# INSTITUTIONAL INNOVATIONS IN IRRIGATION MANAGEMENT: A CASE STUDY FROM NORTHERN PAKISTAN

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> ...a number of the organizational arrangements and processes observed in Fai Muang Mai [and other irrigation systems] are expositions of an underlying *property grid.* That property grid, formed during the initial period of constructing the hydraulic works and continually reproduced, provides the logic both for the persistence of certain old practices and the creation of new procedures as circumstances require (Coward 1985:7; emphasis added).

## INTRODUCTION

Irrigation analysts and development agencies now recognize irrigation management as a socio-technical process (Uphoff 1985b) consisting of a technical infrastructure and an institutional framework which determines the use of that infrastructure. Both are equally important in the success of the irrigation system.

Irrigation systems require considerable labor investments for system development and maintenance. Those who invest labor in the hydraulic system thereby enter into property relations with each other and have a vested interest in the common property represented by their hydraulic works (Coward 1983). These relationships are based on past and continuing labor investments in the irrigation system leading to "terre-capital" formation (Tamaki 1977). The underlying property grid formed by these relationships determines the entitlements of individuals within the irrigation system.

The notion of hydraulic property defined by property relationships is a useful beginning for an understanding of the institutional complexities in farmer-managed irrigation systems. These relationships are not constant. Changes may occur due to historical evolution or due to the availability of new inputs, such as markets or new technology, which change the nature and value of the resource.

To permit a more dynamic analysis, Bromley (1986) feels a concept of property as a secure claim or entitlement to a resource which offers "a stream of benefits to humans over time" may be useful. Mirroring the notion of the socio-technical process, harnessing the stream of benefits requires both physical ability and effective institutional arrangements which define its management and control, and hence its nature and allocation.

Enduring irrigation systems, like other resource management systems, need organizational structures for system management. These organizational structures and the institutional rules and conventions regulating the system constitute the Common Property

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Regime (ibid.) which ensures continuity and sustainability of the system. It is the non-perception of these regimes which has misled some into believing that the commons[1] will inevitably be overexploited (Hardin 1968).

In addition to a basic skepticism about the effectiveness of their technical capabilities, governments and intervening agencies often consider existing "social arrangements" obsolete, thus legitimizing modifications (Coward 1985:14). In order to refute these assumptions, the capacity and nature of institutional innovations found in Common Property Regimes with viable irrigation systems need to be documented and analyzed.

Four hypotheses are suggested as characteristic of this process:

*Hypothesis 1*: Historical growth and changing externalities may stimulate institutional innovations in the rules or organizational structures of Common Property Regimes.

*Hypothesis 2*: Barring complete breakdown or replacement of the irrigation system, these institutional innovations will adhere to the logic of the underlying property grid (i.e., existing property relationships).

*Hypothesis 3*: Although some of its functions may become redundant, and some of the institutional rules accordingly modified, the modified Common Property Regime will tend to replicate pre-existing organizational structures as far as possible.

*Hypothesis 4*: Where the irrigation system is managed by existing organizational structures, intervention will succeed to the extent it builds on the existing Common Property Regime.

Testing these hypotheses requires microlevel data to understand the dynamics of irrigation systems and to disaggregate the contributions made by the intervening agency and local groups to irrigation development. This paper analyzes a farmer-managed irrigation system in the Hunza Valley in northern Pakistan to test the hypotheses. Local farmers there have been tapping glacial melt from the Ultor Glacier to irrigate fields since the 1880s. Two major changes in the irrigation management system are documented and examined.

A private development agency, the Aga Khan Rural Support Programme (AKRSP), entered the arena in 1983 and has been supporting construction of a new irrigation canal to supplement existing water resources. This intervention sheds light on the directions in which similar agency-sponsored institutional changes may occur.

The historical evolution of the irrigation system, and the villagers' response to AKRSP's post-1983 intervention, provide useful case study material which will be used to test the above hypotheses. Toward the end of this paper, an attempt will be made to derive implications for development theory.

## THE CASE OF ALIABAD

Aliabad is located in the Hunza Valley, 100 kilometers (km) beyond Gilgit and slightly more than 700 km from Islamabad along the Karakorum Highway. It is one of the three new settlements -- Hyderabad and Dorkhand are the other two -- which have developed out of the expansion of the fabled capital of Hunza: Baltit (now renamed Karimabad) and its satellite, Ganish. These villages are contiguous and share the same water resources emanating from the Ultor Glacier.

