Institutional Analysis of Lurin Sayoc Irrigation System, Quinua District, Peru

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1 Part I: Static Analysis - Collective action

Lurin Sayoc is one of the two barrios of Quinua district in the Peruvian highlands. There are different principles of water distribution for dry season crops, rainy season crops, or depending on the farm location (upper or lower savanna). The key resources (natural infrastructure) in the Lurin Sayoc system are land (private) and Rivers and Streams. The key resource relevant to the commons dilemma faced by the community is irrigation water (common-pool). Municipal authorities legitimize customary altitude-based rules of water distribution especially in those seasons when water is most needed, but do not make new rules. During the rest of the year, users who base their decisions on some pre-established rules collectively manage water. The author reported many fights around water use.

This case was part of the original CPR database developed in the 1980s by Edella Schlager and Shui Yan Tang at Indiana University. The original CPR report may be found at https://seslibrary.asu.edu/seslibrary/case/74/cpr.

1.1 The Commons Dilemma

- Potential over appropriation / poor coordination of appropriation: The system presents rules and norms that set up an incentive structure that cause water appropriation dilemmas (when and how much to use water from an irrigation system). As a result, the system present problems as water theft (water appropriation when it is others' turn), corruption (people with greater political power gets water when wanted), and water appropriation using physical force.

- Potential under provision of public infrastructure: Everyone contributes to the maintenance of the hard infrastructure (irrigation canals and reservoirs) either with labor or paying a fine. All users also contribute to the soft infrastructure (management in some seasons, guarding for thefts, and participating in religious festival that are offered to the earth and water energy). It is not stated, but normally water appropriation dilemmas lead to the under provisioning of hard infrastructure.

1.2 Biophysical Context (IAD)

- **Natural infrastructure:** This socio-ecological system takes place in an area of different ecological zones:

- Over 4,100m: Alpine rain tundra and subalpine wet paramo (cold, moist and cloudy with no agricultural activity only grassland)

- Between 4,000m and 4,100m: Montane Prairie (they grow tubers, but they do not use irrigation in this area)

- Between 3,400m and 4,000m: Montane Moist Forest (they grow quick maturing crops, but they do not use irrigation in this area)

- Between 3,005m and 3,400m: Upper Savanna: crops grown without irrigation - wheat, habas, barley, potatoes, olluku, oca, mascua (fast maturation crops), and with irrigation - almidon (maize).

- Between 2,850m and 3,005m: Lower Savanna: crops grown without irrigation - wheat and barley, and with irrigation: quinua, beans, squash.

- Between 2,500m and 2,850: Montane Thorn steppe (cactus, they grow low water intensive crops but with a different irrigation system from Rio Chaco)

The irrigation system originates in the moisture forest (springs and streams), and users farm mainly with rain. There are two seasons: rainy season (normally from September - October to April), and dry season (normally from May to August). Weather is very variable, sometimes the rainy season is shorter and it can also have dry periods. In the lower savanna, because of higher sunshine and temperature and few water resources, there is more evapotranspiration that makes the region even drier.

- **Human-made infrastructure:** The system have many reservoirs (the main one is Lurin Sayoc Qucha), canals of different sizes between 25 and 85 cm wide, and 25 and 100 cm deep, a canal that collects seepage, and gates to retain water and allocate water. This is a characteristic that enables the control of water use.

1.3 Attributes of the Community (IAD)

- **Social Infrastructure**: The Quinua district is conformed by 5,348 people who are mainly subsistence farmers. They eventually participate in a local market and exchange goods through barter. The municipal authorities manage water, but only during the rainy season because it is when the water demand is higher. Their role is to allocate water, and they do it with the participation of users. The municipal authorities are not responsible for controlling water use, or for sanctioning water theft. If it is the turn of an individual or neighbors to appropriate water, he or they are in charge of changing gates, storing water in the reservoir, and to guard for water thefts.

  Once a year, before the agricultural cycle begins, all users (one per family) clean the irrigation infrastructure or pay a fine. Each group of farmers clean and restore what they use, then farmers from the lower savanna have to clean a bigger portion of the

system. Also, twice a year they participate in irrigation festivals (religious) where they perform dances as an offer to the earth and water energy. The first festival is also when the community cleans the irrigation infrastructure.

The culture and religion is a characteristic that enables collective action among users, they all have a common sense of cooperation for the provisioning of the infrastructure.

- **Human Infrastructure**: There is not enough information to infer about human infrastructure.

