

## 1 General Comments

This case involves one of the oldest commons dilemmas known to man that can be traced back to the first humans... Water and Irrigation. As M. Anderies and M. Janssen write in their book Sustaining the Commons “We use water every day to drink, to cook, to shower, to wash, to flush, to clean, to irrigate, to swim in, etc. The importance of water makes it a central object of many social dilemmas: too little clean water, too much polluted water, unequal distributions of water, and natural disasters.” In this particular case it is the irrigation practices of a somewhat rural Pakistani Gondalpur Irrigation System which is located in Chak Aziz; Pirpur, Punjab Province in Pakistan.

## 2 Part I: System Structure - Collective action

The primary resource is the Main Watercourse in Gondalpur, situated in Main Watercourse in Gondalpur of Pakistan. More generally, it is located in Middle East & South Asia.

Latitude 31.170406 \ Longitude 72.709716



Regional Map revealing the site is about 200 km South of Islamabad and about 100 km West of the border to India



The resource appropriated related to the social dilemma is water for irrigation diverted with barrages from rivers to be distributed through canals. The original case was reported in 1986 and catalogues an action arena involving 50 farmers. The main watercourse of the village has serious problems in maintenance and water allocation. In the late 1980's Indiana University Students Edella Schlager and Shui Yan Tang conducted this CPR coding:

“Relatively good information has been collected about the stakes of participants who appropriate from Main Watercourse in Gondalpur. The condition of this resource is well understood. At the beginning of the period discussed by the authors, there was an extreme shortage of biological and physical resources withdrawn compared to the amount of water available. The system is located within one country. Within this country, the system's location is divided among several general purpose local jurisdictions at the same level. A permanent population lives year round in this location. There is frequent contact and communication between people in this location and officials in a nearby administrative center. This location is also characterized by an economy that is changing and tied to other economic networks during the entire time period.

Complete information is available regarding the strategies used by key groups interacting with the system. There is thorough documentation of the operational rules for this resource. This is the result of a high level of confidence that the authors who recorded the features of Main Watercourse in Gondalpur have a complete knowledge of its particulars. Furthermore, the authors have provided sufficient data to formulate a structured coding process.

The appropriation resources are situated in the area covered by the main watercourse of the Gondalpur village. The boundaries of the location are the boundaries of a watercourse. The appropriation resource present in this location consists of canals that deliver water to farmlands, and tubewells. Regarding the use of the irrigation system, there were few adverse affects throughout the entire period in the relationships among appropriation processes.”

2.1 The Commons Dilemma

It is perhaps impossible to write it better than this excerpt, “Water Governance is the first of many examples that we will present in the remainder of this book on “**Sustaining the Commons**” or, unfortunately “not sustaining the commons” in many cases. We are finally in a position to give a precise definition of the commons. There are two kinds of commons: commons provided by nature, and commons provided by humans. Often these two types of commons interact (e.g., a community irrigation system). The

most important distinguishing feature of a “commons” is that it involves one or several common-pool resources over which there are no established private property rights. The second distinguishing feature of a “commons” is that it involves actions on the part of the individuals who use it to maintain its productivity. These actions are one of two sorts: (1) making a contribution of real resources (money, time, or physical capital), or (2) restricting one’s activities with respect to the use of the common-pool resource associated with the commons.”

Again an image taken from **Sustaining the Commons** perhaps cannot emphasize enough the importance of this topic as can be seen in the 2007 assessment that the entire country of Pakistan is under approaching water scarcity and physical water scarcity. The vast majority portion of Pakistan to include this case’s sight is firmly in the latter.

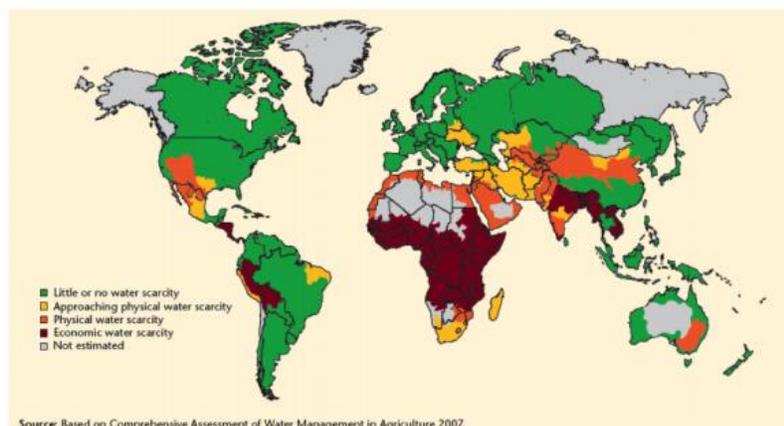


Figure 5.1: Water scarcity.