Aliabad was established during the last two decades of the 19th century when the then Mir of Hunza authorized selected households from the four lineages living in Baltit -- Birataling, Brong, Diramiting, and Khurkutz -- to construct an irrigation channel from the Ultor Glacier beyond Baltit in order to settle the relatively flat land further down the valley. Since then, Aliabad has expanded to 337 households. Although Aliabad shares the irrigation system with Baltit and Hyderabad, this paper will focus primarily on the three Aliabad subsystems. These subsystems act as a second level of organization.[2]

Two smaller settlements -- Aga Khanabad and Dorkhand -- also come within the subsystem management level of Aliabad. Residents of these two settlements are from the same four lineages as those of Aliabad but they migrated here from Ganish, a village in the foothills of Baltit. The relatively small number of households within Dorkhand and Aga Khanabad makes the settlement a more significant unit than the lineages within it. Having been two separate villages in the past they now operate virtually as neighborhoods of Aliabad. In the Hunza context, neighborhoods can also operate as corporate units which may override lineage considerations.

> Segments of disparate lineages, and even of disparate clans, compose the neighborhood. Although the neighborhood does not have the sharply defined collective identity of the village nor the village's many functional attributes, it is nonetheless corporate. It is a durable, named group with recruitment based on residence within marked sections of the village. It has explicit sanctions and commitments overseen by an executive committee, and regularized arrangements for the safeguarding of women and property and for joint ritual and economic activities (Ali 1984:236).

As shall be seen later in this paper, the operational units chosen by the villagers to form village organizations under AKRSP's auspices were precisely these six units -- four lineage-based units from Aliabad and two neighborhood-based units from Dorkhand and Aga Khanabad -- which agreed to cooperate at one level in the irrigation system. For the purposes of this paper, these six units which form part of the Aliabad irrigation subsystem will be discussed as one unit of organization.

### The Agrarian Setting

Karimabad is located at an altitude of 2,405 meters. Aliabad proper being approximately 200 meters lower. Annual precipitation at Karimabad averages 145.1 millimeters (mm, Whiteman 1985). There are no records for Aliabad but any variation will be on the lower side because of its physiographic location. Not only agricultural crops but even fruit and fuel-wood trees are entirely dependent on irrigation. This is evident from the sharp contrast in vegetation between the irrigated areas and the desert-like terrain adjacent to it.

With very few exceptions, landholdings are equitable. Almost all farmers in the northern areas enjoy ownership rights to the lands they cultivate (Saunders 1983). Traditionally, these lands are not alienable beyond the lineage (Ali 1984:236).

Aliabad lies in the transition zone between the double-cropped and single-cropped zone. Were it not for the acute shortage of land, single-cropping would have been practiced (Whiteman 1985) as is evident in comparative locations in neighboring valleys.

Wheat is the most important crop in Aliabad. An early variety of maize is sometimes planted but the low grain yield means it is used largely as fodder. Some buckwheat and barley are also planted. Alfalfa is cultivated on the steeper slopes as winter fodder.

The residents of Aliabad and, in fact, of all Hunzukutz[3], practice an intensive form of agroforestry, combining fodder production with extensive horticulture and silviculture. But traditional rules prohibit tree planting within 24 *gash* (literally "forearm," meaning the distance from fingers to elbow or about 0.46 meters), or 11 meters of a neighbor's wheat field. Apricots are the most abundant fruit and, along with apples, almonds, and grapes, provide a critical nutritional supplement. The significance of fruit trees can be illustrated from the fact that, of a sample of 24 households, the number of fruit trees owned ranged from 10-500 with an average of about 96 trees per household. This is not an unusual number for the Hunza Valley. Apples and other exotic fruit such as cherries and pomegranates are now preferred because of the higher market value after the opening of the Karakorum Highway in 1978. Poplars are the most common trees and are preferred because of their rapid growth, straight pole-like trunks, and value as fodder. Other trees include willows and Russian olives (*elegenus*).

There is potential for further land development in areas where the communities of Aliabad have hereditary rights (Table 1). The total population of these 501 households is 3,887, an average of 7.76 people per household.

The major constraint for land development is water scarcity (Table 2). Understanding the irrigation system is necessary before the discussion can proceed further.

## THE IRRIGATION SYSTEM

Due to the extremely low rainfall, irrigation plays a critical role in the entire Hunza Valley. Glacial melt is tapped and carried up to 10 km through indigenous channels (*kuhl*) across precarious slopes to alluvial fans and river terraces which constitute most of the arable land. These kuhls often have to cross almost vertical rock faces and a passage is then carved out or blasted along the rock wall. As in the case of landslide-prone areas in Nepal (Martin and Yoder 1983), kuhls may take the form of tunnels. In Hunza, this is more often the case when the kuhl is traversing across scree. The kuhl is constructed on the scree slope and covered with slabs of rock. The scree soon covers the slabs forming a sort of tunnel. Actual tunnels and aqueducts are also found but are relatively rare.

