AN EVALUATION OF IRRIGATION PROJECTS UNDERTAKEN BY AKRSP IN THE GILGIT DISTRICT OF NORTHERN PAKISTAN

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INTRODUCTION

Methodological Approach

The Aga Khan Rural Support Program (AKRSP), an affiliate of the Aga Khan Foundation, initiated a development program in the Northern Areas of Pakistan at the end of 1983. The program's objective was to increase farm household incomes and, in its first three years of operation, its major accomplishment was the establishment of self-sustaining village organizations (VO) in each village using a "productive physical infrastructure" (PPI) as an entry point. A majority of the PPI schemes undertaken involve irrigation channels and, by the end of June, 154 had been identified and 97 completed. This paper will present an interim evaluation of the 154 irrigation schemes. However, before the benefits of these irrigation schemes can be fully realized, the new land which they will help to irrigate must be developed. As such, the costs and benefits of the land development package have been included in this analysis.

This analysis uses a 15 percent discount rate and a planning horizon of 21 years. This period was a convenient choice because of its compatibility with the requirements of the computer software used to conduct the analysis and because it provided the policy planners a sufficiently long term perspective on the impact of the program. Although this period does not strictly represent the economic life of the projects, it will not materially alter their benefit/cost profile.

The data used in this analysis was taken from various sources. Previous AKRSP Monitoring, Evaluation, and Research (MER) division discussion notes were used extensively. AKRSP's wheat surveys provided invaluable information on the local farming systems and enabled an examination of existing cropping patterns and comparisons across villages. Publications covering the United Nations Development Programme/Food and Agriculture Organization (UNDP/FAO) experience in the Northern Areas were used for cross checks on yields and farmer management practices. Detailed discussions with the program senior engineer and program senior agriculturalist provided another valuable source of information. The data was analyzed using the BENCOS computer software package designed for economic analyses in developing countries.

It would not be possible to write this paper without making certain assumptions which will be refined after more information becomes available. All assumptions have been made explicit to place the evaluation in its proper perspective. Therefore, it is best to read this as a first document that will be amended as time goes on.

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Irrigation History of the Area

The Karakoram region of Northern Pakistan falls in a partial rain shadow and does not receive the monsoon rains. The area is arid and cultivation depends on irrigation. There are three rivers in the Gilgit district: Hunza, Gilgit, and Skardu. These rivers lie above most villages and cannot be channelled for cultivation. Irrigation channels, fed by glacial sources, provide a crucial, and in most cases, the only source of water to the small subsistence agricultural communities in the area.

Although there is little documentation on the irrigation history of the area, existing evidence suggests that the first irrigation channels were constructed by people who migrated to the area hundreds of years ago. Typically, the kinds of channels that could be built using the meager resources of the local people were relatively simple and did not require major outside support. These channels were largely fed by glaciers and snowmelt. The water flow has always been highly variable, increasing many fold in summer and becoming a mere trickle in winter; in some areas the capacity flow is 35 times its minimum. This variation put increasing pressure on the people to devise an effective water management system. However, there was a limit to developing additional water sources. Consequently, a greater effort was exerted to increase the efficiency of the existing system.

The next phase in the construction of irrigation channels was undertaken by the traditional rulers. Some systems were more sophisticated than others, depending on the support of their ruler and the degree of internal village cohesion, and the degree of water scarcity and proximity to glacial water sources. The politics of the area also influenced the irrigation system that developed because political support was often rewarded by title to unsettled land and by rights to extended glacial sources. In some areas, the *mirs* and *rajas* (rulers) employed forced labor to construct channels and instituted a system of *malia* (land tax) to extract the benefits of the increased water supply in the form of compulsory taxation on agricultural produce.

This system worked well because it could induce collective development of projects that could not be undertaken individually and because it ensured that, during the initial phase of the project, the people who had been sent to develop new land would be sustained by the members of their families who had stayed behind to cultivate their existing holdings. The villages of Sultanabad, Oshikandas, and Mohammadabad were developed in this fashion by Hunzakuts under the supervision of the Mir of Hunza.

The mirdoms were able to ensure gradual development of new land in areas where people had nearly exceeded their individual capacity to cultivate new land. The mirs helped the collective construction of irrigation channels. Once this was done, most of the remaining potential irrigation channels could not be built with collective endeavor alone. More material support was required to blast through the mountains to reach the water sources. Just prior to the abolition of the mirdom system in 1974, this system reached near capacity and little new land was being brought under cultivation.

Thereafter, the development needs of the area were assigned to different government departments. This was done partly to redress the institutional vacuum created by the abolition of the traditional rulers. The Northern Areas Public Works Department (NAPWD) began constructing about 20 large irrigation schemes, each at an average cost of 1.85 million Pakistani Rupees.[1] Only one of these schemes is still functioning.

These schemes suffered from lack of technical and operational planning. Theoretical formulations provided the main guidelines for planning. The local people, who developed considerable expertise in designing irrigation systems, were not consulted at any stage of construction. The difficult and unstable terrain posed special problems in establishing channel gradients, and village elders should have been consulted on past glacial movements, avalanches, and flood paths. However, the factor singularly responsible for the failure of these schemes was the department's inability to institute a system which would transfer the maintenance of these channels to the farm households who were using them. It is reported that 15 of these 20 schemes failed because of poor maintenance.

The Local Bodies and Rural Development (LB&RD) department was another institution entrusted with the construction of irrigation schemes in the area, and it helped improve some of the irrigation channels. The LB&RD could have achieved a lot more than it did if not for its system of disbursing funds for the channels. Each union council member was given a share of the development funds allocated for the Northern Areas. However, this share was based on the population in each area and not on the development priorities in each *tehsil* (sub-district). This piecemeal method of disbursement did not allow the completion of any scheme and the work done in a previous year often would be completely washed away before the next installment was received. The farmers had neither the capacity nor the incentive to maintain an incomplete channel which offered no economic return.

At the time, current thinking did not subscribe to the view that the people should be given labor payments for a project which was designed ultimately to increase their incomes. Other agencies like UNDP/FAO, which endorsed this view, gave drill machines and other construction implements to aid sporadic self-help efforts. However, people who could be producely employed on their farms or who could seek off-farm employment (construction of government projects or gathering fuelwood for sale) could not be persuaded to work without the promise of wages. The attraction of increasing future incomes by increasing their assets was luring but it did not answer the more immediate needs of survival. This was the situation at the end of 1983.

The Traditional Water Management System

The water management systems devised by the people of this area are extremely sophisticated in the construction and management of channels because water sources were scarce and uncertain. Most of the irrigation channels are fed by glaciers, and villages assert property rights on glacial water. The fate of a village is closely tied to that of its glacier. Sudden glacial movements have wrought havoc on the tenuous water systems and some villages have "gone dry" due to glacial retreats. Artificial birthing of new glaciers by the mating of male and female glaciers is well entrenched in local tradition. Incredible as it may seem, local inhabitants testify that the Minawer glacier is one example of a successful mating arranged 29 years ago. Recently, the farmers of Sikkanderabad (AKRSP n.d.:72-74) "planted the seeds" of a new glacier to ease their acute water shortage.

