# Institutional Analysis of Diaz Ordaz Small-Scale Irrigation System, Oaxaca Valley, Mexico

August 31, 2015

## 1 Part I: Static Analysis - Collective action

The Diaz Ordaz irrigation system is located near Mitla village in the Oaxaca Valley, Mexico. The key resources (natural infrastructure) in the Diaz Ordaz system are land (private), rivers, and streams. The key resource relevant to the commons dilemma faced by the community is irrigation water (common-pool). The irrigation system is fed predominantly by the *Heu Ro'o* stream. A diversion dam, made of earth and rocks, is used to divert water from the main canals to individual sections. There are different rules of water distribution for allocating water to the sections depending on water availability. The local governmental authority (Síndico) is the responsible agent for allocating water from the river to the sections. Each section (tramo) has its administrative officials that are responsible for distribution of water within their respective sections, assign obligatory work loads, collect a tax, and to mediate disputes.

This case study is part of the original CPR database developed in the 1980s by Edella Schlager and Shui Yan Tang at Indiana University. It is currently available in CBIE's SES-library https://seslibrary.asu.edu/seslibrary/case/50/view.

### 1.1 The Commons Dilemma

- Potential over appropriation / poor coordination of appropriation: The common dilemma arises as the lack of any active monitoring rules leads to water theft and conflicts related to water appropriation between irrigators from different sections. As a result, irrigators must find informal ways to enforce effective management. When rainfall and streamflow are high, the resource users follow the riparian doctrine (where landowners close to the water source have rights to it whenever they wish) and conflicts regarding water rights are low. When rainfall and streamflow reduce, frequency of these conflicts increase and are reported to the Síndico. In an attempt to resolve the conflicts, the Síndico can declare the water "under rule" and invoke the prior appropriation doctrine (where historical precedence alone is the criteria to determine water rights).

- Potential under provision of public infrastructure: All irrigators are responsible for maintenance of the hard infrastructure (channels and diversion dam). All irrigators are responsible for maintenance of the hard infrastructure (channels and diversion dam). All cultivators contribute either in labor, materials, or cash. Apparently,

the potential under provisioning of public infrastructure was overcome because the cultivators are organized by the administrative officials of the section to which they belong. Also, there is an agreement that major aqueducts and breaks in the canal have to be repaired by downstream users of the damage (users of at the extensions of the canal).

## 1.2 Biophysical Context (IAD)

- **Natural infrastructure:** The town of Daz Ordaz, also known as Santo Domingo del Valle, is a small-scale irrigation system located in the Tlacolula wing on the border of the Mitla village in the Oaxaca Valley of Mexico. The village has an estimated 50 squares kilometers of land, of which less than 10 percent is cultivated. The topography of the village is mostly mountainous and barren. Approximately 500 hectares of this land are dry farmed and 150 hectares are regularly irrigated.

  Irrigation water is primarily diverted from an intermittent stream called the *Hue Ro'o*, whose watershed extends to the upstream settlements as well. There are two types of river water: flash floods, which occur one to six times per year, and clear water, which occurs throughout the rainy season. Floodwater derives its rich nutrient content from upstream fields, and is subsequently carried downstream by erosion. Clear water includes all river flow that is not floodwater.

  The rain season is not predictable in terms of magnitude (i.e. varies from 435 to 825 mm/yr) and start and end days. Appropriation rules depend on the rain season's timing and magnitude.

- **Human-made infrastructure:** Six diversion dams (*ru'u tom*) take water from the main canal. These dams, which are 2 metres in height and about 20 metres in width, are made with logs spaced every meter. They are interlaced with rock and dirt. Most of these dams have concrete footing to avoid the problem of undercutting. Water from the diversion dams enters the fields through individual sluice gates. A tramo (section) is then irrigated by a common sluice along the diversion canal.

  The canal is divided into the *ja'a tom*, the canal's head located between the main sluice and the first irrigated parcel, and into segments called 'bias'- that were built in different moments by different adjacent parcel owners. When the bias meets an arroyo, the segment ends there and a small aqueduct helps water flow cross the arroyo, and then another segment continues. The aqueducts and segment downstream the arroyo was built and managed by downstream users.

