

# Diaz Ordaz Irrigation System

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## 1 Part I: Static Analysis - Collective action

Díaz Ordaz, also known as Santo Domingo del Valle, is a small town located in the Tlacolula wing of the Oaxaca Valley of Mexico. The town's small-scale irrigation system is a crucial common pool resource that has been subject to collective action problems relating to water appropriation and public infrastructure provision (dam, canal, and aqueduct maintenance). The irrigation system is fed predominantly by the *Heu Ro'o* stream via a diversion dam, which is then diverted from the main canals to individual sections called *tramos*. There are different rules of allocating water to the tramos depending on water availability. The local governmental authority (Síndico) is the agent responsible for allocating water to the tramos. Each tramo has its own administrative officials that are responsible for distributing water within the tramo, assigning obligatory work loads to users, collecting taxes, and mediating disputes.

### 1.1 The Commons Dilemma

- Potential over-appropriation or poor coordination of appropriation: lack of 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 appropriation rules or utilize conflict resolution spaces afforded by the Síndico and specific officials of the given tramo. 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. The water abundance lowers the frequency of appropriation conflicts, but when rainfall and streamflow reduce, frequency of these conflicts increases. To resolve the conflicts, the Síndico can declare the water “under rule” and invoke the prior appropriation doctrine where tramos are apportioned water on a “first come - first served” basis.
- Potential under provision of public infrastructure: All irrigators are responsible for maintenance of the hard infrastructure (channels and diversion dam). All cultivators contribute either in labor, materials, or cash. To prevent under-provision or free riding concerns, tramo-specific administrative officials organize cultivator contributions. Also, major aqueducts and breaks in the canal must be repaired by users downstream of the damage.

## 1.2 Biophysical Context (IAD)

- **Natural infrastructure:** Diaz Ordaz cultivates only 10% of its estimated 50 square kilometers of land. 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. Natural obstacles, like arroyos, exist in the way of the canal system that must be crossed.

Diaz Ordaz diverts irrigation water 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 intermittently 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 rainy season is not predictable in terms of magnitude (varies from 435 to 825 mm/yr) and duration (start and end days).

- **Hard-human-made infrastructure:** Six diversion dams (*ru'u tom*) take water from the Hue Ro'o. These dams, which are 2 meters in height and about 20 meters 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 travels along a canal through an initial head ditch (*Ja'a Tam*) before passing through the remaining canal segments (*bias*). There are 18 segments in the Diaz Ordaz network. These segments are subdivided into 2-12 sections called *tramos*. Each tramo encompasses all land parcels sharing a common sluice gate from the diversion canal.

When the *bias* meets an arroyo, the segment ends, a small aqueduct (*calicanto*) helps water flow across the arroyo, and another segment begins. The aqueducts and segments downstream of the arroyo are 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. Section membership is obligatory to all irrigators who own lands within the designated territory. There are between 13 to 41 users in each section.
- **Human Infrastructure:** Residents of Diaz Ordaz are primarily farmers, working with both dry and irrigated crops. Others work as wage laborers in surrounding farms, herders, or blanket weavers and other small craftspeople.

Stress tolerance of officials, especially the Síndico, steers the transition dynamics of the appropriation regime. Given the unpredictable rainy seasons and local hydrology, not even the síndico can anticipate the 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 they declare the system under rule, without warning.

Due to the absence of experiential criteria, Síndicos often lack understanding of irrigation systems.

## 1.4 Rules in Use (IAD)

### 1. Position Rules:

- Every tramo has administrative 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 and is the primary local water authority. The Síndico is selected by consensus and holds the position for three years. There is no criteria for water administration or irrigation experience.

### 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.
- Irrigators are allowed to be members of multiple tramos if a household's fields cross tramo boundaries.

### 3. Choice Rules:

- Section Officials:
  - The section officials are responsible for resolving disputes among irrigators in the section when “under rule.” If they are unable to resolve these conflicts, they bring them to higher authorities.
  - The section officials are responsible for distributing water allocated to their section and collecting taxes (*impuestos*) 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, requiring them to be cleaned by a certain date.
- Síndico:
  - The Síndico is responsible for distributing water to the 70+ tramos.
  - The Síndico determines the appropriation regime (riparian or prior appropriation).
  - The Síndico is 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. Defining such offenses is within the discretion of the Síndico.
  - The Síndico must monitor dam integrity and direct repairs.
- 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 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.
- Irrigators should occupy the position of section official at some point.

#### 4. Aggregation Rules:

- Tramo administrative officials control water distribution, labor and tax obligations, and conflict resolution within the confines of their tramo.
- The Síndico controls water distribution and conflict resolution between tramos.

#### 5. Payoffs Rules:

- Taxes (*impuestos*) and work loads (*tareas*) that the tramo administrative officials demand of users must be proportional to the amount of maize seeded on their respective lands in one planting (approximately equal to the size of the field).
- The Síndico does not receive compensation or praise for serving his/her term.

#### 6. Scope Rules:

- During riparian appropriation, irrigators are free to use the water provided they do not harm the ability of another to use.

#### 7. Information Rules:

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

### 1.5 Summary

The Díaz Ordaz irrigation system is vulnerable to appropriation and infrastructure provision collective action problems, but institutional checks prevent free-riding and ensure proportionate distribution of water and maintenance labor. The irrigators in Díaz Ordaz belong to diversion sections with their own appointed administrative officials. At the entire system level, a single official, the Síndico, is responsible for allocating water to the different sections, resolving conflicts, and deciding on the appropriation regime for the system (riparian or prior appropriation). This is often a subjective decision, simply a result of the Síndico's stress level from handling disputes. The section officials are responsible for distributing the allotted water to and compelling maintenance labor from irrigators proportionate to their land size.

## 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.

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