In constructing water channels, the local people devised various ways to ensure technical success. In order to ensure that the gradients were built correctly, water was allowed to flow along as the channel was dug. Village elders were always consulted about glacial movements, avalanches, or mudflows to ensure that these would not disrupt the water supply system of a village. Villagers also devised a system of sanctions against those who did not participate in the collective work of a village.

Responsibility for maintaining channels constructed by the people gradually evolved into a functional system. The *jirga*, a body of village elders, often adjudicated village disputes. Initially, the jirga decided water allocations but later its jurisdiction was expanded to maintenance issues. The village divided responsibility for maintenance and entrusted it either to different clans or households with each clan or household responsible for a section of the channel. Also they undertook to issue an early warning in case of impending disaster or to ensure repair in case of danger. In some cases, two or three people were entrusted with the care and maintenance of the channels and were paid in grain donated by each beneficiary household.

The allocation of water and water rights is a complex issue with no single predominant pattern in evidence. In some villages, title to water is not separate from title to land. In areas of acute water shortage, water rights are treated as distinct from the land which it will irrigate. Few of the villages in the area have been officially settled and as such, the villagers rely heavily on the traditional system of distribution enforced by religious and social sanctions. In case of water theft, the miscreants are fined in cash or in-kind. These days the payment is mostly in cash.

The sophistication of the water allocation system depends primarily on scarcity; generally, the more scarce the water, the more well-developed the distribution system and the water rights. Settlement office records indicate that water rights were distributed to existing clans and are passed on through inheritance along with other assets. The basis of the allocation is not clear. In some cases, geographical proximity was considered sufficient.

Distribution is also seasonal. In the Ulter channel, for example, a wooden frame is placed at the head to distribute the water flow. Half goes to the Hamachi and Kiser irrigation channels and half goes to Sammerquand. Subsidiary channels then direct the water to individual fields. In water sharing, the velocity of water and other factors are considered in deciding shares. In Hunza, due to acute shortages, water is given first to wheat fields, then to fodder crops, and finally to trees. Thus, people who want to plant more trees are restricted not only by the land constraint but also by the water constraint. It is expected that orchard and tree plantations in Hunza will increase due to the increased water supply in that area.

According to the old settlement records of Hainzal, all the cultivated lands could be irrigated, and uncultivated land could get irrigation water once cultivated. If a farmer developed barren land, he was allowed to irrigate it according to his specified water rights. Water from irrigation channels could be diverted to mills provided they did not interfere with the irrigation rights of others. Gardens could not be irrigated. In some villages, irrigation rights were apportioned on the basis of the revenue paid by each household to the government. Forests were generally considered government property and individual households were not given water shares for adjoining forests in settled villages. No person had the right to construct subsidiary channels if there was scarcity of water in the area.

By the end of 1983, the Northern Areas had developed farmer-managed irrigation systems which had, on average, the capacity to irrigate about 70 hectares (ha) of cultivated land in each village. Almost all the irrigated area in the Gilgit district was under the command of a farmer-managed irrigation network. Besides that, the management and maintenance of the system was well established in local social tradition. The sustainability of the system was enhanced by the fact that property rights on water and the new land which it helped to cultivate were very explicit; where they were not, they were fairly easily imputed from past custom. There were few disputes regarding the distribution of rights on water or land within villages; disputes were more likely to be between villages. Due to the difficult terrain and the unstable physical environment, the management focus of the local system was on maintenance issues.

The system had the capacity to maintain and operate the existing network of channels but it lacked the ability to build new channels or extend old ones without outside assistance. Although each village had some marginal land, used primarily for pastures and growing fuel wood, it could not be more productive due to water scarcity. Development entrepreneurs felt that the most substantial increase in overall productivity could be achieved by irrigating presently barren land and by increasing the existing water supply of villages in the Gilgit district (Saunders 1983).

The few new channels that were being constructed by the NAPWD were unable to mobilize the indigenous capacity of the people in planning and maintaining new projects. Moreover, wherever a government project was built, the distribution of the additional resources it helped create was preempted by officials who based their decisions on political considerations. This further exacerbated the maintenance issue and the question of sustaining the project. As such, the system had reached a static phase.

AKRSP's Intervention in the Irrigation System

When AKRSP first came to the Northern Areas in December 1982, it was confronted by this static phase. Its strategy in developing the area required the creation of productive physical infrastructure (PPI) projects; a self-sustaining village organization (VO) which would oversee construction, management, and maintenance of these projects; and a process for managing and constructing development projects on a continuing basis. One PPI scheme was granted to each village and project identification was left to the villagers. A majority of the villages selected irrigation channels as their priority project. In return for financial aid, AKRSP asked the villagers to form a development-oriented VO. The terms of partnership with the VO included regular savings to build up the VO's equity capital, weekly meetings, participation in extension training programs, and collective land development.

By the end of June 1986, AKRSP and the VO had identified 154 irrigation channels (about 63 per cent of all PPI schemes undertaken by AKRSP). These included construction of 66 new irrigation channels and the extension and modification of 88 old channels. The LB&RD had attempted to rehabilitate several earlier but had not succeeded for one reason or another. Of the 154 irrigation channels 97 were completed. Apart from these, AKRSP also helped to construct lift irrigation, sedimentation tanks to improve water quality, and water storage tanks. This was the largest investment in irrigation schemes ever undertaken in the Gilgit district. The potential land which this water will irrigate is expected to double existing landholdings and, thus, influence the cropping pattern by removing two important constraints; water and land. The increased yields will have both forward and backward linkages on the farm economy with implications for input and factor markets.

An analysis of the part played by VOs in constructing PPI projects indicates some interesting features of the AKRSP approach. In implementing the program, AKRSP follows a diagnostic procedure which entails holding detailed dialogues with a majority of village residents and involving them in each stage: identification, feasibility, and construction.

In the identification stage a project is only chosen if it benefits a majority of village households. To determine the technical feasibility of the projects, village elders, nominated by the villagers, accompany the AKRSP surveyors. The VO is given responsibility for implementing and maintaining the project. But, because of the public nature of meetings, accountability is given to the entire village and not to one or two people. The interaction of local people and AKRSP at each stage ensures that village concerns are considered, participation is ensured, and local expertise is mobilized in support of the project. Villagers have invariably accepted the cost estimates prepared by AKRSP because their representatives are involved in the survey. Payments to compensate for land or other assets affected by the construction is left to the villagers. AKRSP has a strict policy of not interfering with the distribution of benefits from these projects.

Two other important aspects of AKRSP's policy are labor payments as part of the PPI grant and grant disbursements by installment. The former are in keeping with the understanding that the opportunity cost of rural labor is not zero and that it will be difficult to induce people to work on the project without remuneration at subsistence income levels which forces them to be concerned about current levels of consumption. Development agencies that do not pay wages have not adequately considered the fact that the future benefit stream was being discounted heavily by the farmers of this area.

