de María	Tunal	Private property	91.43	34	2.69
25.San Antonio Mextepec	Tepetitlán	Ejido	184.65	251	0.74
		Private property	5.00	30	0.17
26.Dolores Hidalgo	Tepetitlán	Ejido	319.70	240	1.33
		Private property	14.00	14	1.00
27.Palmillas	Tunal	Ejido	135.75	115	1.18
		Private property	27.53	32	0.86
28.San Agustín Mextepec	Enyege	Ejido	369.45	336	1.10
		Private property	14.00	14	1.00
29.Santa Ana la Ladera	Enyege	Ejido	192.85	718	0.26
		Private property	3.50	32	1.10
30.Santa Ana Ixtlahuaca	Enyege	Ejido	9.15	18	0.51
		Private property	35.40	63	0.56
31.San Andrés del Pedregal	Enyege	Ejido	297.20	144	2.06
		Private property	35.68	57	0.63
32.San Miguel Enyege	Enyege	Ejido	176.75	200	0.88
		Private property	26.35	49	0.54
33.La Cabecera	Tunal	Ejido	435.20	120	3.63

		Private property	81.53	60	1.36
34.San Juan Jalpa	Tepetitlán	Ejido	360.02	405	0.89
		Private property	94.75	134	0.71
Totals			9511.38	6834	1.39

Note.- Only the *barrios* found during field-work were listed; there is no official record of barrios.

Source: Source: Vargas y Guzmán, 2003 with modifications.



Source: Based on field-work.

ANALYSIS OF EQUITY IN DISTRIBUTION OF IRRIGATION WATER BY CROP PATTERN, SPECIFICALLY THE VARIETY OF CORN CULTIVATED

The dominant crop in the irrigation system is maize, so community cropping pattern was established by variety of maize, i.e. short and long cycle with attention to planting, irrigation and harvesting dates. Additionally, consideration of “other” crops with attention to planting, irrigation and harvesting dates.

The communities that benefit from the Tepetitlan irrigation system sow different maize, the extremes are a variety of long-cycle maize and a very short-cycle maize. Production per hectare is much higher for long-cycle maize than for short-cycle maize. Election of long or short cycle maize depends on the irrigation date. Therefore a systematic pattern of long or short cycle maize means a systematic unequal water distribution.

Rain, frost, irrigation, and cultivation of maize

The Tepetitlan is at 2,600 meters above sea level, with a rainfall of less than 800 mm and has a sub-humid climate. The traditional agricultural classification is that of *tierra*

fria. The climatic conditions make it impossible to achieve more than one crop of corn a year because of the presence of frost. Mazahuan farmers recognize three kinds of frost: the early frosts that start at the beginning of October, the black frosts between the months of November and February and the late frosts in March. Irrigation is vital, otherwise only very short-cycle maize can be planted because of the limits imposed by the start of the rain season and that of the frost season (Palerm, 1976). The date of the first irrigation determines if the maize that can be planted will be of a short or long cycle; in both cases, the harvest is during the months of November and December. Earliest planting has to be done after black frost (as of March 12).

SOIL TYPE AND PREFERENTIAL IRRIGATION DATES

The cropping pattern strategy to analyze inequality and modifications in water distribution has an additional advantage. The “official” or real water schedule does not allow, in the Tepetitlan irrigation system, to fully determine whether it is possible to plant long or short cycle maize because soil type and the technology used in ploughing (field preparation for sowing) modifies the preferential irrigation dates.

The Mazahuas say there are three types of soil in the Tepetitlan irrigation system: *barrial*, white and *arcillosa*. The soil type is important because it determines the soil's drying after the pre-sowing irrigation, which determines the date to start sowing maize. The drying time depends on soil type and ranges from one to three weeks.

However, the drying time necessary for soil can be modified by the use of different technology (tractors or plows) for ploughing. If animal drawn ploughs are used the required drying time for the same soil is less than if done with a tractor. If a tractor is used on the *barrial* soil, it will take 15 days to dry, but if done with an animal drawn plough drying time will be one week to 10 days. When a tractor is used for white soil, it will take 25 to 30 days to dry, and the time will be reduced to 15 to 20 days with an animal drawn plough. For example, in the *barrial* soil to sow May cycle maize, use of a tractor requires irrigation in February. However, if an animal drawn plough is used (and therefore the soil requires less drying time), irrigation can be postponed. (Tables 2, 3 and 4).

Table 2. Soil type, plough technology, irrigation dates and sowing of long-cycle maize (**May** maize)

CORN CROP	MONTHS	F				M				A			
	WEEKS	1	2	3	4	1	2	3	4	1	2	3	4
May maize Barrial soil Plough	Irrigation					■	■						
	Sowing						■	■	■				
May maize Barrial soil Tractor	Irrigation			■	■								
	Sowing							■	■				
May maize White soil Plough	Irrigation			■	■								
	Sowing						■	■					
May maize White soil Tractor	Irrigation			■	■								
	Sowing							■	■				
May maize Clayey land Yoke	Irrigation					■	■	■					
	Sowing						■	■	■				
May maize Clayey soil Tractor	Irrigation					■	■						
	Sowing								■				

Source: Field work. November-December 2009.

Table 3. Soil type, plough technology, irrigation dates and and sowing of long-cycle maize (**April** maize)

CORN CROP	MONTHS	F				M				A			
	WEEKS	1	2	3	4	1	2	3	4	1	2	3	4
April maize Barrial soil Plough	Irrigation							■	■				
	Sowing								■	■	■	■	
April maize Barrial soil Tractor	Irrigation						■	■					
	Sowing									■	■	■	
April maize White soil Plough	Irrigation							■	■				
	Sowing										■	■	■
April maize White soil Tractor	Irrigation							■	■				
	Sowing												■
April maize Arcillosa soil Plough	Irrigation										■	■	■
	Sowing												■
April maize Arcillosa soil Tractor	Irrigation										■	■	■
	Sowing												■

Source: Field work. November-December 2009.

