Irrigation Watercourse in Punjab Province

Last Updated: December 4, 2020

1 Part I: Static Analysis - Collective action

This case covers an unnamed watercourse in the Punjab province of Pakistan near Lahore City. Characteristic of the region, irrigation water through a canal distribution system is the limiting factor for local agriculture. The system faces serious challenges with coordination of water and provisioning of maintenance primarily due to a lack of technical and administrative support from government officials in the Canal Department and an out-of-touch allocation scheme that lends itself to widespread illegal trading and other extralegal activities. Brotherhood and kinship ties, embedded within a caste system, structure the social infrastructure and steer all cooperative efforts.

1.1 The Commons Dilemma

- **Provisioning of Infrastructure:** The users must mobilize themselves to maintain the canals due to absent regulatory overseers, and for the most part, they can compel contributions using appeals to social honor (*Izzat*) proportional to land ownership and punishments like fines or water service denial. However, the users lack technical knowledge of the problems facing their system and possible solutions, including serious water losses that are partially attributed to costly, traditional pumping technology and poor infrastructure management. Farmers are supposed to pay taxes proportional to their water needs for the upkeep of the system through the Canal Department, but the department struggles with rampant corruption and does not meet the needs of the users.

- **Coordination of Water Rights:** The system follows *pucca warabundi* (strict turn-based regiment) that assigns a day and time of use to each user. However, the strict regiment seriously misses the nuances of variable crop water needs, system losses, and unforeseen social disturbances. Without a local governing body or higher level support, the majority of users revert to illegal trading to provide needed flexibility and negotiate system-wide water allocations with corrupt Canal Department officials outside of official permittance.

1.2 Biophysical Context (IAD)

- **Natural infrastructure:** The system derives water from the Lahore branch canal, which brings water from the Upper Bari Doab. While the canal system reduces spatial variability in water access, the system is still subject to temporal variability in canal

flow, both intra-annual and interannual. This is due to two intra-annual precipitation regimes that characterize the two cropping seasons: *kharif* (summer, 10-15 inches rainfall) and *rabi* (winter, 3-5 inches rainfall). The erratic monsoon season, which falls in the June-August period, drives the significant interannual variability of 14-31 inches in annual rainfall. The yearly frost does not damage crops, so farmers can grow multiple rounds of crops. The region has generally uniform soil composition, and primarily, the farmers grow wheat, rice, and fodder crops. The area served by the unnamed Punjabi watercourse of this study is 319 acres with 238 acres under cultivation and 73 acres already eroded.

- **Hard-human-made infrastructure:** The watercourse begins as the single *mogha* (outlet) from the regional canal and then follows a main ditch throughout the watercourse with *nakkas* (branches) cut from the main ditch that serve individual users. Due to significant head loss from the mogha and main ditch and elevated farms with respect to the ditch, many farmers must pump the water from the main ditch to their farm level using a *jalar*, a livestock (usually bullock) powered rotating pump. The system contains four jalars, three owned within distinct kinship groups and one jalar shared by two groups. The jalars are very costly to operate and maintain, requiring significant investment of labor, animals, and fodder. Significantly, because of poor elevation control, many farmers have to rely on jalars just to lift water as little as six inches to their fields. From the mogha to the last jalar (the end of the watercourse) there are 11.63 miles of ditch and nakkas despite the mogha and last jalar only being 1 mile apart.

  The built system faces considerable technical challenges, mainly stemming from water losses and sediment accumulation. Losses are created by seepage from ditch walls that have been cut too narrow, dead storage from poor elevation control and inefficient pumping infrastructure, leaks, and spillage. Cumulatively, the study estimates that the system loses at least 50 % of the water it receives from the mogha. Despite somewhat regular cleaning of the main ditch, flow mismanagement from over and under irrigation creates heavy sediment accumulation. When farmers irrigate more than full system supply level, flows reduce for sediments to accumulate. Alternatively, if farmers then irrigate below full system supply level, past sediment accumulations submerge the mogha and further reduce flow, which further accumulates sediment, a detrimental positive feedback. This is difficult to plan for with flow variability coming from the mogha.

  Privately, users own farmland with an average plot size of 5.67 acres and a median plot size of 17 acres. In addition to the jalars being cooperatively managed primarily by kinship groups, farmers also share tractors and some even have joint farming operations to slow the pace of land fragmentation (28 of the 43 farmers). Nine farmers rent their land. To supplement the canal water, some farmers operate private tubewells, and there is one cooperatively-run tubewell. The only communication technology commonly owned by farmers is a radio, a key option for transmitting irrigation updates from government officials.

1.3 Attributes of the Community (IAD)

- **Social Infrastructure**: Two castes live within the study area with very little inter-

caste engagement: the Bhatti and the Arian. The Bhatti own land near the mogha in a generally contiguous area separate from the Arian, which are divided into four kinship groups (*baradri*). The kinship groups form the basis for social cooperation and conflict with some cases of intermarriage and occasional inter-group conflicts. Because of this, the groups generally share private infrastructure and coordinate jalar operation among themselves. While *pucca warabundi* provides strict distribution of water among the whole system and therefore, minimizes inter-group conflict, within group jalar systems, many follow *kutcha warabundi* where they can flexibly allocate rights among themselves, mainly in the form of trading. In addition to kutcha warabundi, social infrastructure is crucial to task distribution and needs fulfillment. Specifically, this can take the form of wangar, where farmers trade work or bullocks for land preparation tasks, seri, where farmers form a partnership to take another's land in exchange for a share of income, or other forms of material needs.