Table 1. Extent of irrigable land in hectares.

| Village organization | Number of members | Land development potential | |
|---|---|---|---|
| | | Developed | Undeveloped |
| Birataling | 83 | 253.0 | 41.5 |
| Brong | 85 | 121.5 | 253.0 |
| Diramiting | 85 | 253.0 | 43.0 |
| Khurkutz | 84 | 253.0 | 43.0 |
| Aga Khanabad | 86 | 108.5 | 40.5 |
| Dorkhand | 78 | 273.0 | 43.3 |
| Total | 501 | 1262.0 | 464.3 |

*Source: AKRSP (1986).*

Table 2. Constraints inhibiting land use changes identified by 24 respondents during field data collection.

| Major constraint identified | Percent in favor of change[a] |
|---|---|
| Scarcity of water | 52.0 |
| Rules against tree planting | 24.0 |
| Lack of agricultural inputs | 14.0 |
| Other | 9.5 |

[a]N = 21; percentages are rounded and do not necessarily total 100%.

## Physical Infrastructure

Aliabad is irrigated by three kuhls: Samarkand, Barbar, and Harchi. Samarkand is the major kuhl and is divided into four secondary channels: Dalah, Makuchim, Chooshihar, and Peer. Of these, Dalah and Makuchim are reported to date back to the 1880s, the time of the original settlement in Aliabad. They service the main wheat fields of Aliabad. The other two secondary channels were added subsequently for sloping alfalfa fields and orchards. Water is released into them only when there is surplus. For example, Peer is provided with water only after June 15.

A number of attempts have been made to improve and extend the irrigation infrastructure. Notable are two attempts to construct a kuhl from another source, Hassanabad Nala, in the direction of the tail of the existing system. The first major attempt was by the British around 1940. This kuhl had a very small command area and was not much use to the farmers. It fell into disrepair and disuse after the first few years. The second was by the Northern Areas Works Organization (NAWO) in 1975. Construction of this kuhl was aborted because it was considered technically too difficult. With AKRSP's support, farmers are now attempting to construct a major kuhl from the same source which other agencies had declared unfeasible.

**Allocation of Water**

During the summer season a peak discharge of 5 cusecs reaches Aliabad through Dalah alone. The other secondary channels have less capacity and a combined discharge of 3 cusecs, providing a maximum total discharge of 8 cusecs for Samarkand kuhl.[4]

Like Samarkand kuhl, Barbar kuhl is also shared by Baltit, Hyderabad, and Aliabad. In fact, they share a common intake from the glacial stream. Water is released in Barbar only when it is in excess of the capacity of Samarkand, usually in June or July. At that point, the wooden gates regulating allocation of water between the villages are removed and surplus water diverted to Barbar kuhl.

Harchi has a different intake and is shared by Aliabad with two other villages -- Ganish and Altit -- each of which is entitled to one share of the water to Aliabad's two. A proportional weir (*chaukhat*), similar to the Sumatran *penaro* (Coward 1985) and Nepalese *saacho* (Martin and Yoder 1983), with four proportionate inlets, is installed at the source (*sarband*). These openings have been adjusted to compensate for the differential rate of flow within the kuhl. The openings in the center are slightly smaller than the two openings on the sides to ensure an equal discharge from the four openings.

Samarkand also has regulatory gates but because the major share of its discharge is earmarked for Aliabad, its role is less crucial. Water has been allocated to Hyderabad every eighth day, the intervening seven being Aliabad's share. Baltit's rights are limited to the allocation of one water inlet the size of a fist, controlled by installing a stone gate with a hole (*tori*[5]), a structure usually used for tertiary channels.

However, Baltit has a 50 percent share in the discharge of Barbar kuhl. The entire discharge during the day is allocated to Baltit while the night discharges are shared between Hyderabad and Aliabad in the ratio of 9 to 4. Normally, the water in Barbar is enough to irrigate individual fields in Aliabad two to three times a year.

The difference in timing between Baltit and the other villages is significant. Perhaps to avoid possible misappropriation of water, fields are not irrigated at night. Most tertiary channels have storage reservoirs where water is diverted, to be appropriately distributed in the morning. Because there is always loss of water through seepage from the reservoirs, a night's share amounts to junior rights (Bromley 1986) as compared to Baltit's senior rights during the daytime when water can be directly applied to the fields. The proportion of discharge from Barbar which is actually distributed to Baltit's fields thus amounts to more than the proportion of their time share.

Three full-time watchmen (*yatkuin* or *dargha*) look after the interests of Aliabad at the intake. They live in a shed at the intake site from February through November each year and are compensated both in cash and in-kind (*gharbal*). Each yatkuin is reported to have been paid Rupees (Rs) 200[6] (US$14.29) per lineage and provided a small amount of essential commodities in-kind by each household. Additional yatkuin are appointed to supervise the flow through the other regulatory gates and, in the past, to patrol the entire length of the kuhls. One such yatkuin at Peer was paid Rs 10 (US$0.71) per household in 1985.