The phasing of the grant in installments performs an important monitoring function by ensuring that a specified part of the project is completed before additional funds are paid to the village. The final installment is given only after a project is completed. This method of implementation helps to avoid having to maintain complicated muster roles. A major drawback of the NAPWD's approach was an excessive concern with muster role monitoring to the detriment of actual progress on the schemes.

FARM INCOME ANALYSIS

Farmer Resource Ownership

At present, the average farm household in the Gilgit district owns about 0.76 ha of cultivated land. This estimate does not include communal pastures and forests but, if these are included, the average landholding per household comes to about one hectare. Table 1 gives aggregate and Table 2 gives individual estimates of land utilization for the Gilgit district.

Table 1. Estimates of land utilization for aggregates for individual and communal lands, Gilgit District, 1985.

	Area (ha)	% of total	
Cultivated area	20392	43	
Orchards	3874		8
Annual crops	16518		35
Uncultivated area	26612	57	
Cultivable waste	6474		14
Uncultivable forest	3672		8
Uncultivable other	16466		35
Total area	47004	100	

Source: AKRSP 1985.

These figures are verified by the wheat surveys conducted by AKRSP's MER division in 1983 and 1985. MER prepared a land use profile of the average farmer from the 1985 wheat survey data. These data indicate the present average cropping pattern in the area. On a one hectare farm, about 40 percent is planted to perennial crops, 10 percent to forest, 18 percent to orchards, and 12 percent to alfalfa. Annual crops are grown on 60 percent of the land. Wheat takes a major share (36%); clover, 14 percent; and barley and vegetables, about 5 percent. In the double cropped area, 34 percent of the land is used for maize cultivation, 26 percent for pulses, and 4 percent for vegetables. The cropping intensity is about 134 percent.

Differences between small- and large-scale farmers were examined to draw inferences about how an increase in the amount of land might affect the cropping pattern. It is

Table 2. Estimates of land utilization for individually-operated holdings (n = 26,685 farms), Gilgit District, 1985.

	Area (ha)		% of total	
	Total	Per farm		
Cultivated area	20392	0.76	70	
Orchards	3874	0.15		14
Annual crops	16518	0.61		56
Uncultivated area	8492	0.32	30	
Cultivable waste	6474	0.24		22
Uncultivable area	2018	0.80		8
Total area	28884	1.08	100	

Source: AKRSP 1985.

estimated that, on average, each household will be able to irrigate an additional 0.71 ha of new land in villages where an irrigation project was constructed. Based on this, a profile of the average projected land use for new land was prepared (Table 3). These projections reflect AKRSP's understanding of the kind of choices that will be made by farmers in the future. For illustrative purposes, new land has been divided into two stages of 0.5 ha each. These stages can help in illustrating the distinction between small and large beneficiaries of land development as well as highlight the gradual process of land development.

Table 3. Projected land use for new land.

	1st 0.5 ha		2nd 0.5 ha		Total 1 ha		Present use of 1 ha of land (%)	
	ha	%	ha	%	ha	%		
Perennial crops	0.25	50	0.35	70	0.60	60	40	
Forest	0.09	18	0.13	26	0.22	22		10
Orchard	0.09	18	0.13	26	0.22	22		18
Alfalfa	0.07	14	0.09	18	0.16	16		12
Annual crops	0.25	50	0.15	30	0.40	40	60	
Rabi	0.25	50	0.15	30	0.40	40	60	
Wheat	0.15		0.07		0.22			36
Barley	0.03		0.03		0.06			5
Vegetable	0.03		0.01		0.04			5
Clover	0.04		0.04		0.08			14
Kharif*	0.14	28	0.08	16	0.22	22	34	
Maize	0.09		0.05		0.14			26
Pulse	0.02		0.02		0.04			4
Vegetable	0.03		0.01		0.04			4

*Double crop, villages only.

At the completion of the land development process, perennial crops will form 60 per cent of the total new land, compared to the present 40 percent. Areas planted to forest, orchards, and alfalfa will all increase. In the rabi season, the share of wheat will decline from 60 percent in the old land to 55 percent in the new land. Clover and vegetables might increase their share somewhat. In the kharif season, (double cropping areas only) the share of maize should decrease, leaving proportionately more land for pulses and vegetables than now. Kharif land use, however, is hard to project since relevant data are extremely meager.

The average livestock ownership per household is 18 animals, with about 7 large animals and 11 goats and sheep per household. Meat is a preferred food item but is consumed rarely. The area is deficit in meat and dairy products due to the acute fodder shortage and lack of labor to shepherd animals to the high mountain pastures. Much of the meat is imported. Each household normally slaughters an animal and stores it for consumption during the fierce winter months.

Agroecological Variation

The agriculture of each valley in the Northern Areas depends on the soil quality and type, water availability, and altitude. These factors vary greatly in the Gilgit district. The altitude of villages where cropping is possible varies from about 1,500-3,350 meters, although barley and wheat have also been observed at 3,660 meters At such high altitudes wheat does not mature and is used primarily for fodder. The average lapse rate is about 0.6-0.7 degrees centigrade (with the mean temperature) per 100 meters In single cropped areas generally more land is cultivated than in double cropped areas. Forty-five percent of the villages under study were in double cropped areas, while 55 per cent were in single cropped areas.

All types of soil are present in the region. In the relatively flat lands the soil ranges from silt loams to gravely sandy loams. On the slopes, the soils range from stony loamy sand to gravely sandy loams. There is no distinct zonation of soils in villages. Some old river terraces generally provide better quality soils. Alluvial fans and moraines have highly variable soil quality and the extent of land development required also varies greatly in these areas.

FINANCIAL INVESTMENT ANALYSIS

Estimated Costs

Project costs. The cost of improving the irrigation system of an entire area depends on several factors, the most important of which are: type of irrigation, terrain, design standards, and whether the project is new or the extension and modification of an old channel. The 154 irrigation projects that AKRSP has so far designed in the Gilgit district can all be classified as surface irrigation. Of these, 88 are old irrigation projects and 66 are new channels. The distinction between old and new is somewhat tenuous in AKRSP's case, as it eclipses the fact that the widening and extension of old channels can often be more costly than the building of new ones. However, the distinction is important because the expected benefit stream of old and new channels is different.

There are direct and indirect costs, and, as much as possible, an attempt will be made to quantify all costs. Those which cannot be presently quantified will be listed. The assumptions made to assist in quantification will be made explicit and where necessary, sensitivity analysis will be made to estimate the effect of assumption changes on the cost profile of projects. An attempt will also be made to trace through the linkage effects of costs on other aspects of the farming system and the regional economy.

Broadly speaking, costs of the irrigation channels have two components: the cost to AKRSP and the cost to the villagers. The cost to AKRSP includes a) the grant for material and labor payments made to the villagers, b) charges for engineering, survey, and research (ESR); and c) implements granted to VOs for land development. The costs of operating a helicopter have been included separately in the cost/benefit analysis as a percentage of the total funds invested in the irrigation projects.

The cost to the VO includes: a) the difference between the estimated cost and the negotiated grant of a project, b) maintenance cost, and c) the VO's extra effort to extend the project beyond the specifications prepared by the engineers. In computing the present cost of maintenance, a discount rate of 15 percent was used with 21 years as the assumed life of the project.