While the area lacks official local governing bodies after the dissolution of Basic Democracy in the region, the kinship groups elect their own leaders. Generally, social influence correlates with land ownership in the area while education level, caste position, spiritual attainment, elder status and links with officials also contribute. The relative influence of the kinship groups as a whole also correlates with land ownership.

- **Human Infrastructure**: The system contains 41 farmers. Farmers struggle to operate and maintain their system, which suffers from serious inefficiencies due to two levels of unawareness. First, they are unaware of external variability from interannual variability at the basin-level and unannounced system closures by the Canal Department. Second, farmers lack system knowledge to address technical inefficiencies in the watercourse. Technical and administrative support is the responsibility of the Canal Department, but it has not been able to offer that support. Most farmers in the watercourse area are illiterate, which further limits their ability to receive updates.

1.4 Rules in Use (IAD)

1. **Position Rules:**
   - Kinship Group Leader: 35 of the 41 farmers cast votes for leader of their brotherhood groups.
   - Canal Department Local Overseer (*Patwari*): chosen by the Canal Department.
   - Canal Department Supervisor (*Zillander*): chosen by the Canal Department.
2. **Boundary Rules:**
   - Inter-caste cooperation is avoided.
   - Jalar use is bounded by geographic proximity and kinship identification.
   - Watercourse membership is restricted to land ownership adjacent to the watercourse and its branches (*nakkas*).
3. **Choice Rules:**
   - **Trading:** Pucca warabundi officially prohibits trading of water rights, but this is often broken by users without sanction. This can take the form of a partial

or full turn exchange (an assigned day and time of day) or an exchange of canal water for tubewell water.

- Patwari, though it is illegal, may negotiate the size of moghas and provide "extra water."
- Farmers are prohibited from cutting nakkas into the main ditch over 1 per 25 acres, but this is often ignored without sanction.

4. **Aggregation Rules:**
   - Kinship Group Leader represents group interests but cooperates with other watercourse leaders to handle collective issues.
   - The patwari oversees an area of around 3000-5000 acres or about 400 farms.
   - Zillander supervises 10-14 patwaris.
5. **Payoffs Rules:**
   - Honor (*Izzat*) is a powerful motivator for cooperative behavior in the system.
   - The patwari, though it is illegal, may earn payments (*faslana*) from the community in exchange for extralegal water provision at the mogha level.
   - Farmers may apply for remissions from taxes when they experience crop failure (*kharaba*), but since this is often a cumbersome process, many revert to faslana.
   - Due to the inherent inefficiencies associated with jalars, farmers operating jalars are granted either half the regular tax rate or an increase of 50% authorized discharge from the mogha.
6. **Scope Rules:**
   - Watercourses in the area should officially receive 1 cusec of discharge per 268 acres of service land. However, due to remissions granted for the jalars and inconsistent land reporting, the watercourse of this study receives 1 cusec per 110 acres.
   - Pucca warabundi, the general law of the watercourse, is a strict system of allotted days and time of day turns for farmers proportional to land ownership. It is supposed to be binding for all users and enforceable by the Canal Department.
     - Within jalars, kutcha warabundi, a system of flexible trading among users, occurs.
   - Farmers must collectively clean the main ditch serving the watercourse area of sediment build-up. Farmers clean stretches upstream of the jalar that serves them, assigned a certain length of ditch to clean. If they fail to contribute, they will be fined or denied water.
     - Each farmer within the area of Jalar I to the entrance must clean 2.5 feet per phar (3 hours of water received)
     - Each farmer within the area of Jalar I to Jalar II must clean 7.5 feet/phar
     - Farmers within the area of Jalar II to Jalar IV clean the ditch cooperatively with all farmers participating, except those of the Bhatti caste.
   - The patwari zillander must supervise the upkeep of the watercourse ditches and incentivize cleaning and maintenance.

7. **Information Rules:**

   - The Canal Department must communicate canal closures, coming repairs or cleanings, system forecasts, and policy changes to farmers through the patwari and conspicuous mediums like the newspaper or radio.
   - The Canal Department and its patwaris are responsible for diffusing technical and administrative expertise and other innovations to farmers.

1.5 Summary

The Punjabi watercourse presented here faces considerable technical and institutional challenges to provide irrigation water. Minimal technical expertise and support from the Canal Department has left the existing system in a dysfunctional state with considerable water losses, sediment accumulation, and uninformed farmers. Despite this, the watercourse users have devised ways to leverage social infrastructure and extralegal mechanisms, including trading and negotiation with officials, to allocate water rights according to their realtime needs and provide basic operation and maintenance of shared ditch and pumping infrastructure. This crucial social infrastructure consists of close kinship groups, embedded within two non-cooperating castes, that are the basis of collaborative efforts and the primary organizing unit for semi-private hard infrastructure.

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

- Shui Yan Tang, Indiana University.
- Ute Brady, School of Human Evolution and Social Change, Arizona State University
- Adam Wiechman, School of Sustainability, Arizona State University