A large number of tori have been installed at the tertiary level within the Aliabad subsystem. At the lowest level, that of individual farmers, water is shared on a rotational basis by the *warabundi* system (see Renfro and Sparling 1983) which determines the time share of the farmers.

A cross section of 24 respondents from Aliabad reported irrigating their wheat fields 5-8 times in 1985, with a median of 6.7 irrigations. Of these, 23 respondents felt that water availability was insufficient even for wheat, the crop which gets priority for all inputs.

**Water Rights and Land Use**

The relationship of water rights to land tenure varies within Gilgit District, even within the Hunza Valley. In some villages the two go together but in areas of acute water shortage, water rights are distinct from land rights (Hussein et al. 1986). Transactions of water shares also take place in some villages.

In Aliabad, water rights are directly linked to land rights. However, the allocation of water rights varies with land use. Wheat has top priority with alfalfa, vital as winter fodder for livestock, a close second. Fruit orchards come next, with plantations of multipurpose trees interplanted with grasses coming last. If alfalfa is planted on cropland, it is given priority. If, however, it is interplanted with trees, it loses its priority.

Trees have junior rights to water, while wheat and alfalfa have senior rights when planted on cropland. If regular cropland is converted to orchards, it retains senior rights. However, the 11 meter mandatory spacing from neighbors' fields acts as a constraint on horticulture development even though cash returns from orchards are at least five times that from wheat.

Some expressed resentment at what they considered to be anachronistic rules, but older farmers, who have had to be self-sufficient in the past, stressed the imperatives of food security. They explained the apparent discrimination against trees by pointing out the shading effect on other crops, but also expressed concern that the long roots of trees could reach far into the neighbor's fields in search of vital moisture. The severe scarcity of water does not permit this "luxury."

In spite of traditional logic, the availability of sufficient wheat imported from Punjab and the lure of lucrative incomes through the opening of distant markets for fruit (results of the completion of the Karakorum Highway) are generating a lobby seeking amendments to the institutional constraints against tree planting. Table 2 (above) shows that more respondents chose these junior rights than chose lack of agricultural inputs as the major constraint on positive land use changes.

If hypothesis 1 is correct, we can expect reassignment of water rights in favor of fruit trees in the near future.

**Maintenance of the Irrigation Infrastructure**

Each year, the kuhl is cleaned and repaired at the end of May. Every household in the villages is required to participate in this annual maintenance. The kuhl is divided into portions which are alloted to subsections of the irrigation community for repair. For example, Samarkand kuhl has been divided into five portions and alloted to five settlements from among its users nearest to those portions. Minor repairs during the course of the season are done by those responsible for patrolling the length of the kuhl but any significant breach results in the mobilization of the entire user-group. However, in such cases, the subsystem groups mobilized for emergency repairs will always be those downstream. For instance, farmers of Hyderabad and Aliabad are required to go to Baltit's assistance to repair any major breach, and Aliabad farmers are required to assist in repairing breaches in Hyderabad. Once the water reaches the tail of Aliabad, those at the head cannot be mobilized for repairs.

Households which cannot or do not wish to contribute labor may compensate in cash. The rate of compensation was Rs 300 (US$21.43) during the 1985 season. This included compensation for annual repair as well as maintenance during the course of the season. Of the sample of 24 farmers, 15 provided maintenance labor in 1985, while 8 paid cash. One was exempted as he was an office-bearer of the village organization. On an average, villagers provided 8.2 days of maintenance labor besides the annual spring repair. This low figure may be less than the average invested in annual maintenance over a longer time period as there were no major disasters in 1985.

Nevertheless, this is a considerably lower rate than that reported for hill irrigation in Nepal (Martin and Yoder 1983) and may be a function of low rainfall, which reduces the incidence of landslides. The investment of past labor to form hydraulic property (Coward 1983) and terre-capital (Tamaki 1977) is proportionately much greater in Aliabad than in the Nepal cases, in comparison with the amount of maintenance labor required to benefit from that property.

**Innovations in the Irrigation Management Structure**

The earliest reported management structure was lineage based. Because at the time Aliabad village was initially established, the settlers were alloted blocks of arable land on a lineage basis to be internally allocated within houeholds of the lineage, water shares were similarly allocated. Each lineage was allocated water for a day on a rotational basis. Internal distribution was the responsibility of the lineage. There were thus two levels of organization: a decision-making unit at the level of the kuhl, and an operational one at the level of the lineage.