Table 3. Soil type, plough technology, irrigation dates and and sowing of short-cycle maize ('Violent' maize)

CORN CROP	MONTHS	APRIL		MAY		
	WEEKS	3	4	1	2	3

Violent maize Barrial soil Plough	Irrigation	■	■				
	Sowing			■	■		
Violent maize Barrial soil Tractor	Irrigation	■	■		■	■	
	Sowing						
Violent maize White soil Plough	Irrigation	■	■				
	Sowing			■	■		
Violent maize White soil Tractor	Irrigation	■	■				
	Sowing					■	■
Violent maize <i>Arcillosa</i> soil Yoke or tractor	Irrigation			■	■		
	Sowing					■	■
Violent maize Barrial soil Plough	Irrigation		■	■	■		
	Sowing					■	■
Violent maize Barrial soil Tractor	Irrigation			■	■		
	Sowing					■	■
Violent maize White soil Plough	Irrigation			■	■		
	Sowing					■	■
Violent maize White soil Tractor	Irrigation			■	■		
	Sowing					■	■
Violent maize Arcillosa soil Plough	Irrigation			■	■		
	Sowing					■	■
April maize Arcillosa soil Tractor	Irrigation			■	■		
	Sowing					■	■

Source: Field work. November-December 2009.

THE WATER DISTRIBUTION PATTERN

The irrigation schedule plan established since it was an Irrigation District, indicates that irrigation initiates upstream and ends downstream. The downstream users must wait until the upstream users finish watering or close some floodgates to start irrigating.

The unequal distribution of water has to do with the position the communities occupy, i.e. if they are located down or upstream on the main or secondary canals.

The planting of long or short cycle maize depends on the dates in which the communities get their irrigation water. Those that get the water early in the year (mid-February or early March) sow long-cycle maize; those that get the water in late-March sow April maize, and those that get the water until late-April sow the violent or very short cycle maize, which is usually grown in rain-fed lands and used as a last resource when the irrigation water comes belatedly. The variety of maize is an element that allows overcoming different irrigation dates.

The most-used varieties of maize, according to the local classification, from longer to shorter cycle are: March White, April White, Yellow, Black, Red and Pink. This isn't a complete range of the varieties of maize used in Tepetitlan, but they are the most common in the Tepetitlan irrigation system.

Non compliance of the official irrigation schedule, such as upstream communities not closing their gates after irrigating for March and April maize sowing due to the presence of "other" crops such as tomatoes and flowers --these other crops require from 3 to 6 irrigations during the months of February, March, April and May (see table 5 on other crops and irrigation dates)-- was taken into consideration. The surface irrigated by the Enyege and Tepetitlan main canals does have "other" crops, but not the surface irrigated by the Tunal main canal.

Table no.5 Irrigation, planting and harvesting of "other" crops.

OTHER CROPS		O	N	D	E	F	M	A	M	J	J	A	S	O	N	D
Tomato	Irrigation					■	■	■	■							
	Planting						■									
	Harvesting												■			
Broad bean	Irrigation				■	■										
	Planting	■														
	Harvesting								■							
Dry bean	Irrigation						■	■								
	Planting						■	■								
	Harvesting														■	■
Flower	Irrigation						■	■	■							
	Planting						■									
	Harvesting									■	■	■	■	■		
Oats	Irrigation					■	■	■								
	Planting				■											
	Harvesting							■	■							

Source: Field work. November-December 2009.

ANALYSIS ON THE EQUITABLE DISTRIBUTION OF IRRIGATION WATER BASED ON THE INTENSITY OF COMMUNITY ORGANIZATION TOWARDS WATER DISTRIBUTION

To determine whether there were differences in water distribution, the social organization for water distribution at community level and the existence of inter-community agreements was taken into consideration. The community level response to water scarcity is more intensity of community level organization; for example communities downstream on the same main canal are more organized than those upstream (Wade, 1988). The same situation has been analyzed for the Cuautla river irrigation systems, differences in community level organization are linked to their

upstream/ downstream position (Palerm, Pimentel, Salcedo, 2000; see also Palerm, 2001).

In the Tepetitlán irrigation system the communities located *downstream* on the main or secondary canals were found to have a post turn-over proliferation of community authorities linked to water distribution (Table 6). This seemed to be an organizational response to water scarcity, and *possibly*, to a situation of growing restriction in the irrigation water schedule.

Table no.6 – Community authorities and downstream/upstream location in the Tepetitlan irrigation system, 2010

Land tenure type	Water authorities at the community level	Location on a main canal		Location on a secondary canal	
		Upstream	Downstream	Upstream	Downstream
EJIDO					
	Irrigation delegate	x	x	x	x
	Irrigation committee		x	x	x
	Irrigation surveillance committee		x		x
	Water or Irrigation Judge(s)		x		x
	Comisariado Ejidal		x		x
	Ejido supervisory board		x		x
PRIVATEPROPERTY	Irrigation officer	x	x	x	x
	Municipal delegate		x	x	x
BARRIOS					
	No authorities				

Source: Field-work data. 2010.