The key elements of this dilemma are all present 1) scarcity as seen above, 2) difficult to exclude with so many interested parties with access as evidenced by the ability to free ride and a lack of adequate monitoring and sanctioning , and 3) subtractability as water even though is a renewable resource cannot be used simultaneously for two different purposes.

## 2.2 Biophysical Context (IAD)

- Natural infrastructure:

Clearly this region receives its water from melting ice pack from the Hindu Hush and Himalayan Mountains. Punjab literally means the land of five waters and refers to the five rivers that flow through it: the Jhelum, the Ravi, the Sutlej, the Beas, and the Chenab which is the largest. The annual monsoon season from July to September is also a period of heavy rainfall.

- Hard human-made infrastructure:

This monograph contains four papers about irrigation organization and management in Pakistan. “For example, while Punjab irrigates 8.32 million hectares through a single entity, California delivers water to 3.8 million irrigated hectares through a decentralized network of 244 water districts (DWR 1983).” The paper by James Wolf analyzes the present level of financing operation and maintenance at the provincial level, and evaluates its adequacy. “Historical: Although irrigation had been practiced along the rivers and streams of Pakistan for centuries, the Indus system today dates primarily from works constructed by the British between 1850 and 1947, and from works built post-partition and/or as a result of the 1960 Indus Waters Treaty. The first irrigation works were constructed to create employment opportunities for war veterans (Michel 1967). A second series of facilities were opened to encourage resettlement in areas that were largely uninhabited and thereby generate revenues from sale of state lands. A second objective was to maximize the command area and prevent famine by providing water to a large number of families. The objective of projects constructed in the early 1900s was to generate revenue by selling water and taxing land, agricultural produce, and trade (Merrey 1983). Above all, projects were designed to keep administrative and operational staff requirements as low as possible. Systems were intended to provide "equitable distribution (of water) without any interference by the canal establishment -which is an important advantage to the irrigation community" (Clibborne 1924:146). This laissez faire

attitude toward canal operations, combined with a design that required only minimal regulation, established the basis for today's relatively low involvement of government personnel in active system operations.

Scope of Government Responsibility: In Pakistan, irrigation system O&M is the responsibility of the Provincial Irrigation Departments (PIDs). PID responsibility begins after water is diverted from the dams and terminates at the outlets to some 89,000 watercourses which serve areas that vary in size from 80 - 280 hectares, and typically about 160 hectares. Compared to other Asian countries, this is a relatively large area to be served by a single outlet. In Thailand and Malaysia an outlet serves 50 - 80 hectares; Indonesia, 20 - 30 hectares; Sri Lanka, 12 - 16 hectares; Philippines, 10 hectares; Korea, 0.8 - 2 hectares; and Japan, 0.4 hectares. Thus, other factors being equal, irrigation department expenditures in Pakistan should be less than those in other Asian countries.”

The three papers by Douglas Merrey analyze local level sociological and ecological processes and their implications for irrigation system management and development policy at the macro level. Merrey demonstrates his case by looking at the main watercourse of a village which has serious problems in maintenance and water allocation. He argues that the minute subdivision of land and therefore irrigation times; the absence of an indigenous local capacity to ensure cooperation on collective tasks; and the "embeddedness" of irrigation management tasks in a highly fragmented and competitive social structure are deep-rooted problems requiring fundamental changes in system design and organization.

The boundary of this resource has natural/constructed attributes which do not limit entry. The boundaries of this resource are the same as the location, and exist in one country, but are divided among several general purpose local jurisdictions at a single level. The boundaries of this resource are independent of a development project designed by non-residents.

#### 2.4 Rules in Use (IAD)

The rules in use, ie. soft human-made infrastructure, are provided by resident farmer internal communication and agreed upon rules and Provincial Irrigation Departments (see system representation). Based on the study, the following specific rules are relevant for this case:

Position Rules: Boundary Rules: Choice Rules: Scope rules: Payoff Rules

##### Boundary Rules

The following rules define the requirements that must be met before individuals are eligible to harvest or withdraw units from the appropriation resource.

The national and local level(s) of government or organization had no jurisdiction over the resource.

A rule exists requiring ownership or leasing of land in the location of the resource. This rule is enforced at the regional and rules-in-use level(s).

Entry rights may be transmitted to anyone designated by the original owner.

Within one generation of potential resource appropriators, entry rights can be given, leased, rented, sold or transferred to others.