The irrigation system was gradually expanded to meet the needs of the growing population. As additional tracts of land were brought into the command area of the primary and secondary channels, these tracts were also distributed among all participating lineages, and further among households within each lineage. The result was that over a period of time, fragments of arable land owned by lineages and by households were scattered over the entire farmland of Aliabad.

The preexisting irrigation management system necessitated irrigating lands of a lineage on a single day. This was rendered impractical by the scattered nature of landholdings. A contradiction thus developed between the institutional system and the technical system. In 1953 this was resolved by the formation of a *jirga* (council) for irrigation management. Historical necessity thus stimulated institutional innovation (Hypothesis 1) which operated at the intermediary level between the kuhl and the lineages.

The jirga consisted of 16 members representing all segments of water users from the Aliabad subsystem. It acted as the sanctioning body, and had a supervisory role. It was also the forum for conflict resolution. Operationally, the jirga still relied on the lineages for distribution of water and maintenance of the irrigation infrastructure but the distribution system was altered. Components of the previous organizational structure were thus retained (Hypothesis 3).

Aliabad's share of water was now allocated to fields on a rotational basis. Starting with land at the head, distribution would take place towards the tail, each farmer getting his share. On reaching the tail, distribution would again commence from the head. To ensure equity, distribution the following year would commence from the tail and move towards the head. This pattern of distribution was implemented on a rotational basis by the lineages, each lineage being responsible for water distribution for one year. Although this distribution system is apparently quite different from the previous one, it seeks, in fact, to remove the contradiction between the accepted relationships of landed property and hydrological possibilities. It is thus an attempt to rationalize the distribution system in accordance with the demands of the underlying property grid (Hypothesis 2).

The jirga system was more complex than the lineage-based system and was composed of three operational levels of organization: it articulated with the kuhl organization at the top, Aliabad Jirga itself formed the second level, and the lineage within Aliabad constituted the third level. It functioned with an acceptable degree of efficiency for 32 years.

During the past decade, the efficiency of the jirga system seems to have declined. This may be attributed to an increase in the incidence of migration resulting in an increase in the numbers of absentees from communal maintenance tasks. It is also a function of monetization and other rapid changes taking place with the incorporation of the Hunza

Valley into mainstream Pakistani society (Dani 1986). If Hypothesis 1 is correct, institutional change could be anticipated.

In fact, as of 1986, the jirga has been replaced by the Volunteer Corps of the Ismaili community (all residents of Aliabad are Ismaili). The Volunteer Corps is a local militia whose practical role, in the past, was confined to participation in village welfare schemes. The Volunteer Corps has now been assigned the task of irrigation management. It supervises and manages the distribution of water from the source to the farmgate, and also patrols the length of the kuhls to guard against possible misappropriation or natural damage to the irrigation structures. Minor maintenance jobs are done by the Volunteers, but they mobilize all farmers for emergency repairs as well as for the annual repairs in May (Hypothesis 3).

The Volunteer Corps consists of 76 members. As 36 of these are too old to work, the management is carried out by 40 members. In lieu of these services, every household pays the Volunteer Corps Rs 100 (US$7.14) annually. The total amount thus generated was Rs 50,100 (US$3,578) in 1986, which went into the Volunteer Corps Fund.

One tier of the organizational structure has thus been replaced, but the Volunteer Corps will continue to distribute water using the warabundi system. The change is thus a change in form only; it does not affect the underlying property relationships (Hypothesis 2).

The history of Aliabad's irrigation management is one of an amazingly responsive and adaptive Common Property Regime, which clearly belies Hardin's (1968) notion of the commons as a situation where individuals always seek to maximize their interest at the cost of public interest, and which are thereby viable only in low population densities with abundant common resources.

Bromley (1986) classifies positive reciprocity as the most preferred form of interdependence in Common Property Regimes. The nature of relationships between Aliabad farmers and their hydraulic property continues to be one of modified positive reciprocity. Even with the latest change in the management structure, positive reciprocity is ensured by retention of the responsibility for annual maintenance and emergency repairs within the domain of the water users (lineages). The Common Property Regime is thus not only alive, but thriving.

One further organizational innovation is the formation of a federation of potential water users for the construction of the AKRSP-sponsored kuhl. This innovation will be discussed in greater detail in the next section.

## INTERVENTION BY THE AGA KHAN RURAL SUPPORT PROGRAMME (AKRSP)

AKRSP is a private, non-profit organization, seeking to induce community-based agrarian development in the northern areas of Pakistan. The basic principles followed by AKRSP[7] are:

1. Establishing Village Organizations (VOs),

2. providing assistance for Productive Physical Infrastructures (PPIs), and

3. developing extension-and-supplies infrastructure for continuously providing services to the VO.