However, when correlating organization with the maize cropping pattern, it was found that the *organized* downstream communities, over a main canal or over a secondary canal, had managed to *improve* water distribution. The improvements consisted on a) an earlier schedule for water distribution, which in turn makes the planting of a longer-cycle maize possible; this earlier schedule was made possible by organizational actions taken **outside** the community; b) a larger irrigated surface made possible by community organization actions **inside** the community: planned and supervised water distribution impacts on time needed to irrigate and allows irrigation of more surface in the allotted schedule.

Community organization calling for actions **outside** the community as well as **inside** the community seems interesting.

The maize cropping pattern in downstream communities show that the pattern stays *at least* the same as before turn-over, and, in the case of the newly organized communities, the maize cropping pattern has **improved**: by being able to sow longer-cycle maize or by incrementing the irrigated area in a given year. Notwithstanding, in some cases, the situation has worsened (mostly for *barríos*). In Tables 7 and 8, the results are presented in a summarized form, and in the following section the ethnographic data of some of the cases is presented.

Table 7. Before and after turn-over: crops patterns, community level organization and water distribution. Downstream in the general canals.

Ejido	Maize Type		Water Distribution	Tasks Inside Organization	Tasks Outside Organization	Authorities		OBSERVATIONS	
	Before	Now				Before	Now		
Downstream	Nenaci and Torrecillas barrio	April White	April white	Equal	No	Yes To preserve historical irrigation schedule and request water in earlier date	Irrigation District ditch rider	Irrigation District ditch rider Irrigation delegate Water judge Comisariado ejidal	Authorities from the Nenaci ejido deliver water to a barrio (Torrecillas) of another community
	San Miguel Tenochtitlán	April White	April white	Equal	No	Yes To preserve historical irrigation schedule	Irrigation District ditch rider Comisariado ejidal	Irrigation District ditch rider Water judge Comisariado ejidal	
	Emiliano Zapata	Yellow Pink Red Black	April white Pink Black Yellow	Improvement	Yes Previously, there were non-irrigated surfaces	Yes Irrigation schedule improvement	Irrigation District ditch rider	Irrigation Committee Water judge Comisariado ejidal	
	Guadalupe Cachi Direct irrigation	April White Yellow Black	April white Yellow	Improvement	Yes Cultivation of violent maize is eliminated, improvising the internal water distribution	Yes To conserve historical irrigation schedule	Irrigation District ditch rider	Water judges Comisariado ejidal Irrigation delegate	
	Guadalupe Cachi Jagüey river "Tecomate Dam"	April White	March white April white	Improvement	Yes Jagüey filling capacity and internal distribution is improved	Yes The Irrigation District staff opened their intakes in a late schedule (mid-March), and they now open their intakes in late February	Irrigation District ditch rider	Water judges Comisariado ejidal Irrigation delegate	
	Guadalupe Cachi Jagüey irrigation "Presa Larga"	Yellow Pink Black	March white April White Yellow	Improvement	Yes	Yes Historical irrigation schedule established by the Irrigation District are modified, they return to those proposed by the National Agrarian Commission	Irrigation District ditch rider Canal assistant	Water judges Comisariado ejidal Irrigation delegate	The return to the schedule proposed by the National Agrarian Commission is due to the communities (Cachi Guadalupe and San Mateo).
	San Juan Jalpa	Yellow Red Pink	Yellow Red Pink	Equal	No	No	Irrigation District ditch rider	Irrigation delegate	There are still non-irrigated surfaces and late irrigation schedules

Source: Field-work data, 2010.

Table no.8 - Before and after turn-over: crop patterns, organization and water management. A secondary canal on the Tepetitlán main canal.

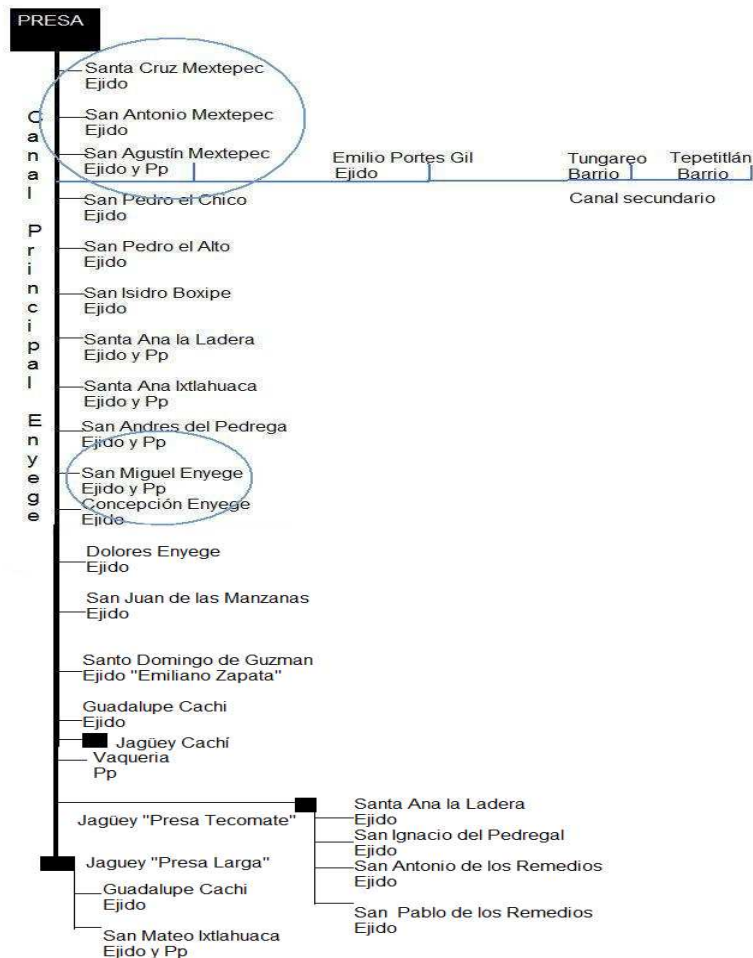
Ejido		Maize Type		Water Distribution	Tasks Inside Organization	Tasks Outside Organization	Authorities		OBSERVATIONS
		Before	Now				Before	Now	
Upstream	San Antonio Mextepec	White Yellow	White Yellow	Equal	No.	Yes To conserve historical irrigation schedule	Irrigation District ditch rider	Comisariado ejidal Irrigation Delegate	
	Dolores Hidalgo	April white	March white	Improvement	Yes Coordination for water distribution	Yes Improvement for irrigation schedule	Irrigation District ditch rider	Comisariado ejidal Water Judges (4)	
Downstream	Emilio Portes Gil, composed by the barrios: Centro Cañada Tungareo Tepetitlán	March white	March white April white	Worse	No	No	Irrigation District ditch rider	Comisariado ejidal Water Judge	Irrigators of the Tungareo and Tepetitlán barrios were especially affected.
	La Concepción de los Baños	April white Black Pink	April white, Yellow	Improvement	Yes Coordination for water distribution	Yes Surveillance of the canal and closing of floodgates	Irrigation District ditch rider Comisariado ejidal Water judge	Irrigation Delegate Security committee or Water Judges (4)	Previously, there were non-irrigated surfaces
	Jalpa de Dolores	April white Black Red	April white Black Red	Equal	No	No.	Irrigation District ditch rider	Irrigation Delegate	Ejido authorities do not intervene in irrigation businesses. Some users still don't have access to irrigation water.