When transfer on a temporary or permanent basis is allowed, the person who makes the transfer determines to whom such rights can be transferred.

##### Authority and Scope Rules

The default conditions for both authority and scope rules do not apply.

The following paragraphs include information on rules of 1 cycle(s).

Authority Rules:

The national and local level(s) of government or organization had no jurisdiction over the resource.

There is a rule requiring withdrawal at a fixed time slot, based on the amount of land held. This rule is enforced at the regional level(s), and is part of the most restrictive, regularly adopted/used set of rules.

There is a rule requiring withdrawal at a fixed time slot, based on unincorporated, specific criteria. This rule is enforced at the rules-in-use level(s), and is part of the most restrictive, regularly adopted/used set of rules.

## 2.5 Summary

A number of inferences, educated guesses both highly confident and just confident

There are not distinct and stable micro-environmental or ecological zones within this resource (educated guess).

There are not strategic points within the resource where the main flow of the water for irrigation can be controlled (inferred). There is considerable, and mildly predictable variation over space in the availability of water for irrigation within the resource (inferred). There is considerable, and mildly predictable variation in the flow of water for irrigation within a single year (inferred). There is considerable, but unpredictable variation in the flow of water for irrigation from year to year (inferred).

The boundaries of the production resource are totally separated from the boundaries of the appropriation resource (highly confident). The boundaries of the production resource are totally separated from the boundaries of the location (highly confident). The boundaries of the distribution resource are not identical to the boundaries of the appropriation resource. The distribution resource is a facility connected to the appropriation resource (highly confident). The boundaries of the production resource are not equivalent to the boundaries of the distribution resource. The production resource is a facility connected to the distribution resource (highly confident).

The headworks (production resource) are operated by the same agency(s) (or the same group(s) of people) as the appropriation resource, but the agency(s) or the group(s) of people are not the sole operator(s) of the headworks (highly confident). A regular agency(s) of a regional government (e.g. State Department of Water Resources) operates the headworks for this system (highly confident). The irrigators being served by this production organization do not participate in the selection of the officials of the production agency except as citizens in a general election (highly confident). The distribution system is operated by the same agency(s) or the groups(s) of people as the appropriation system, but the distribution system is not solely operated by the same agency(s) (or the same group(s) of people) as the appropriation resource (highly confident). A regular agency(s) of a regional government (e.g. State Department of Water Resources) operate(s) the distribution system (highly confident). The irrigators being served by this production organization do not participate in the selection of the officials of the distribution agency, except as citizens in a general election (highly confident). The distribution system is solely operated by the same agency(s) (or the same group(s) of people) as the headwork's of the system (inferred).

The processes described in the related documents are primarily related to appropriation, production, distribution and use. The formal owner(s) of the resource discussed in this study is a regional government. The set of individuals who have rights to withdraw from this resource is well-defined. As of the beginning of this period, the owners are exercising (or attempting to exercise de jure) and effective in gaining closed access to this resource. Since the beginning of this period, the appropriators are exercising (or attempting to exercise de jure) effective closed access to this resource.

As of the beginning of the period, the quality of the units being withdrawn from the resource was poor (confident). As of the end of the period, the quality of the units being withdrawn from the resource was poor (confident). At the beginning of the period of the study, there were problems of pollution in this resource, due to the appropriation process (inferred). At the end of the period of the study, there were problems of pollution in this resource due to the appropriation process (inferred). As of the beginning of the period, the extent of technical externalities resulting from the appropriation activities of participants from this resource was relatively high (confident). As of the end of the period, the extent of technical externalities resulting from the appropriation activities of participants from this resource was relatively high (confident). At the beginning of this study, the interference between the appropriation technology for this resource and the appropriation processes for other resources in this location had no effect on the appropriation resources (educated guess). At the end of this study, the interference between the appropriation technology for this resource and the appropriation processes for other resources in this location had no effect on the appropriation resources (educated guess). At the beginning of this study the appropriation resource was experiencing considerable deterioration

due to poor maintenance (confident). At the end of this study the appropriation resource was experiencing considerable deterioration due to poor maintenance (highly confident). At the beginning of this period the appropriator's shared low levels of mutual trust (e.g. oral promises rarely used) (inferred). At the end of the period the appropriator's shared low levels of mutual trust (e.g. oral promises rarely used) (inferred). By the end of this period no change had occurred in the property rights regime related to the appropriation resource (inferred).