## 1.3 Attributes of the Community (IAD)

- **Social Infrastructure**: The irrigation system is divided into more than 70 sub-units called tramos (sections). Section membership is obligatory to all irrigators who own lands within the designated territory. There are between 13 to 41 users in each section. Each section has administrative officials who are water users selected through rotation (every year). These officials are responsible for assigning maintenance works to all irrigators within the section, collecting small taxes, and distributing water allocated to their section. At a higher authority level, there is the Síndico, which is a local government official chosen by consensus by water users. The Síndico is responsible

for allocating water to the irrigation sections, among other responsibilities such as conflict mediation.

- **Human Infrastructure**: People's tolerance to stress is a key characteristic that makes the system work. Given the unpredictability of raining seasons and of the local hydrology, not even the Síndico can anticipate when he will decide to change from riparian rights to prior appropriation doctrine. As precipitation and streamflow decrease and conflicts continue to rise, the Síndico grows overtaxed and weary until he declares the system under rule, without warning.

## 1.4 Rules in Use (IAD)

1. **Position Rules:**
   - Every irrigation section has management officials - president, scribe, and treasurer. These positions are filled every year through rotation. An irrigator can hold positions in more than one section, if they own lands in multiple sections. The management officials do not receive any compensation for their services.
   - The Síndico is the second highest government official in the municipality. He/She is the legal representative of the state government at the local level. The Síndico is selected by consensus and holds the position for three years.
2. **Boundary Rules:**
   - All irrigators in each section who own and/or cultivate a parcel within the designated territory are eligible for section membership. Temporary or permanent transfer of ownership of the parcel entails transfer of section membership as well.
3. **Choice Rules:**
   - Section Officials:
     - The section officials are responsible for resolving disputes among irrigators in the section when municipality water is "under rule". In case, they are unable to resolve these conflicts, they escalate them to higher authorities.
     - They are responsible for distributing water allocated to their section and collecting taxes from irrigators in the section.
     - The section officials identify the sections of canals to be cleaned and assign them to different irrigators within the section.
   - Síndico:
     - The Síndico is responsible for distributing water to the 70+ irrigation sections.
     - The Síndico must decide if the system should change from a riparian doctrine to a prior appropriation doctrine, and vice versa.
     - The Síndico is also responsible for resolving all intra-village conflicts. He/She is solely responsible for referring all cases of capital offenses and civil disobedience to the district courts.
   - Irrigators:

- All irrigators in each section contribute equal shares either in labor, materials, or cash for maintaining the canal head and the diversion dam.
- Major repair works to aqueducts and main canal are carried out by irrigators in the downstream from the damage.
- All irrigators clean the canal section assigned to them by the section officials. They may either do this themselves or hire labor to clean their assigned portions by a certain time. They may not work collectively with other irrigators in the section.
- When in prior appropriation doctrine, should take water only in their time period or only their allotment (depending to the section of which they are and to the decision of local officials). When in riparian rights farmers can take as much water as they want, when in prior appropriation doctrine (or water under rule) farmers may use water from the canal in the designed schedule or gets a fixed water allotment.
- Irrigators should occupy the position of section official at some point.

4. **Aggregation Rules:**

   - Irrigators choose their local official at the Tramo level and the Síndico official.

5. **Payoffs Rules:**

   - All irrigators must pay a tax proportional to the amount of maize seeded on their respective lands in one planting (this is approximately equal to the size of the field).

6. **Scope Rules:**

   - Water allocation within the sections is either divided equally among all irrigators or based on the surface area of land owned by each irrigator.

7. **Information Rules:**

   - There is no mention of information rules in the original case study.

### 1.5 Summary

Farmers, with the participation of the municipal authorities, organize themselves in the irrigation system. The Síndico is responsible for allocating water to different sections. The section officials are responsible for distributing water allotted to their respective sections. Farmers often play the role of section officials (i.e., participate in water allocation decisions, canals cleansing, etc.). Generally, the riparian doctrine is followed for water allocation. As a result of this, disputes arise among irrigators regarding water rights during dry seasons. In order to subside the conflicts, the Síndico declares the water "under rule" and invokes the prior appropriation rule.

## 2 Part II. Dynamic Analysis - Robustness

Given the source document, there is insufficient data to make any assessment on the temporal dynamics (resource and social conditions, etc.) of this particular common-pool

resource. The contributors thus far have been unable to locate any specific updates for this case study.

# 3 Part III. Case Contributors


- Sechindra Vallury, School of Sustainability, Arizona State University.
- Cathy Rubinos, School of Sustainability, Arizona State University.
- Maria del Mar Mancha Cisneros, School of Life Sciences, Arizona State University