Source: Field-work data, 2010.

Cases

ENYEGE GENERAL CANAL. The Enyege canal dates from the mid-nineteenth century. The dam's capacity was expanded in 1920, incrementing the canal's length from 16 to 36 kilometers. According to the documentation in the National Registry File and the Historical Water Archive, there was a conflict between the upstream and downstream communities after the land distribution. There is also a mention of the necessity of water regulation.

Figure no.1. Enyege General Canal



Fuente: Elaboración propia con datos de campo.

Upstream on the Enyege main canal

The sampled upstream communities are San Antonio Mextepec, San Agustín Mextepec and San Miguel Enyege.

Irrigation water is available for about a month (February 20 to March 20) in these communities. Although the irrigation schedule for the upstream communities ends in late March, the intakes are kept open, on the one hand there is no authority that supervises the area, on the other upstream community authorities argue that tomato and flower producers still need the water.

“We have no problems with the irrigation water ... during the month our water is scheduled **each user is responsible for their irrigation, they**

must only warn their community authority that they have already paid their contribution and have their receipt. (Interview with Justo José Cayetano. Comisariado ejidal San Miguel Enyege. Date of interview, October 12, 2009).

When a user wants to irrigate, he goes and asks the Water Judge to open the intakes. The Water Judge may leave the key with another ejido authority or lend it to the user to open the intakes (Camilo, Benítez. Ejido user from San Antonio Mextepec. Date of interview, October 10, 2009).

In cases which there are individual intakes on the main canal, such as for users from San Antonio Mextepec, the users have the water from the main canal at their disposal **without the need of an authority** from the WUA or the community level authority.

Downstream on the Enyege main canal

The sampled downstream communities were Emiliano Zapata y Guadalupe Cachí.

The Emiliano Zapata ejido is located downstream over the Enyege main canal (see Figure 1). Although the Emiliano Zapata ejido is located upstream from Guadalupe Cachí, Cachí is the first one to irrigate because the control valve is located in Cachí land

The Emiliano Zapata irrigation schedules are variable (from March 15 to 20 to April 30), though not as extreme as under the Irrigation District authority. Users refer that, sometimes, the lands located further away from the canal did not get any irrigation water.

The cropping pattern has undergone changes. Before turn-over, users would sow yellow, black, pink and red maize, and they now sow white, April yellow, yellow, black and pink maize. That is to say, based on their cropping pattern, their water supply situation has improved.

Before turn-over the Emiliano Zapata ejido had no local water authority. The Irrigation District's ditch rider established the irrigation schedules and delivered water at plot level. Because there was no supervision, disputes were common within the ejido, and the Irrigation District ditch rider often closed and opened gates without staying to supervise. The community authority liaised with the Irrigation District's ditch rider for the community level water distribution.

After turn-over a community Irrigation Committee was established. The Irrigation Committee president also took the position as irrigation delegate to the Tepetitlan WUA. The members of the Irrigation Committee are also called water judges.

The Irrigation Committee started negotiations with the WUA Committee changes in the water schedule before the usual delivery dates (mid-April); therefore managing to get water delivered mid-March and early April. The local Committee makes a written request in December to the WUA Committee. In addition, they advocate directly so the upstream ejidos close their intakes after irrigating.

During the irrigation season, the Emiliano Zapata Irrigation Committee and users travel the upstream Enyege main canal in the afternoons and close the

upstream communities' intakes to take advantage irrigation water during the night. When the Enyege main canal carries less than half its water there are user groups that with the support of community authorities travel upstream closing intakes where there are no irrigators. Closing of intakes takes negotiating with upstream communities that have flower and tomato crops.