#### INFORMATION LEVELS

There are readily available maps or charts of the appropriation resource for use by the appropriators (inferred). Maps and/or charts of the production and distribution resources are available to appropriators (educated guess). The appropriators of this resource can be seen by each other while withdrawing units from the resource (educated guess). No appropriators are in radio communication with each other while appropriating from the resource (educated guess). There are actions being taken, by appropriators or officials, to generate information about the condition of the resource (inferred). There are sometimes records of the withdrawals from this resource kept in a systematic way (educated guess). There was no information in the study about whether or not there are records of the physical factors which directly affected the resource kept in a systematic way. There are not records of the appropriators' contribution to the maintenance of the resource kept in a systematic way (inferred). Records are kept in a language accessible to most of the appropriators (inferred). The keepers of these records are officials at some level (inferred). The case study did not indicate whether or not these records are available for inspection by appropriators. There are arenas being used for the exchange of information about conditions of the resource (inferred). Appropriators get together to discuss mutual problems of the resource Infrequently/Irregularly (educated guess). The appropriators have a considerable familiarity with the characteristics of this resource (educated guess).

#### POTENTIAL ACTIONS AND LEVELS OF CONTROL

There are no specialized staff or workers to undertake maintenance (inferred). The quality or quantity of the units available to the appropriators is not adversely affected by the strategies of prior appropriators (educated guess). There are not problems of pollution resulting from activities of others who are not appropriators of this resource or inhabitants of this location (e.g. acid rain, sewage disposal) (educated guess). There does not appear to be an insurance mechanism available to the appropriators related to variability of income from the resource (educated guess).

#### PATTERNS OF INTERACTION

Differences between subgroups relating to gender identification does not affect communication (educated guess). Differences between subgroups relating to ethnic identification does not affect communication (educated guess). Differences between subgroups relating to clan identification are large and significantly affected communication (confident). Differences between subgroups relating to racial identification does not affect communication (educated guess). Differences between subgroups relating to caste identification are small and did not affect communication (confident). Differences between subgroups relating to religious identification does not affect communication (educated guess). Differences between subgroups relating to languages spoken does not exist (inferred). Differences between subgroups relating to general cultural views of the resource system and its use does not exist (inferred). Differences between subgroups relating to any problems that affect communication are large and significantly affected communication (confident).

The general manner in which appropriators related to one another during this study is a relatively negative, perhaps even spiteful manner -- one indicator of this would be vandalism by appropriators against appropriators. (inferred). The documents do not present evidence of concurrent or prior history of cooperative actions between the appropriators in regards to other activities (inferred). If someone violated the rules-in-use related to the appropriation process from this resource, it is likely as not that he/she would encounter social sanctions imposed by other appropriators (who are not filling positions as official monitors) (educated guess). If someone violates the rules-in-use related to the appropriation process from this resource, it is likely as not that he/she would encounter physical sanctions by other appropriators (who are not filling positions as official monitors) (educated guess).

#### POSITIONS AND PARTICIPANTS

At the end of the period studied the position of non-appropriator (individuals prevented from using the resource) did exist (educated guess). At the beginning of the period there was a general estimate of 51-100 appropriators (educated guess). There was a general estimate of 51-100 appropriators at the end of the period (educated guess). The "official" position of monitor (apart from the willingness of all appropriators to monitor) does not exist (highly confident).

“Pakistan's irrigation bureaucracy is enormous. The Punjab PID has more than 50,000 employees. In contrast, the United States Bureau of Reclamation currently has about 7,500 employees. More than 80,000 individuals were employed by the four PIDs in 1983/84 (Table 4). In aggregate, this is about one employee per watercourse or one employee per 88 - 216 irrigated hectares, depending on the province. Bottrall (1981 ) notes that the ratio in other Asian countries ranges from one employee per 122 - 496 irrigated hectares. In Punjab, almost 40% of the total work force is assigned to canal irrigation, followed by 26% who work with tubewells, 15% in the special revenue group (whose function is to assess water charges), and 6% who work with drainage. The remaining 13% is assigned to administration or to a number of less labor-intensive categories such as dams, flood control, hydrology, hill torrents, land reclamation, waterlogging and salinity, workshops, research, design, stores, water treaty, and water allocation.”

## EVALUATION OF RESULTS

There are appropriators who were consistently disadvantaged in this period (inferred). The study did not indicate whether or not the relatively worst off appropriators have or have not been cut out of their benefits from this resource or substantially harmed. By the end of the period studied the distance between those who were the least advantaged and those who were the most advantaged could be characterized as increasing over time (inferred).

## AUTHOR'S EVALUATION AND CAUSAL ASSUMPTIONS

In this coding form the author focuses on the readers' concept of results and the evaluation of results (inferred).