The total costs. The total cost of the 154 irrigation projects initiated by AKRSP up to the end of March 1986 was PRs 39.05 million. AKRSP's share was PRs 21.01 million and the balance was the VOs' share (Table 4).

AKRSP bears a rough average of about 54 percent of the cost of each irrigation channel. The largest factor in AKRSP's costs is labor (51%), with material costs of 33 percent and ESR of about 15 percent. The largest cost to the VO is for maintenance -- about 49 percent of the total costs over the 21-year life of the project -- and pooled labor (both skilled and unskilled) is about 24 percent. The balance (27%) makes up the difference between estimated cost and the negotiated grant. The village is expected to bear the last two costs in the first year of the project.

Unit costs to AKRSP. The cost per cusec of all irrigation channels is PRs 27,105 and the cost per meter is PRs 43. The cost per hectare of newly irrigated land is about PRs 2,067. A study on the economic return to investment in irrigation in India (World Bank 1982) indicates a cost range of Rs 8,000-20,000/ha[2] of surface irrigation projects. The paper reports that the Sixth Plan implies an average capital cost at 1979/80 prices of about Rs 15,000/ha of surface irrigation potential created. Although these figures are not directly comparable with those of Pakistan, they do indicate the cost-effectiveness of these small irrigation schemes. Even if the cost to the VO is included in these figures the average cost per hectare of newly irrigated land is PRs 3,842. When helicopter costs are also included, the costs rises to PRs 4,336.

Table 4. Costs of irrigation projects, March 1986.

	Total (PRs '000)	Average (PRs)
AKRSP cost component		
Negotiated Grant: Material cost	6881	44681
Labor	10778	69987
Engineering, survey & research	3047	19785
Land development implements	300	1948
Village organization cost component		
VO subsidy (estimated cost-negotiated grant)	4786	31078
Maintenance cost*	8850	57468
Village labor subsidy (skilled)**	1232	8000
Village labor subsidy (unskilled)***	3172	20597
Total AKRSP cost component	21006	136401
Total village organization cost component	18040	117143
Grand total	39046	253544

See note 1 for exchange rates. *Calculated at 15% discount rate for 21 years; **average 160 skilled days extra on a project x 50 x 154; ***average 824 unskilled days extra on a project x 25 x 154.

The cost profile over time. All costs increased from 1983 to 1986 (Table 5).

Average estimated costs have increased from PRs 102,849 to PRs 244,199. This near 150 percent increase could be due to the fact that the irrigation canals constructed in 1986 were longer and more complex than earlier ones. However, the average negotiated grant increased from PRs 109,082 to PRs 144,418, only a 32 percent increase. This means that at this stage of the program, the VOs are being called upon to exert greater effort in the construction of PPIs (productive physical infrastructures). As ESR (engineering, survey, and research) is calculated as a percentage of the estimated cost of a project it was expected that with the increase in estimated cost, ESR costs would also increase. However, in percentage terms there is no change in ESR. Average length increased by 16 per cent, although average capacity decreased by about 11 per cent. Cost per cusec has increased by 53 percent, cost per meter by 17 percent, and cost per hectare of newly irrigated land by 38 percent. Figures 1-3 illustrate these costs graphically.

Table 5. Irrigation channels cost profile by year (in Pakistani Rupees).

	1983	1984	1985	1986
All irrigation channels (n)	48	60	37	9
Average estimated costs	102849	143628	159070	244199
Average negotiated costs	109082	114510	115579	144418
Cost per cusec	22634	29574	28721	34603
Cost per foot	12	15	12	14
Cost per ha of new land	1934	2061	2129	2686
Breakdown of costs				
Average material cost	30740	49434	50695	64015
Average labor cost	78359	65077	64895	80402
Average ESR	17566	20708	21075	26601
Average length (feet)	10929	9202	11300	12653
Average capacity (cusecs)	5.76	4.76	5.03	5.10

Percentage changes	1983-84	1984-85	1985-86
Average cost	18	10	53
Average negotiated cost	5	1	25
Cost per cusec	30	2	20
Cost per meter	25	20	17
Cost per ha of new land	6	3	26

Figure 1. Estimated compared to negotiated costs for irrigation channels, 1983-86, Gilgit district.

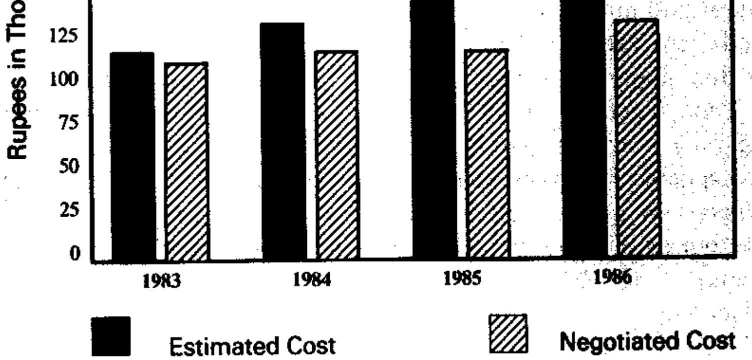


Figure 2. Cost of new land compared to irrigation channel capacity costs, 1983-86, Gilgit district

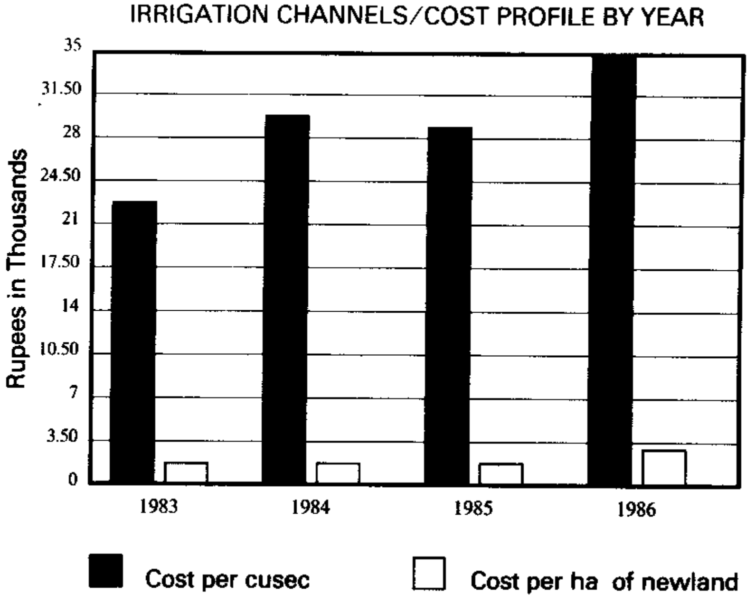
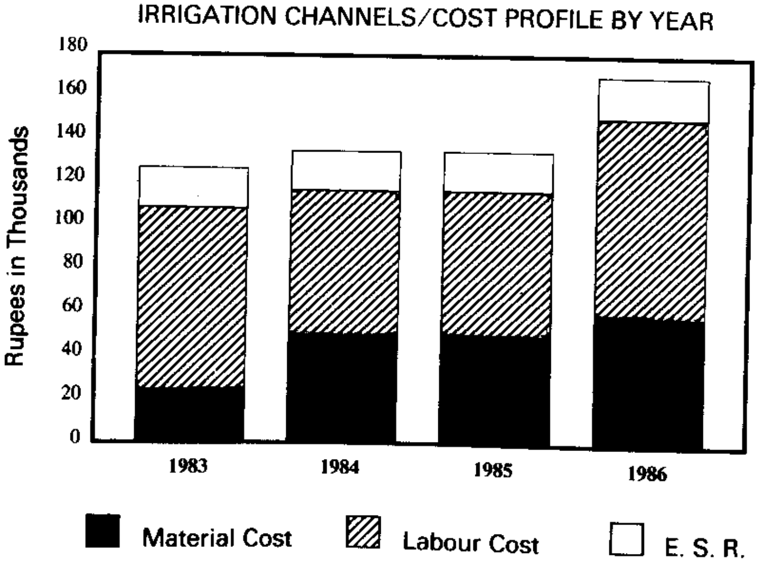