The Emiliano Zapata Irrigation Committee also negotiated with authorities from the Guadalupe Cachí ejido, so that Cachi water judges placed no obstacles to closure of Cachi intakes when Emiliano Zapata was irrigating. The process is that the Emiliano Zapata Irrigation Committee organizes an assembly to find a solution to irrigation delays. Then a verbal request to the Cachí community authority so that Cachi waters not take water when they had no right; and, if the Cachí authorities did not solve the water situation that same day, the Emiliano Zapata Irrigation Committee would request the intervention of the WUA Committee to compel Cachí to close their intakes.

Users who are irrigating must be constantly checking that the users from Cachí do not block the water. They keep watch from the intake on the Enyege main canal, all the way from Cachí to their community.

“Though it does wear us out, this is something we have to do, because the judge only opens the intake, and it is up to us to make sure the water reaches our land. Sometimes, when I am irrigating, the water level in the canal starts decreasing; and some neighbors that are also irrigating and I need to go see where the water has been blocked, walking along the canal for about a quarter mile, only to come back and see the water has been capped again. What we do now is to have someone stay by the intake to make sure no one closes it, and it usually goes by families: a son or nephew keeps watch while the father or uncle irrigates.” (Interview with Mr. Felipe Reyes. User from Emiliano Zapata’s ejido. Date of interview, November 5, 2009).

When the authorities from Cachí and Emiliano Zapata supported the same WUA Committee, which happened in 2006, there were no problems concerning the blocking of intakes by Cachí. Though water was scarce that year, they allowed it to flow without blocking it (Interview with Mr. Roberto Ramos, Cachí supervisory board. Date of interview, September 11, 2009).

The Emiliano Zapata Irrigation Committee is responsible for distributing water within the ejido. In order to maintain an irrigation order in the ejido, Committee members coordinate to monitor the water intakes throughout the ejido’s length and width. To distribute water among irrigators, each Committee member was assigned a third part of the ejido’s irrigators (164). Each member was assigned a number of users and days for water distribution. Additionally, concerning the irrigation turns, one year they begin downstream, and the next they begin upstream.

“The users come around three in the morning, knocking on my door to say ‘let’s go open the intakes to start irrigating’. As if sleepwalking, I get up to go to the canal, sometimes accompanied by my son. When I get back I try to catch some sleep, but right away I have another two users asking for more water. So I go, open the intakes wider, and when more users come asking for water, I tell them ‘wait another day, because there isn’t

enough'." (Interview with Mr. Lorenzo Zabala, Emiliano Zapata's Water Judge. Date of interview, January 10, 2010).

The Irrigation Committee establishes irrigation dates that users must respect. Those who don't follow these dates are either fined or left last. Before dictating the water distribution orders, the Committee invites all irrigators to an informative assembly on how necessary it is to comply with orders, benefits and losses that disorder causes. The Committee tries to raise awareness amongst the water users so they consider they aren't the only ones who need water and that individuality does not help solve problems, that they must work together and maintain order and respect to the elected authorities. The irrigators also give their opinions. These meetings last from 3 to 4 hours, and they also serve as venting forums..

The Irrigation Committee's activities on water distribution have effected a difference, before only half the land with water rights had access to irrigation water.

This community organization is also displayed for cleaning of lateral canals. During the maintenance, starting on 6:00 am, all users clean their canals until finished: the first ones to arrive clean the first three to four meters. Late coming users clean the rest of the canal. The user's presence helps the authorities to maintain control without possibility of users shirking their duties or allowing situations giving way to bribery. Users monitor both the performance of authority and of fellow users.

Guadalupe Cachí Ejido. Located at the end of the Enyega canal (see Figure 1), the Cachí community has access to water direct from the dam, and also has access to the water of three jagueyes, which are: "Cachí", "Presa Larga" and "Presa Tecomate". Both cases have had improvements in the maize patterns.

In the case of direct irrigation, the maize pattern was the April white, yellow and black type. They now sow April white maize and intermediate-cycle (between long and short rotation cycled) maize in larger quantities, and have dropped the short-cycled maize (black). They organized to negotiate outside the community to keep the historical irrigation schedule as well organized inside the community to evenly distribute the irrigation water. To improve water distribution within Cachí, more than one water judge was established in the community with the purpose of water intake control; before the lack of supervision led to users closer to the intake to take more water leaving less for users downstream in the same community

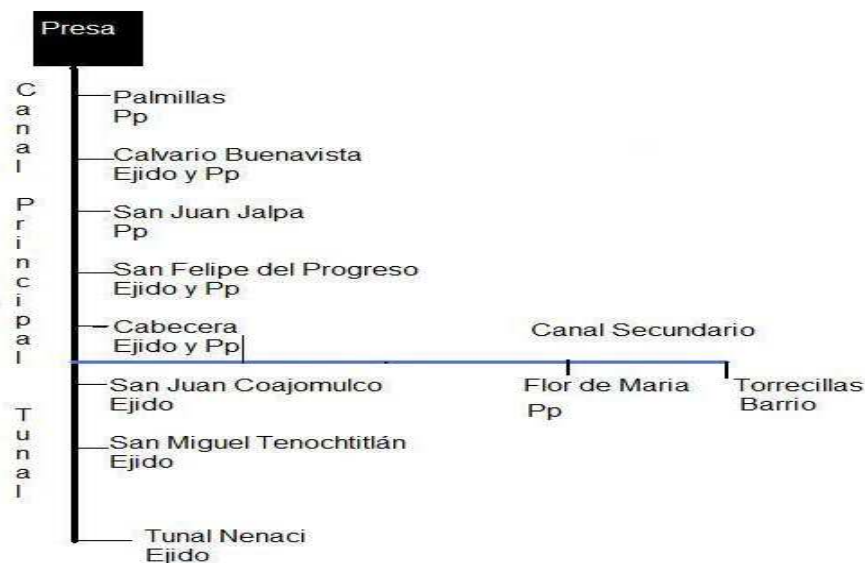
In the 'Tecomate Dam's jaguey case, the maize crop pattern was the April white and yellow. They now sow March white and April white. The improvement in cropping pattern is related with the fact that the ejido authorities (water delegate and water or irrigation judges and other community authorities) now make sure that the jaguey (water tank) is filled to its maximum capacity, and actively seek support to de-silt the jaguey when needed. Before turn-over , the jaguey didn't get appropriate maintenance, so the storage capacity was reduced. Additionally, community has no control over the opening of the jaguey and the Irrigation District usually opened the jaguey in dates that were late for the irrigators (late March).