The basic tools of implementation are: the Diagnostic Survey, a series of diagnostic dialogues carried out with villagers, to form a VO and to identify and plan the PPI as an entry point; and Village Planning to develop a sequence of profitable projects for the village. Planning is thus made "location-specific" (Coward 1985:14) and is "inductive" (Uphoff 1982) in nature.

For extension, AKRSP relies on Social Organizers. Their functions are analogous to those of Group Organizers in the Small Farmers Development Programme in Nepal (Ghai and Rahman 1979), Community Organizers of the National Irrigation Administration in the Philippines (Korten 1982), and Institutional Organizers in the Gal Oya Project in Sri Lanka (Uphoff 1985a). AKRSP's Social Organizers are provided technical backup by a full-time sub-engineer who stays with them in the field.

After a PPI is identified, it and the villagers are surveyed, and cost estimates are prepared by the AKRSP sub-engineer. These estimates are further negotiated downward through dialogues with the VO. AKRSP does not adhere to the policy of mobilizing free labor in lieu of participation. The cost estimate includes a reduced wage rate as compensation for the loss of income to villagers who work on the PPI.

It is here that room for negotiation exists. The negotiated cost thus includes cost of material and a reduced amount in lieu of labor costs which is a function of the opportunity cost of labor and the eagerness of villagers to initiate the scheme to receive benefit from it sooner. Because construction is carried out entirely by villagers, costs are one-fifth of what they would be under the contractual system followed by government agencies.[8]

AKRSP then holds a final dialogue with the VO regarding the basis of its terms of partnership. In brief, these amount to forming a VO which assembles regularly, undertakes collective responsibility for implementation and maintenance of the PPI scheme, encourages members to save a small amount at each meeting,[9] and pledges to participate in other development projects of AKRSP. If the VO fulfills these conditions, AKRSP concudes what they call the "third dialogue" by handing over the first installment of the PPI grant. Technical guidance during the implementation phase is provided when necessary but, by and large, villagers manage on their own.

**AKRSP in Aliabad**

During AKRSP's dialogues with the villagers of Aliabad, scarcity of water was identified as the main constraint for agricultural development. Members of six VOs expressed the need for a kuhl from Hassanabad Nala, the source of the kuhls aborted earlier. Four of these VOs were based on the four lineages of Aliabad village, while the other two were based on residence in the neighboring settlements of Dorkhand and Aga Khanabad.

Initial surveys revealed a cost estimate of Rs 1 million (US$71,429) for the construction of the kuhl. This was well above the usual amount of PPI grants -- Rs 100,000 (US$7,143) to a VO. The six VOs, considering themselves part of the same irrigation community, decided to pool their PPI grants. AKRSP had not encountered this situation before but decided to go along with the villagers' wishes. A hypothetical channel was designed and divided into six segments for budget purposes. These segments were allocated to individual VOs and the third dialogue was carried out on 15 January 1984. The total negotiated cost for all six VOs was Rs 784,980 (US$56,070).

The total length of the kuhl to the boundary of Aliabad's agricultural land is 4,674 meters[10]. The kuhl is designed to have a top width of 1.2 meters, bed width of 1.2 meters, and depth of 1.0 meter. The kuhl is expeced to have a discharge of 5 cusecs when completed. The water discharge at the intake is estimated to range from 15-100 cusecs. Because of the substantial amount of water at the source, if completed, this kuhl will provide a more reliable discharge for Aliabad than the existing ones. However, the abandoned Northern Areas Works Organization (NAWO) kuhl 10 meters above the AKRSP kuhl being constructed is mute evidence of the extreme difficulty of the terrain. Fifty-seven percent of the total grant was designated for labor costs. The remainder was earmarked for tools and explosives, without which the work would be impossible.

## Institutional Innovation for Implementation

Although the PPI grant for the construction of the kuhl was limited to six VOs within the Aliabad subsystem, these VOs negotiated with the four VOs of Hyderabad and four of Baltit who would also stand to benefit from completion of the kuhl. Even if those villages did not obtain much water directly from Aliabad kuhl, the new kuhl would reduce pressure on the existing irrigation system by increasing the total amount of water available to the higher level system shared by Aliabad with Hyderabad and Baltit. In accordance with the principle that labor investments create hydraulic property (Coward 1983), those eight VOs realized that assisting with the construction of the kuhl would secure their claim to the new resource. They therefore voluntarily decided to assist Aliabad in the construction of the new kuhl.

One of AKRSP's admonishments to the VOs has been to avoid reliance on representative committees for resource management. All matters are to be discussed and decided upon at regular VO meetings which all members are supposed to attend. In spite of AKRSP's exhortations against formation of management committees, the ingenuity of Aliabad's villagers could not be restrained. Being fully aware that day-to-day matters could not be referred to the full assembly, they formed a Federation of the 14 VOs, each represented by the VO President or Manager, to deal with the management of Aliabad kuhl during construction.