Figure 3. Costs for materials, labor, and ESR (engineering, survey, and research) for irrigation channels, 1983-86, Gilgit district.



Land development costs. The irrigation channels will benefit land which has not yet been developed for cultivation and land which is presently under cultivation. The costs of developing the new land will be considered before presenting a cost-benefit profile of the projects.

There are two costs involved in land development: costs to AKRSP and those to the farm household. Funds are given to the VO as a loan with a five percent service charge. AKRSP received the funds from National Development Finance Corporation (NDFC) as a long-term interest-free loan, and the only cost to AKRSP is an administrative cost which is calculated at 15 percent of loans to be disbursed in the future. The 15 percent also includes costs that will be incurred to assess the land development requirements of a village. Repayment of these loans will be made with the help of elected office-bearers who will be given a commission of 2.5 percent on the recovery of the loan.

The costs to the villagers of developing new land is fairly high, partly due to the difficult terrain involved. According to an ESR estimate, it takes about PRs 900-2,500 to develop 0.05 ha of new land for annual crops. Costs of developing new land for perennial crops is estimated at about PRs 350 per 0.05 ha. Each irrigation project brings an estimated average of 66 ha of new land under cultivation, which means that each farm household brings about 0.71 ha of new land under irrigation. Assuming that the farmer will ultimately grow perennial crops on 60 per cent of this land and annual crops on the balance, the cost of developing this land will be PRs 14,664 per family. The cost of developing new land per village is about PRs 1.36 million. Although this figure is quite large in relation to the resources of a farm household, the cost of development is moderated by the system of labor pooling practiced in the area and the fact that this development will be phased over 8-11 years.

In consultation with ESR, an estimate based on labor requirements was prepared for phasing the land development in an average village. Labor is affected by several factors: First, there is no net migration into the Northern Areas and, assuming this will not change, the substantial amount of labor required suggests that land reclamation will be a long-drawn-out process. Second, the government has a large development allocation for the Northern Areas and can be expected to provide a competing source of off-farm employment. Third, because the terrain and climate do not allow work throughout the year and the average farmer cannot work full time on this development, preparing land for cultivation can take the average family up to 11 years. Five years after the average farmer has begun the land development process he is likely to have developed 50 percent of his new land.

The entire land development effort will require, without any cost overruns, an estimated PRs 217 million and 4.14 million unskilled person-days. If the VOs pool their labor and use family labor, land development will require PRs 117:5 million. Although the total cost to the farm family will remain unchanged, the financial implications will substantially change depending on whether family labor or pooled VO labor is used. Moreover, land development may also be completed somewhat earlier if the VO is used. The earlier returns will alter the cost-benefit profile and the internal rate of return as examined later.

Production costs. Cultivating new land also entails production costs, which include the additional labor required to manage and cultivate the new lands as well as the inputs. In estimating, input costs were assumed to be constant, substitutability between inputs was assumed unchanged, and government price policy was assumed unchanged. Family labor, farm yard manure, and other nonpurchased inputs were valued at opportunity cost. Where available, market values were used, and where a market price was not explicit, it was imputed from first principles. Production costs were PRs 3.92 million in the first year after project completion. These will gradually rise until they reach a maximum of PRs 70.75 million in the 17th year when all the new land is under full production.

Helicopter costs. The program has a helicopter to expedite visits by management to the villages and ensure quick and regular follow-up by the senior program members based in Gilgit. The costs to AKRSP of the helicopter were estimated at about PRs 30,000 per flying hour, which includes leasing and maintenance expenditures. Helicopter costs make up about 24 percent of the annual AKRSP budget. As such, 24 percent of the amount spent on irrigation channels has been taken as the machinery cost to the irrigation component of the PPI. This amounts to PRs 5.04 million for the 154 irrigation channels under progress.

Financial Benefits

This section presents estimates of direct and indirect benefits to be realized by the farmers in the Gilgit district as a result of the irrigation projects. Within each classification there are tangible and intangible benefits. Quantification of the direct tangible benefits, though difficult, is possible with the use of explicit assumptions. Indirect benefits also require restrictive assumptions. Intangible benefits, on the other hand, can present serious problems of quantification. Consequently, in the present analysis, the direct benefits will be examined more closely.

A combined average profile of benefits from old and new channels was prepared for estimating benefits. A new irrigation channel will help to bring an average of 66 ha of previously undeveloped land under irrigation. The projected cropping pattern on this land was made by relaxing the land constraint and then examining the cropping patterns of large and small farms from the wheat surveys. The analysis assumes present profitability, and the projected cropping pattern does not reflect any changes due to the introduction of new crops. These assumptions may not be realistic but have the advantage of establishing a minimum threshold of profitability.

Expected yields were computed from various sources and cross-checked. The high degree of variation in the soil quality, terrain, and altitude was incorporated into the analysis by preparing an average profile on yields in the project area. Government price policy was assumed constant and yields were multiplied by existing product prices. The effects of the increased production on prices was examined in the sensitivity analysis. All costs and benefits were phased over a 21 year time frame. Particular attention was given to phasing benefits separately for perennial crops. In most cases benefits from perennial crops have a time lag which was incorporated into the analysis. Annual crops were also phased to reflect the farmers' limited resource ownership and input requirement. Farmer concerns with risk and diversification were incorporated into the cropping pattern used.

The benefits from irrigating new land start in the second year after the completion of the channel, when they total PRs 15.89 million. Third year benefits rise to PRs 27.18 million, a 71 percent increase. Thereafter, the benefits keep increasing and jump to PRs 114 million in the 7th year when fruit production starts. The benefits reach a maximum of PRs 367.52 million in the 17th year when all the new land comes under full production. This benefit profile continues to the 21st year.