1.4 Rules in Use (IAD)

1. **Position Rules:**
   - Water Managers: Municipal authorities are in charge of allocating water during rainy seasons and when water is scarce. In the rest of the year, every user becomes a manager. An individual plays a manager role too when he is assigned to control water theft and to divert and store water.
   - Type of Farmers: Because they belong to two different altitudinal regions that have different use of the irrigation system, there are two types of farmers: farmers from the upper savanna and farmers from the lower savanna.
2. **Boundary Rules:** Farmers have to be residents of the community in order to use the water system. Who can be the municipal authority is not mentioned.
3. **Choice Rules:**
   - Users must either clean the canals and reservoirs or pay a fine, and participate in the religious festivals in order to use water from the irrigation
   - During the dry season, the entire community manages water. Then, individual farmers may participate in this management and make decisions depending on who collaborates more in the infrastructure provision, or has greater needs. Users may withdraw water in a first-come first-served basis once a week (could be any day), but not for irrigation purposes. In September (still dry season but close to the rainy season), users can withdraw water from the system only on Sundays.
   - During the rainy season, the municipal authorities must manage the water system. They decide how to allocate water with users assembled at the distribution point. Before 1970, managers were rural political officials who allocated water to people who asked for it.
4. **Aggregation Rules:** Farmers participate in the allocation decision whether the municipal authority is managing the system or not.
5. **Information Rules:** When an individual gets water, he/she is responsible for changing gates to divert water to their field, storing water in the reservoir, and to guard for water thefts. So, other users should know whose turn is it to appropriate water, and thus directly participate in the system management.

6. **Scope Rules:** If someone withdraws water from the system when it is not his turn, that action is considered theft. Also, no matter which season it is, every Sunday the rule of first-come first-served works again. There is another set of rules for water allocation rights. There is a group that has senior rights to fill their cisterns for domestic use: old people who have fulfilled many religious and political obligations and anyone that has given a religious fiesta in that year.

7. **Payoffs Rules:** The benefits from using the irrigation system are those related to the benefits from the agricultural activity. The cost of using water is to clean it once a week or to pay a fine. There is no rule for stating the consequences of water theft but seemingly the norm is that he would receive a physical punishment.

1.5 Summary

Farmers with the participation of the municipal authorities organize themselves around an irrigation system. Because of particular ecological characteristics the irrigation system is used to supplement the use of rain to farm around rainy seasons. Farmers often play the role of managers (participate in water allocation decisions, canals cleansing, monitoring water theft, etc.). Allocation rules are not well defined and discretionary (when it is not first-come first-served, they collectively decide depending on who collaborates more in the infrastructure provision, or has greater needs) which cause fights among water users.

2 Part II. Dynamic Analysis - Robustness

The follow up of the Hanan Sayoc Irrigation system study was made in 2013 by Cathy Rubinos at Arizona State University. The update is based on Mitchell (1994) who described the socio- economic changes from his previous field work used in Mitchell (1976)

2.1 Shocks, Capacities, Vulnerabilities

Shocks that were successfully overcome:

- Inequity issues and the agrarian reform of the 70s: By the 60's there where some *hacendados* (big land owners) that where receiving more water than the rest of farmers due to its political influences. Farmers organized themselves in an Irrigation District and convinced authorities to make a more equitable distribution. Later, in the 70's, the agrarian reform expropriated these farmlands and redistributed to workers. The irrigation was resilient to this internal shock.

Shocks that changed the system structure

Increasing population and ecological constraints required the creation of new irrigation infrastructure to bring more water to the system. However, farmers did not find incentives to build this new infrastructure because: agriculture was not as profitable as before, they did not want to work collectively any more, and in general they had less labor force. As a result, the farming activity is now very marginal, and the system is used to bring water for domestic used mainly.

- Increasing water demand:

1. Population Growth: Mainly from reduced infant mortality.
2. Ecological constraints.- It is either too high and cold, or too low and dry for intensive farming. Then, if farmers want to grow crops where there is a possibility to do intensive agriculture because of the climate, they needed to build new infrastructure (dam and canals).

- Farmers were not willing to build new irrigation infrastructure:

1. Dam: The government try to forced people from the Lurin Sayoc Irrigation System to contribute to the work to build a dam in the neighbor system Hannan Sayoc. This caused a huge disagreement among the community, and the collective action to work for the infrastructure provision was broken.
2. Reduction in Labor Force: Governmental policies, as fixing food prices at a low level, and importing subsidized food from abroad, affected farmers' income and the incentive for them to continue farming. Community members then, decided to work in jobs that are not related to agriculture as: artisan, truckers, and petty entrepreneurs of all sorts. Users decided that the energy costs to build new irrigation infrastructure was too high and the return too low. Also, even with a growing population, the labor force decreased because of other pressures such as: children that used to work are studying now, male reduction because of terrorism, migration of males to the city (so they wont get kidnapped to form part of the terrorism group "lighting path")

2.2 Robustness Summary

(The links mention below correspond to the system representation on the SES library) Farmers overcome one internal shock: Inequity between small holders and big land owners and the agrarian reform (link 8 to resource users). However, later, a series of shocks changed the system structure to a point that now agriculture is not the main activity in the system as it used to be. These shocks were: 1) Increasing population (link 8 to resource users) and 2) ecological constraints (link 7 to the resource), that required the creation of new irrigation infrastructure to bring more water to the system. However, users were not able to build this new infrastructure because of 3) Changes in food prices (link 8 to resource users) that make agriculture a less productive activity, 4) the lost of incentives to work collectively (link 8 to public infrastructure providers), 5) and that in general they had less labor force (link 8 to public infrastructure providers).

3 Part III. Case Contributors

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