Although this, in itself, does not explicitly prove Hypothesis 4, it can be suggested that one of the reasons why AKRSP's intervention in Aliabad has succeeded in galvanizing locals into action is, that the program had the capacity to absorb local modification which structured the construction of Aliabad kuhl along the lines of the existing hydraulic regime.

The organization of construction thus resembles the three-tiered structure of the existing irrigation system. At the top is the Federation of all potential water users, a total strength of more than 900 households. The second level contains the three subsystems: Aliabad, Hyderabad, and Baltit, which also exhibit a corporate identity in terms of major decision making. The third level is that of the VOs, the level which AKRSP usually deals within its development work.

The VOs thus act as the "building blocks" (Coward 1980) of the higher levels of organization. Aliabad seems to support the results of the analysis of rural local organizations that "the best structure is a combination of an assembly of all members, meeting periodically, supplemented by some committee system, possibly an executive committee" (Esman and Uphoff 1984:144-146).

**Current Status of Aliabad Kuhl**

The work proceeded rapidly during the first year but even the combined grants of the six VOs proved insufficient. The estimate of required materials and labor proved to be an underestimate. Actually, the villagers say, and the Field Engineer verifies, that the VOs decided to enlarge the size of the kuhl beyond that of the original design to increase the discharge. This resulted in a higher rate of utilization of materials and labor per unit length than originally anticipated.

To compensate for this, the Federation solicited contributions from the VO members. When work was slowed down by the extremely hard rock face, Rs 150,000 (US$10,714) was collected from all the households for procuring a compressor/drill machine. When their cash ran out, another collection of Rs 21,000 (US$1,500) was made for explosives. In spite of these efforts, an estimated 20 percent of the channel still remained unfinished by the end of 1985.

Unwilling to give up, Aliabad's VOs decided to renegotiate with AKRSP. Fortunately, at this time, the Northern Areas Council had granted substantial sums of money from the government's regular development budget to each of its members for local development. Lacking the organization to implement these schemes on their own, several members offered to collaborate with AKRSP. One such member was the former Mir of Hunza. He agreed to contribute another Rs 150,000 towards completion of the Aliabad kuhl and AKRSP offered the use of one of its compressors in addition to the one owned by Aliabad.

A combined meeting of all six VOs with representation from the other eight participating VOs was held in February 1986. At this meeting, the VOs pledged to make a final effort towards completing the kuhl with the help of the additional resources provided.

The eagerness of elected representatives to contribute resources towards AKRSP's projects rather than adopt usual channels of development, which are more amenable to misappropriation, is important. It is indicative of a growing recognition of institutional development and participation as prerequisites for local resource management. It is also an indicator of the success of the program and, as such, serves as a reaffirmation of the inductive planning approach adopted by AKRSP.

In Aliabad, as in many other villages in the northern areas, AKRSP's strategy of relying on local knowledge for planning and design, and collective management for implementation and maintenance has been markedly successful (Hypothesis 4). Aliabad kuhl is now closer to completion than ever before, and at far lower costs.

Nonetheless, AKRSP should be wary of getting carried away by the initial successes achieved lest they fall by the wayside as another "hothouse" success. Aliabad's case clearly demonstrates the need for a "learning process" approach (Korten 1980) with scope within the program for redefining problems and redirecting efforts as warranted by data and experience.

Aliabad's irrigation system illustrates the value of existing organizational structures for rural resource management, particularly where these resources are managed by Common Property Regimes. AKRSP's strategy of a single level of organization seems to work fine in smaller villages of less than 100 households. Larger villages, with a much wider resource management area, may require multiple levels of organization. At least for Aliabad's irrigation system, this seems to be the case.

## SUMMARY AND CONCLUSIONS

This paper started with a discussion of certain terms and concepts from the literature on irrigation management and Common Property Regimes. The irrigation system at Aliabad was then described in considerable detail. The irrigation system illustrates the creation of hydraulic property and terre-capital formation through the accumulation of past labor, reinforced by regular maintenance of the irrigation system.

For all practical purposes, the irrigation system functions as a Common Property Regime. The irrigation regime is characterized by positive reciprocity among all its members, manifested in the periodic renewal of their relationships through participation in maintenance tasks.

Junior water rights for tree planting were recognized as one of the major constraints to land use changes. The increasing demand for fruit trees suggests that these junior rights will be carefully considered and, most probably, revised. This change will symbolize formal recognition of the transformation of Aliabad from a subsistence economy to one that is more market-oriented.

The evolution of the irrigation management structure from a simple lineage-based one, through a three-tiered structure with the addition of the jirga, to management by the

Volunteer Corps is the history of continuous adaptation to changing constraints and opportunities. These institutional innovations lie at the core of this discussion.