In addition to bringing new land under cultivation, the extension and modification of old channels will also increase the water availability on about 100 ha of previously cultivated land per channel with a cropping intensity of 134 percent. The increased water supply will decrease the watering interval from seven to five days (Husain 1985). This will increase the water availability in these villages by approximately 20 percent. The effect of this on crop yields was estimated from yield response factor information (Doorenbos et al. 1979). The yield response for wheat, maize, and barley is understated as the existing *warabandi* (water allocation) system gives priority to these crops. The assumption made here is that even when water is scarce these crops received more water than others. The estimated benefit from increased yields for all the 154 projects is PRs 5.63 million each year, which accrue from the first year after an irrigation project has been completed.

Benefit/Cost Analysis

The discount rate, representing the opportunity cost of capital, used in this analysis was 15 percent. The gross benefit/cost ratio for this analysis is 2.02. The reciprocal of this ratio, often called the cost-effectiveness ratio, is 0.49. This indicates that benefits could fall by 51 percent (i.e., 1-0.49) before the benefit/cost ratio would be driven down to 1. Similarly, costs could rise by 120 percent before this ratio would be driven down to 1. The net benefit/scarce resource cost ratio for these channels is 18.63. For the purposes of this analysis "scarce resource" was defined as the AKRSP funds invested in these channels. This investment measure gives the returns per AKRSP rupee expended. Thus, for each AKRSP rupee spent, the return is about PRs 19. The estimated internal rate of return for these 154 channels is 37 percent. This indicates the rate of return on the money invested in these projects. The ratio of (benefits - production costs) / (operating + capital costs) equals 3.27.

The present value of net benefit is negative for the first five years after project initiation. The benefit stream turns positive in the 6th year,[3] reaching a maximum of PRs 42.46 million in the 11th year when the forest trees begin to yield income from timber. Thereafter, the benefit stream falls somewhat, with the present value of net benefit at PRs 15.99 million in the 21st year.

Sensitivity Analysis

Sensitivity analysis was used to study the impact of changing assumptions on the economic profile of the irrigation projects (Table 6).

Table 6. Impact of assumption changes on the economic profile of the projects.

Assumpt ons:	Gross benefit/ cost ratio	IRR	Net benefit/scarce resource cost ratio
All benefits reduced by 10%	1.82	33.40	15.15
All benefits reduced by 20%	1.62	29.37	11.66
No benefits on previously cultivated land	1.93	33.58	16.94
No benefits on previously cultivated land and benefits on new land reduced by 20%	1.54	26.80	10.31
No benefits on previously cultivated land and benefits on new land reduced by 50%	0.96	14.02	0.36
All benefits delayed one year	1.71	28.24	13.26
Land development delayed one year	1.92	32.96	15.13
Land development delayed two years	1.75	30.10	10.82
All costs increased by 10%	1.84	33.73	15.46
All costs increased by 20%	1.69	30.73	12.82
Failure rate of 10%	2.00	36.30	16.71
Opportunity cost of capital 50%	0.74	37.27	- 0.32

IRR = Internal rate of return.

The analysis indicates that the project's economic profile is not as sensitive to reductions in benefits on old land as it is to benefits on new land. The projects are sensitive to delays in the land development program after the initial investment in irrigation channels has been made. A delay of one year in implementing land development results in the benefit/cost ratio falling to 1.92 -- a delay of two years makes it fall to 1.75. The internal rate of return (IRR) falls to 33 percent with the one year delay, and to 30 percent with the two year delay. This is illustrative of the returns to investments in the VO and the helicopter, both of which help to speed up land development. At an opportunity cost of capital of 50 percent the projects are not economically viable and the gross benefit/cost ratio falls to 0.74 percent. The interest rate on informal credit in the Northern Areas is not precisely known, however, if it is as high as 50 percent the irrigation projects would not be viable. This is illustrative of the high investment costs in rural areas and provides a partial explanation for the lack of local investment initiatives in these areas.

Comparative Assessment

In this section the AKRSP irrigation channel projects are compared with other irrigation projects in the Northern Areas, and, to the extent information is available, to similar projects in other developing countries.

A comparison of AKRSP channels with those of the Northern Areas Public Works Department (NAPWD) shows very different cost profiles. The AKRSP cost per project is PRs 136,401 and the average cost of a NAPWD channel is PRs 1.85 million. The NAPWD channels are large projects and a better comparative measure might be provided by a unit cost figure. Cost per meter of AKRSP channels is PRs 46 while the NAPWD's cost per meter is PRs 246. AKRSP's cost per cusec is PRs 27,105 while NAPWD's cost per cusec is PRs 125,194. Because only one of the NAPWD projects is presently functioning the benefit/cost ratio and the internal rate of return would show an even greater difference between the AKRSP and NAPWD channels.

An economic analysis of irrigation development in the deltaic regions of Asia in Central Thailand (IRRI 1978) indicate benefit/cost ratios for various phases of the program. The highest among these is 1.56 compared to the 2.02 of the AKRSP irrigation channels. The internal rate of return reported for projects in Thailand ranged from 6.4-18.4 compared to 14.02-37.27 in the AKRSP sensitivity analysis.

SUSTAINABILITY ANALYSIS

Equity

An important issue in discussing the sustainability of a program is the distribution of benefits and responsibilities. Equitable distribution of benefits and obligations ensures the sustainability of the physical and social infrastructure necessary for development. In the case of irrigation channels there are issues of equity in the construction and maintenance of the projects, in the distribution of water rights, and in the division of new land in the command area.

AKRSP has helped to ensure equity during construction by encouraging the entire village to participate. However, the issue is one which is dealt with primarily by the villagers internally. A recent modification in AKRSP's policy which led it to negotiate the estimated labor cost of a project has equity implications. Villagers who decided to work on the irrigation channels for less than the market wage were subsidizing others who would eventually use the project. In Risht village, the VO was aware of the implicit subsidy and fined villagers who did not participate in channel construction. By and large, the VO has paid equal wages for equal work.

The traditional maintenance system of the villages has been reinforced by the presence of a VO. In some villages maintenance responsibility is distributed by clan, in some by geographical proximity, and in some each household assumes responsibility for a certain section. The most common pattern is to appoint one or two *chowkidars* (watchmen) and then to pay them in grain or cash on a monthly or annual basis. The VO has strengthened this system by imposing sanctions itself or by supporting the sanctioning role (*chatorkhand*) of traditional institutions. Thus, each household benefitting from an irrigation channel assumes some responsibility regarding channel maintenance. Similarly, there are well laid out rules for work on a channel destroyed by avalanche or flash floods, and each household is expected to share equally in such work. Exceptions are made in the case of households where there are no males or where the household is too poor to contribute. In such cases, all the village households share the extra work equally.

The two main direct benefits from the irrigation channels are the irrigation water and the new land in the command area which the increased water supply will help irrigate. Generally, water rights are not attached to the land so that people owning large tracts of land do not necessarily benefit more from irrigation. The system of warabundi is based on different criteria in different areas. In villages where there is extreme water scarcity it is common to give priority to those lands used for annual crops. Wheat and maize presently have priority over other crops, and farmers with more area under wheat cultivation have greater access to water. However, the available data (AKRSP 1985) indicate that landholdings are relatively equally distributed with the average developed landholding in a village ranging from 0.41-1.26 ha. Thus, water is also relatively equally distributed as households do not vary much in their cropping decisions within villages.