“The jaguey was sometimes full, but as they didn’t give the order the water went to waste and no one could open the floodgates because the fine was high, and the engineers said we would get punished if we opened it. We now ask the WUA Committee for authorization whenever the jaguey has the necessary water (Interview with Mr. Eusebio Morales Vichis, Water Judge, Block 7. Date of Interview, September 12, 2009).

In the irrigated area by the Presa Larga jaguey, the maize pattern was yellow, black and pink; now April white, March white and yellow. The improvement in the cropping patterns is due to changes in the irrigation schedule and changes in the internal distribution. In the Irrigation District’s schedule water was first delivered to San Mateo Ixtlahuaca (from March 1st to 30), then to Guadalupe Cachí. After the turnover, the Cachí authorities negotiated with the San Mateo Ixtlahuaca’s authorities so they would respect the distribution proposed by the National Agrarian Commission, that is fifteen days for San Mateo and then fifteen days for Guadalupe Cachí, returning again to San Mateo Ixtlahuaca and then back to Guadalupe Cachí. In addition to the change in irrigation schedules, the internal irrigation schedules also modified: the water would first be delivered to the users located far from the jaguey lastly to the ones closest to the jaguey.

TUNAL GENERAL CANAL. The Tunal general canal dates from 1964. It benefits 9 communities (with a ejido and private property land tenure) and one barrio (see Figure 2).

Figure no.2



Fuente: Elaboración propia con datos de campo. 2010

Users report that before the turn-over they “went to the Enyege hacienda [the Irrigation District’s office] to buy water. There was an office and we lined up to pay for water and obtain our receipt, which we needed to show to the Irrigation District ditch rider, because if we didn’t have it and he found us irrigating, he would fine between 50 and 100 pesos, plus a verbal reprimand (Interview with Mr. Peter Vichís, user from Santa Ana la Ladera. Date of Interview, July 7, 2010).

The Irrigation District ditch riders were in charge of opening and closing the intakes on the main canal and had a close relationship with community authorities.

The community authorities reported to the ditch riders at the Irrigation District office on the irrigation's advance. The matters covered by the ditch rider with community authorities were focused on the economic part: how many users had paid for the water, and how many had not. The community authorities were also responsible for control and vigilance of the maintenance of irrigation canals, but they didn't participate on decision making for water distribution schedules.

The WUA Committee detected problems between the upstream and downstream communities in the Tunal main canal after turn-over. This main canal is the only one that has a ditch rider.

Downstream on the Tunal main canal

During the last week of March and the first week of April, the downstream communities receive water once all the upstream communities have finished irrigating. Unlike the other general canals (Tepetitlán or Enyege) there is no change in cropping patterns: there are no crops that require specific irrigation dates (such as tomatoes, beans or flowers).

The downstream water supply situation has not improved, but it hasn't worsened either. The maize pattern type sown before and after the turn-over is the April type.

Tunal Nenaci's ejido and private property. Is located down over the 'El Tunal' general canal. The cropping pattern hasn't been modified: they still sow white April maize.

The Nenaci community organized during 2000 to make sure the irrigation schedules they had before the turn-over did not worsen. The irrigation delegate, water judge and ejido authorities work together with the municipal delegate and the irrigation delegate from the private property.

When the ditch rider from the Irrigation District retired, there was disorder in the irrigation due to unscheduled opening of intakes. Apparently, complaints were directed to the San Miguel Tenochtitlan community. The Nenaci community authorities (irrigation delegate, negotiated with the upstream communities so they would respect the historical irrigation schedules. The Nenaci's authorities are proposing and promoting a change in irrigation schedules so as to take turns on initiating irrigation between upstream and downstream.

Torrecillas Barrio. The ditch rider from the Irrigation District sent the water towards the Torrecillas barrio thru a secondary canal, which served the Cabecera community. The irrigators from the Torrecillas barrio went to an intake in Cabecera to wait for the ditch rider from the Irrigation District. Currently, although there does exist a WUA ditch rider for the main canal 'El Tunal', the ditch rider only handles the intakes on the main canal.

At some point, the irrigation delegate from the Torrecillas barrio negotiated with the Nenaci and Cabecera communities so they would allow the Torrecillas barrio to keep its historical irrigation schedule; apparently, the delegate has had no more initiatives.

The users from the Torrecillas neighborhood must do to the authorities in the Nenaci and Cabecera communities to obtain information on the irrigation schedule, as well as to fulfill maintenance tasks.

In terms of distribution within the barrio, there is no authority to control and monitor the water distribution. Therefore, there are disputes. These same disputes were present before the turn-over, and a fine was charged whenever the ditch rider from the Irrigation District found out about them, but the problem wasn't solved, and so the same problem presents itself year after year. The clashes are exacerbated during late March when the users require water to sow before the end of April.

TEPETITLÁN GENERAL CANAL. The Tepetitlan general canal is the oldest in the irrigation system (1800). It benefits 8 communities and 2 barrios (see Figure 3).