In the first instance, institutional innovation (formation of the jirga) was a response to historical growth. The more recent innovation (mobilization of the Volunteer Corps) was stimulated by changing externalities which completes the logic of Hypothesis 1. In both cases, compliance with the fundamental property grid is observed and property relationships stay unaltered. Furthermore, elements from the existing organizational structure are retained. Hypotheses 2 and 3 thus appear to be supported by the Aliabad case.

AKRSP's role as an indirect investor in the irrigation system was accepted positively by the villagers of Aliabad because the program has no axe to grind and does not, in any way, affect the claims of villagers to water and subsequent land use rights. AKRSP has proved effective in mobilizing local skills, knowledge, and organizational strength. In fact, the latter has sometimes gone far beyond what AKRSP had envisaged by progressing beyond the homogeneous village organization structure to multiple levels within a larger irrigation system. Aliabad is a prime example of this outgrowth. The three-tier structure is a direct descendant of irrigation systems predating the arrival of AKRSP and is a success precisely because of that heredity. This not only supports Hypothesis 4 but also links back to Hypotheses 2 and 3 which also seem to follow as corollaries of Hypothesis 4.

Intervening agencies would do well to learn from AKRSP's experience in Aliabad which clearly demonstrates the benefits of working with existing organizations. These are neatly summed up in a recent state-of-the-art review conducted for the Water Management Synthesis II Project:

> What is most valuable about existing organizations is that they already have procedures for decision making, patterns of communication, and means for building consensus and resolving conflicts; capabilities that invariably take some time to develop under the best of conditions. (Uphoff 1985b:8.10-8.11).

Agency interventions which ignore this and annex existing irrigation systems within an external management structure tend to alienate local groups from the hydraulic property they have created or acquired (Coward 1985, Dani 1986).

The alienation is, however, not limited to material alienation of farmers from their resources. It also extends to cognitive alienation caused by the realization that an external entity now has more authority over their resources than they have. This results in the alienation of responsibility for maintaining the resource base (see Dani 1985 and 1986), as is happening with the NAWO irrigation channels which local farmers refuse to maintain. Such alienation has been the bane of many development programs.

The obvious lesson is that public interventions which search for and attempt to build upon existing organizations will ensure continuity with the past and, therefore, may be easier to sustain in the long run.

We conclude with seven implications emerging from this examination of Aliabad's irrigation system:

1. Villagers are aware that labor investments in the hydraulic system imply rights in the hydraulic property so created and are, therefore, willing to invest maintenance labor in the hydraulic system subsequently when, and only when, these rights are guaranteed. Governments and development agencies would do well to recognize this and not insist on provision of local labor in the absence of clear tenurial and user rights.

2. Farmers are capable of mobilizing substantial resources for the development of their hydraulic works. Recognition of their claims and removal of major obstacles through indirect investments (technical and capital assistance) can catalyze this process.

3. Even in existing common property situations, organizational structures are not static; they adapt and innovate over time, although farmers tend to adhere to structures they are most familiar with.

4. Existing organizations may operate at more than one level. The number of levels depends on the complexity and size of the irrigation system and 100 households seem to be the limit for one-level structures. Farmers are capable of managing at least three levels on their own.

5. It follows from numbers 3 and 4 above, that an analysis of existing institutional arrangements and organizational structures in specific locations should precede any externally supported interventions aimed at institutional development.

6. Smaller units, such as the village organizations, can be the building blocks of larger organizational structures.

7. Development programs could gain by being more receptive to institutional innovations proposed by farmers, particularly when the proposals affect relationships among the farmers.

## NOTES

[1]*Editor's note*: "Commons" is usually defined as a "tract of land owned or used jointly by members of a community."

[2]See Uphoff 1985b: Chapter 4, on levels of organization.

[3]The term *Hunzukutz* is being used as a generic label for all natives of Hunza. The term may also be used in a more restrictive sense to refer to the descendants of those who resided in the capital of old Hunza (i.e., Baltit).

[4]Personal communication (1986) with Sher Ghazi, AKRSP sub-engineer, Hunza Social Organization Unit.

[5]*Tori* literally means plugging a water outlet. Since only the stone outlets can be easily plugged, tori is commonly used to refer to the outlet.

[6]Rupees 14.00 - US$ 1.00 (1984).

[7]See Khan and Husain (1983) for an introduction to AKRSP's approach.

[8]For a detailed comparison between AKRSP's irrigation projects and similar government projects, see Hussein et al. (1986:24).

[9]The amount is kept as collective VO savings for use as emergency and/or maintenance funds or as collateral for credit purposes.

[10]The engineering data in this paragraph has been provided through the courtesy of AKRSP.

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