In accordance with age-old customs new land is divided equally among all existing households. In exceptional cases, landless households also get a share in potentially cultivable land (*shahtote*). As soon as an irrigation channel makes its command area potentially cultivable, villagers divide the land in equal shares among households. In apportioning this land various factors are considered: work required to develop the land, soil quality, accessibility, and potential cropping. Thus, a farmer getting a plot of land that has poor soil will generally get a larger share than a farmer who receives better quality land. To make the system even more fair, lots are drawn to determine who will get which plot. The system is perceived as fair by everybody. There are few disputes over land within villages.

Available data (ibid.) indicate that the distribution of land becomes less skewed when undeveloped land is included in total holdings. The distribution of land per capita is even less skewed and the gap narrows when total land per capita is compared with total land per household. Hence it is reasonable to expect that bringing new land under cultivation will contribute to greater equity in the area.

The equity issue is also important in terms of the manner in which new land will be developed. In principle, villagers have adopted variants of the AKRSP approach. The program policy was formulated with concern about both equity and productivity. Medium and long term development loans were to be advanced to those VOs which resolved to work on the land together. AKRSP felt that this would help farmers take advantage of economies of scale in the use of inputs and obtain savings in transaction costs. In practice, VOs have interpreted collective development to mean different things. Villagers in Khyber use "collective" to mean simultaneous development at several sites; others in Risht and Shahtote use it selectively to apply to land development management and input delivery. VOs in Jaffarabad have developed part of the land as one large farm. In Khyber, the villagers have divided the plots equally but have not yet assigned individual ownership rights in the belief that the collective land development process will be slowed down if people work only on individual holdings. They have plans to assign ownership once the development process is complete. The Shahtote farmers pool their labor and take turns working on each other's land. In Jaffarabad, farmers have collectively planted trees. In part, these interpretations reflect the varying conditions in each village: the extent of social cohesion, individual perceptions about risk and expected profitability, access to markets, and soil and land conditions. As such, it would be unrealistic to expect the same pattern of land development to be successful in each village. However, each of these patterns ensures that land development may not take as long as it would have done without such collective endeavor and that no villager will be left so far behind as to increase inequality.

Productivity

The sustainability of irrigation channels depends on continuing the benefits derived from them. On average, Gilgit farm households will be able to double their incomes by the 11th year after project completion. This assumes present levels of profitability and no other program intervention. By relaxing these constraints, the doubling of incomes can be expected much earlier with AKRSP's intervention in areas such as marketing, introduction of new crops, or improved livestock. The net benefit stream from these projects -- including land development costs -- will, on average, turn positive in the 6th year after completion. The ratio of (benefit - production costs) / (operating costs + capital costs) is 3.27, the gross benefit/cost ratio is 2.02 and the internal rate of return is about 37 percent. These factors indicate the creation of a very productive irrigation system.

Institutional Stability

AKRSP's intervention in a farmer-managed irrigation system has definite implications for the system's future development. AKRSP helped to improve the existing irrigation infrastructure, which almost doubled the existing irrigation capacity in three years. But it is difficult to sustain this development in an area where the physical environment is so unstable without a social infrastructure to support system operation and maintenance. With this understanding, AKRSP has helped to create the institutional structures required to operate and maintain the system. The VO in each village is expected to undertake the maintenance and development tasks.

The total annual maintenance cost of the 154 irrigation channels is about PRs 1.4 million, which must be borne by the villagers. The VOs have opted to handle maintenance tasks within the existing social institutions. To do so, the authority of the traditional jirga has been strengthened by the VO and carries the force of the entire village behind it. Moreover, the presence of a VO has helped the villagers construct other irrigation channels by themselves. In Risht, they are planning to construct a second irrigation channel which will help to bring additional land under cultivation. Village savings will be a major factor in sustaining the VO's development efforts. By the end of March 1986 the VOs of the Gilgit district had collectively saved PRs 10.06 million.

In most villages, substantial economies of scale have been realized by the collective purchase and delivery of agricultural inputs, such as seeds, saplings, fertilizer, and also obtaining credit. Through the VO farmers have been able to share information and reduce the risk of using new inputs whose characteristics are difficult to determine ex-ante. In the sensitivity analysis it was demonstrated that a delay in land development changes the benefit/cost profile of these channels. The benefit/cost ratio falls from 2.02 to 1.71 and the internal rate of return falls from 37 percent to 33 percent with a year's delay, and the benefit/cost ratio falls to 1.75 and the internal rate of return to 30 percent in case of a two year delay in land development. The increased returns from faster project implementation can be regarded as the returns from collective effort. These factors increase the expected profitability of the irrigation channels and the VOs and will help to make them both more sustainable.

FAILURE ANALYSIS

Analysis of Slow Schemes

An analysis of schemes where work has progressed slowly reveals that the reasons for this can be broadly categorized as 1) technical, 2) financial, 3) program policy, 4) socio-political, and 5) climatic. Of the 154 schemes, 3 percent (Jutal, Oshikandas) have technical problems; 1 percent (Hanuchal, Gawachi) suffer from financial problems; 5 percent (Bodolas, Hakis, Zakirabad, Damas) are slow because of social or political tensions in the village which undermines the role of the VO; and 2 percent (Nasirabad, Broshal Hanono, Holshal) are delayed because they are at an altitude where the work season is very short. AKRSP's ability to handle these different kinds of problems varies greatly. Those schemes which suffered as a result of some aspect of AKRSP's policy are the easiest to remedy by a change in the program policy. Technical faults can sometimes be remedied but when the technical feasibility is fundamentally misguided the only solution might be to abandon the project. One indicator of the strength of the VO is its performance on the PPI. Wherever the VO is weak or torn by internal dissension the project has suffered. AKRSP can play only a limited role in remedying this situation.

Financial problems arise when the material costs of a project are underestimated. AKRSP has introduced an element of negotiation in the grant given to the VOs for the channels. It is important that in this negotiation the material cost is not compromised. To some extent the people will even pool their resources through the VO to subsidize labor, but the VO will be helpless if the cost of explosives or other materials is not covered. The importance of not negotiating below a certain level on the labor component is reinforced by experience in villages (Shahtote, Hanuchal, Bodolas) where a nearby government project has attracted away all the available labor.

An illustration of how a simple change in program policy impacted the performance on PPIs is provided by the disbursal of the PPI grant. Initially, the PPI grant was given to the VO in four installments. There was an inordinate delay in the progress of some schemes in the final stages and the reasons for this were discovered during a monitoring exercise. The first installment was given before the start of the project. The second installment after the completion of the first 25 percent of the channel. The third installment was paid after the completion of 50 percent of the channel and the final installment was paid only after the work was fully completed. This meant that those who worked on the last 50 percent of the project had to work without wages until the VO received the last installment. It was difficult to persuade people to do so, especially when alternate sources of on- and off-farm employment were available. AKRSP realized this and divided the installments into five equal parts. This considerably eased the burden in the last stages of project completion and improved progress on slow schemes.