Downstream the Tepetitlan main canal

Ejido and private property San Juan Jalapa. The community is located downstream on the Tepetitlan main canal. The cropping pattern has not been modified: the users have sown yellow, red and pink maize before and after the turn-over. They take water depending on the capacity of the canal, there are no turns; when the water doesn't arrive in April, they plant short-cycled maize to solve the water shortage, and many of them end up not sowing. The same situation prevailed before turn-over. .

Figure no.3, Tepetitlan main canal



Fuente: Elaboración Propia con datos de campo. 2010

Downstream the Tepetitlan main Canal, a secondary canal

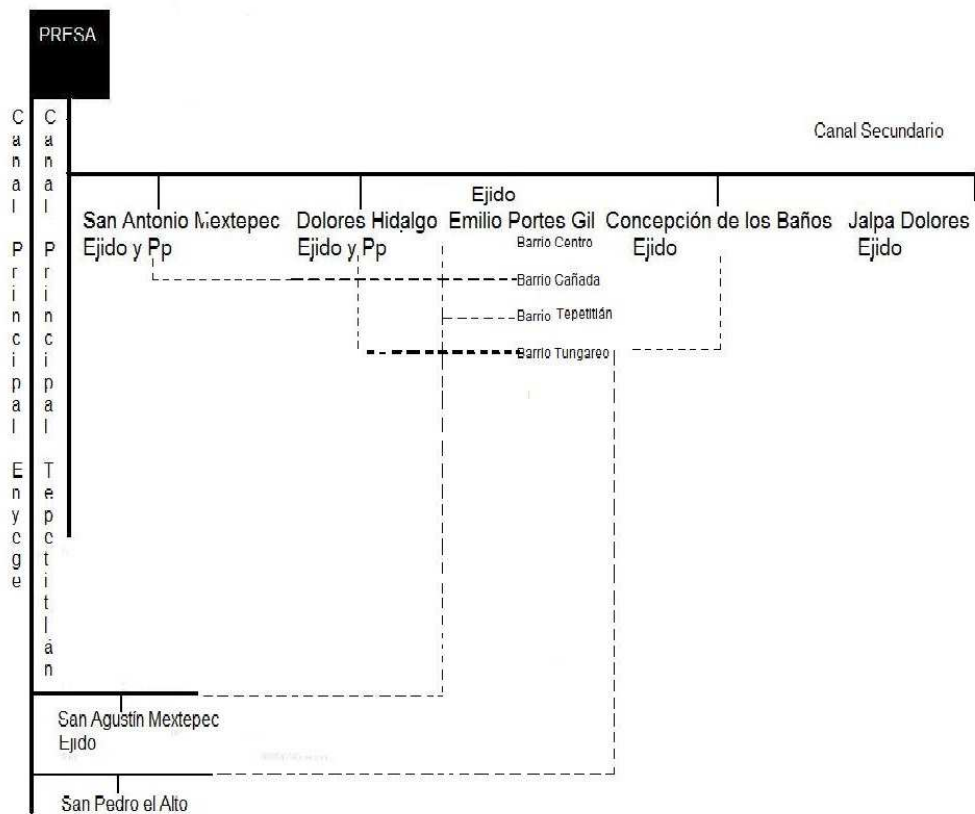
The secondary canal serves San Antonio Mextepec, Dolores Hidalgo, the Emilio Portes Gil barrios; Concepción de los Baños and Jalpa Dolores (see Figure 4).

Dolores Hidalgo. Located upstream on the secondary canal (see Figure no.4). The crop pattern has improved, from white April to white March maize.

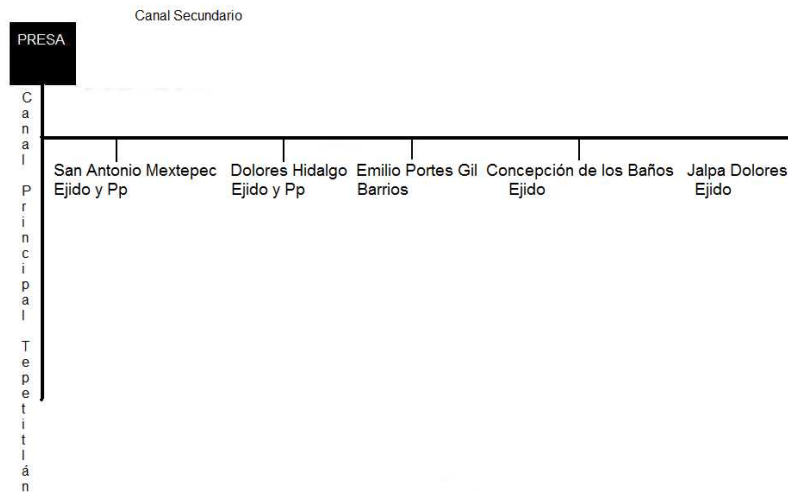
In Dolores Hidalgo there is no coordination between the ejido and private property authorities for the outwards negotiation and internal water distribution. However they do coordinate with another community –San Antonio Mextepec – to negotiate with upstream communities, and the irrigation schedule has improved. The internal water distribution has also improved with the appointment of four water judges, who are responsible for the distribution, keeping an eye on general and lateral water intakes.

There is a division of labor between the community authorities that has been established in community assemblies. The comisariado ejidal with three government levels (municipal, state and federal) as well as the WUA Committee and negotiates with the San Antonio Mextepec community to keep to the irrigation water schedule and close intakes. for the water passages and to respect the amounts and dates that correspond each community. The water judges deal with internal water distribution as well as liaison with the Tungareo barrio users.