The author's results indicated very bad performance in the level of maintenance and the efficient and equity allocation of water. There was an absence of indigenous local capacity to ensure cooperation. The author evaluates the efficiency of the system as low, based on the percentage of commanded area actually irrigated (p.51) To improve efficiency the author suggested better maintenance.

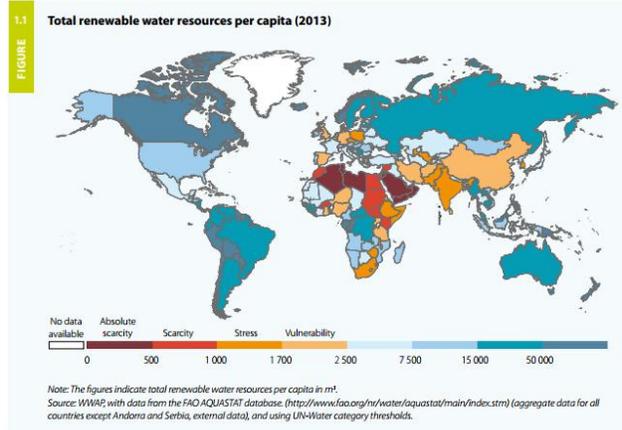
The appropriative power of the technology used threatens the balance between units withdrawn and units available even if no new users are added (inferred).

### Strategies Adopted:

At the beginning of the period the rate of unit withdrawals was increasing (educated guess). At the end of the period the rate of unit withdrawals was constant (educated guess). In irrigation, appropriation resources (at the beginning of the period) produce mostly paddy rice, and also grains other than paddy rice, fodder, sugar cane or beets, and a non-listed product. In irrigation, the appropriation resources (at the end of the period) produce mainly paddy rice, and also grains other than paddy rice, fodder, sugar cane or beets, and a non-listed product. During this time period members have invested resources, such as their own labor, in maintaining or improving the structure of the appropriation resource (inferred). Investment into constructing or improving production or distribution works for maintaining or improving their resource has not been made by members (inferred). Resources have not been expended (including time) to avoid actions that would harm the structure of the appropriation resource (highly confident). The maintenance or improvement work is neither dependent nor contingent on the quantity of units appropriated (inferred). Members have access to an alternative source of supply (inferred). Members of this group have not increased their use of alternative sources of supply of this unit (educated guess). At least one member has assumed entrepreneurial activity in trying to achieve coordinated strategies in relationship to both withdrawal and investment (confident). In characterizing the usual behavior of the members of this subgroup with respect to local operation level rules-in-use (other than in extreme shortage), it can be said that about half of the members follow the rules (inferred). The level of infraction of members who are not rule followers is generally medium (educated guess). Action in the collective choice arena has been proposed to alter the operational or collective-choice rules affecting the appropriation from this resource (educated guess). Attempting to alter the behavior of appropriators, members of this group have threatened or actually used violence to obtain a more favorable situation (regardless of the rules).

### 3 Part II. Dynamic Analysis - Robustness 3.1

Update on the Commons Dilemma as seen in the photo below from the 2015 United Nations World Water Development Report still categorizes most of Pakistan as under water stress. Obviously the situation is only going to get worse with global warming and unsustainable development.



In that same report UN Secretary-General Ban Ki-moon writes, “Water flows through the three pillars of sustainable development – economic, social and environmental. Water resources, and the essential services they provide, are among the keys to achieving poverty reduction, inclusive growth, public health, food security, lives of dignity for all and long-lasting harmony with Earth’s essential ecosystems..... The publication of the World Water Development Report 2015, “Water for a Sustainable World”, comes as Member States strive to build on the gains made under the MDG framework, articulate an inspiring post-2015 development agenda and reach an ambitious agreement on climate change. The report illustrates the complex linkages between water and critical areas such as human health, food and energy security, urbanization, industrial growth and climate change. It also describes the status of the world’s water resources, including an overview of the impacts of unsustainable growth on freshwater resources, and suggests possible responses to these challenges..... The decisions that determine how water resources are used (or abused) are not made by water managers alone. Progress towards sustainable development thus requires engaging a broad range of actors. I appeal to Government leaders as well as civil society and the private sector to join forces to protect and share our most precious resource, and to build a more sustainable future for all.”

### 3.2 Shocks, Capacities, Vulnerabilities.

Obviously as Climate Change makes seasonal ice melt less and less there is a problem in water quantity in an already physical water scarcity area of the world. As the photo map image above shows there is not much room to maneuver concerning water and that region. The fact that such a large governmental organization as the Provincial Irrigation Department has absolutely no control over the very resources they were created to regulate due to a lack of conscious coordination.