In large villages there are problems of coordination which slow down the work. A response to this has been smaller management and maintenance groups divided on some social criterion. Village level problems also include the inexperience of VOs in handling the financial responsibility for the projects. Carried away by their new found prosperity, in a few cases, (Gupis) the VO has given generous wage payments initially and then had problems of adjusting to more realistic wage payments. This has not been a serious problem in any village and the matter is internally solved by the VO. Handling new technology (Qurqundas, Siphon irrigation schemes) which has implied deviating from traditional practices of the village, has not met with much success. It will take time for people to develop the experience to handle these. The importance of local participation in the channels was reinforced by AKRSP's experience in the field. In one or two villages local people were not involved in the feasibility survey. This resulted in a lack of acceptance of the cost estimates prepared by AKRSP.

Analysis of Schemes that Failed

The most common reasons for the failure of schemes, in addition to some of those listed in the preceding section, are 1) ambiguity over the distribution of benefits and 2) maintenance. The case study of Jutal provides a very instructive lesson in the performance of a project when benefits are not clearly defined. The command area of the Jutal irrigation channel had been allocated by the government to some farmers from Hooper who had to be resettled after the destruction of their lands in a natural disaster. The people of Judai, who laid traditional claim to this land decided in all probability, to reinforce their claim by building an irrigation channel. Although an AKRSP resurvey team informed the villagers that the project was not technically feasible due to insufficient water in the source, the VO insisted that there would be enough water in the channel and eventually persuaded a second survey team to approve the project on technical grounds. This was one of the few villages in which the advice of the local participants proved misguided. The judgement of the people may have been guided by their zeal to insure their claim on disputed land rather than on their assessment of the water sources of the village. The village of Sikkwer, a recently settled village, was also beset by an internal land dispute and progress on the project was seriously undermined until the land dispute was finally settled in a court of law.

The failure of the NAPWD to enlist village participation in the maintenance of the irrigation channels built by them has been the major reason for the failure of all but one of their schemes. The difficult terrain and the unstable physical environment make village participation essential for the success of any scheme to ensure proper maintenance. Some AKRSP schemes have also been victims of maintenance problems. The VO has, in most cases, reinforced the well developed traditional mechanisms for the maintenance of these schemes. Where there are tensions in the organization there is likely to be a higher probability of maintenance issues arising. The public nature of AKRSP's dealings has placed responsibility on each member of the village and made them accountable for its success. This will help to minimize maintenance problems. This is one reason that no irrigation channel built under the AKRSP strategy failed due to maintenance problems.

ECONOMIC LINKAGE ANALYSIS

Integrated Resource Management

A farming systems perspective focuses attention on the agroecological environment in an integrated manner and allows an examination of the secondary and tertiary impact of a program intervention. In this section some of the backward and forward linkages of the irrigation and land development program will be discussed. The landholdings of the farmers in 154 villages will nearly double. This would increase the irrigated area in the district by about 10,000 ha and considerably improve water availability on presently cultivated land. This has implications for labor productivity, land markets, food and fodder production, livestock carrying capacity, factor and product markets, agricultural commodity prices, future incomes, and consumption patterns. It is difficult to trace the effects of all these factors; however, an attempt is made to trace the direction of change.

The labor requirements in the villages under study are likely to double with the increased landholding. In view of the labor constraint in most villages and the lack of net immigration into the area, farmers will need to devise ways to increase the productivity of existing labor to optimize the returns from their increased resource base. Where labor efficiency cannot be improved, outside labor can help to develop and cultivate new land. In Sherquilla, for example, outside labor was hired by some farmers.

The increase in cultivable land has initiated a limited land market in an area where none existed. Land sales were virtually unknown in the area. Pathan traders who settled in some valleys about 15 or 20 years ago were unable to buy land. The strict local tradition of not selling land to outsiders is being put under increasing pressure by marginal farmers. In Gupis, some Pathan shopkeepers were able to buy land for the first time after the construction of an irrigation channel. Similarly, some villagers in Shahtote wanted to sell land but were persuaded not to do so for the time being. Not all households in the area will have the resources or the inclination to pursue farming, and with the increase in off-farm employment opportunities some are likely to sell their agricultural land.

The increase in annual and perennial crops may have an effect on commodity prices which will depend on both the supply and demand conditions. Input demand is projected to increase. Supply conditions are also improving due to improvements in the communication network and the institutional support to the input delivery system. As such, the final effect on input prices is difficult to determine at present. The projected cropping pattern shows increasing investment in perennial crops. The aggregate supply curve for such agricultural commodities is highly price inelastic in the short run due to the asset fixity of resources employed in agriculture. The investments being made now are based on calculations of present profitability.

The livestock carrying capacity of the area is also expected to increase with the increase in fodder crops. It is estimated that the increased production of fodder crops will support 22,431 additional head of livestock in the villages under study. This means that the population of goats, which is the preferred meat, can be doubled. Meat is presently imported into the area and eaten only on special occasions.

As incomes increase the consumption patterns may also change. With an increase in incomes, the consumption of livestock products can be expected to increase. The demand for fodder crops is also likely to go up. There will be a shift from inferior grains like barley to the more preferred wheat and maize. Consumption of apricot- and mulberry-based products, which form a major portion in the diets of some valleys, may decline. The consumption of oil, sugar, and tea is likely to increase. All these products are imported. Unless production of these goods is initiated locally or consumption patterns shift towards locally produced goods, the terms of trade between the Gilgit District and the importing regions may deteriorate.

The physical stability of the environment will also be affected by the irrigation intervention. To illustrate: the shortage of fodder led to overgrazing in the pasture areas. This contributed to soil erosion and limited the natural potential of the land. Free grazing on the high pasture lands led to considerable strain and weight loss of the animals traveling to and from high mountain pastures. The development of the dairy industry was inhibited because the animals had to stay away from the villages during the summer months. The preservation of wildlife was endangered in this system because the snow leopards posed a threat to the free grazing animals and had to be killed. The availability of fodder in the villages, if it encourages stall feeding, will sustain the entire system.

Projected Agricultural Trend Assessment

The present analysis was conducted with the assumption of unchanging profitability. Greater access to markets and the introduction of new crops are changing the economic potential of most crops. Wheat, the staple food grain in the area, was grown rather than imported at subsidized rates because of the food security it provided to a region cut off from the rest of the country. As the communication network improves, the subsistence economy will invest in enterprises in which it has a comparative advantage and trade for what it is not profitable to grow in a market economy where exchange is possible. A few enterprises which have been identified as having a future in the area are seed potatoes, fodder cultivation, livestock production, agroforestry, and new crops like saffron and mushrooms. There is a great shortage of fuel in the area and unlike the European experience where alternate energy sources quickly replaced the use of wood, in the Northern Areas fuel cropping has to be kept as an integral part of the farming systems until other energy sources are developed.

NOTES

[1]The exchange rates for US$1.00 were PRs 15.36 (1984) and PRs 17.15 (1986).

[2]*Editor's note*: The authors do not indicate if these are Indian or Pakistani rupees. We assume they are Indian at an average 1982 exchange rate of US$1.00=Rs 9.455.

[3]This does not reflect the cash flow of the farmer as family labor and other nonpurchased inputs were costed.

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