Figure no. 4, Secondary canal of the Tepetitlan main canal



Fuente: Trabajo de campo. 2010



Fuente: Elaboración Propia con datos de campo. 2010

Emilio Portes Gil barrios. Although one of the largest communities it is in fact divided in four barrios (Central, La Cañada, Tepetitlán and Tungareo), with only an ejido-level and no neighborhood-level authority. The water delivery is dispersed; the barrios take the water from several secondary canals. Central, La Cañada and Tepetitlán barrios take the water from a secondary canal shared with San Agustín Mextepec. The Tungareo barrios takes the water from a secondary canal shared with Dolores Hidalgo (see Figure no.4).

The users from the Tungareo barrio go to the water judge from Dolores Hidalgo to open the intakes. They must show the water service receipt and carry out the tasks organized by the Dolores Hidalgo community.

The barrios of the Portes Gil community state that their irrigation water situation got worse after turn-over, since, as they point out “before, we went to see the Irrigation District ditch rider, waited for him by the intake and asked him for water which he sent to the barrio, now we have to go see the water judge or the community authority who even when they agree to send us water it sometimes doesn’t arrive.

Concepción de los Baños. It is located downstream a secondary canal of the Tepetitlán main canal. Its crop pattern has improved: before, they had April white, black and pink maize crops, now, they have April white and yellow maize. Its irrigation schedule has improved, and attention is given to internal distribution --all users have access to irrigation water.

Before the turn-over, the ditch rider from the Irrigation District was mainly in charge of local distribution. Although local authorities liaised with the ditch rider, the community authorities had no possibly of closing intakes on the main canal, the canal to open and as it is now done.

Decisions were taken from top down, the community authorities couldn’t change irrigation schedules because orders were issued by the ditch rider from the Irrigation District. The water judge from the ejido wasn’t respected, but he used to say- “You don’t obey me, but right now I’ll call the ditch rider and see what he says”, so people would listen.

The communities were not consulted on irrigation water distribution schedules; the ditch rider simply told them when they were supposed to irrigate, leaving them always last and sometimes not delivering at all.

The situation in the ejido after the turn-over and the retirement of the ditch rider from the Irrigation District was one of uncertainty. Local community authorities then had no knowledge on system wide water management although there were constant unconformities from the irrigators, who often ran out of water. This led to the WUA Committee to ask for the support of the communities by organizing themselves. In the community assembly the decision was to name an Irrigation Vigilance Committee, composed by the irrigation delegate and three users called irrigation assistants, security guards, water judges.

Day and night, the Irrigation Vigilance Committee watches that the water isn't cut by users on the main canal. They support user groups—for example, 20 to 30 users (men and women) agree on going to “bring the water”. Before closing other community intakes the Vigilance Committee reports to the local authorities. Community authorities negotiates with other upstream communities to close intakes following the historical irrigation schedule (March 1st to 30).

The authorities from another communities also give their support, trying to minimize the effect on downstream ejidos, agreeing to keep the intakes closed when there is no ongoing irrigation.

When the upstream community authorities (Dolores Hidalgo, San Antonio Mextepec) from the secondary canal refused to grant permission to the Vigilance Committee from Concepción de los Baños, the Vigilance Committee turned to the WUA Committee for help, which conveyed an irrigation delegate assembly to solve the problem. Also the WUA Committee may authorize closure of intakes.

The community authorities are responsible for distributing water within the ejido. Decision on internal water distribution are made locally, whereas before local authorities could not change the distribution model, which was always from top down. In this community users who don't pay the irrigation water price or don't make a contribution to community work are left last.

Jalpa de Dolores. It is located at the end of the secondary canal, and it has only 12 users and 6.5 hectares. There is no coordination between the local community authorities. The irrigation schedule remains the same and there are still non-irrigated patches of land because there is no outward negotiation and internal organization for water distribution. Users still sow yellow, red and pink maize.

Concerning irrigation, an authority from Jalapa Dolores said “we cannot do anything, because even if we try, attending their meetings [from the Dolores Hidalgo community] so they won't leave us without water, we can't voice our complaints because they are more and the canal is within their ejidos.” (Interview with Mr. Rodolfo Crisanto. Water judge from the Jalpa Dolores ejido. Date of Interview, October 15, 2009).

CONCLUSIONS

Water distribution has undergone modifications since the end of the centralized management of the irrigation system. Before the turn-over, water distribution

was –and still is- inequitable. Irrigation always starts upstream. However, there is pressure from the downstream communities to modify this scheme and take turns between the upstream and downstream communities. Trawick (2001) notes that equitable and transparent water distribution is the basis of long-term self-managed irrigation systems.

After the turn-over, the downstream communities' capacity to organize and negotiate outward with other communities as well as organize for the internal water distribution has allowed to maintain and **improve** water distribution.

The community organization has been based on including all community authorities in water management.

After the turn-over the new intensity of downstream communities' organizations has led to collective surveillance actions, agreements between communities and improvements in irrigation schedules. Furthermore, the internal community organization has led to larger irrigated surfaces thanks to a more efficient water distribution.

However, with the turn-over, some downstream communities have a worsened irrigation water situation, mostly barrios with little population and no local authorities.

The fact that the water distribution situation is stable or has even improved – based on evidence from the maize cropping patterns is notable. The way the Irrigation District authorities, a centralized management scheme, had a more unequal distribution than today is note-worthy, as well as the communities organizational growth and deployment after the turn-over. The organization capacity of the mazahua communities was inhibited by the centralized administration of the Tepetitlan irrigation system.

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