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# MANAGEMENT OF IRRIGATION WATER AND ITS IMPACT ON AGRICULTURE PRODUCTIVITY

- A Case Study of Mirwah Canal Khairpur Mirs

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## **Abstract**

On the inflow side canal water in the canal command area of Mirwah is mismanaged by irrigation officials and head-end and influential farmers. Farmers in Sindh generally and Khairpur particularly irrigate their land without scientific techniques and there is no economic pricing of water that might encourage conservation. This, together with the lack of any adequate substitute in the form of administrative control of water and cropping patterns, has been responsible for the excessive water-coefficient of output, and the unequal distribution of water, which have been at the heart of the problem of mismanagement water on the inflow side. The need for restructuring the irrigation system in Sindh is urgent not only because of both allocation and distribution, because, over the years, the province has suffered from unequal distribution of water between big and small farmers, and between head-end and tail-end farmers.

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Water plays a significant role in the economic progress of any country and specifically the countries that depend on the agricultural production. Pakistan is an agricultural country and the distribution of water play significant role in the production of various crops. In Sindh and particularly district Khairpur the economy is agricultural oriented. Though, nearly 88 percent of the available water is used for irrigation purpose. Pakistan's economy primarily depends upon Agriculture. It is the sole major sector and accounts for 24 per cent of the GDP and employs 48.4 per cent of the total workforce. About 68 per cent of country's population lives in rural areas and is directly or indirectly connected with agriculture for its living. Over 70 per cent of our exports depend on agricultural-based products. Water is the backbone of agriculture.

Agriculture is the mainstay of the economy of Sindh Province accounting for the livelihood of more than 70 per cent of the population in the Province. Water is the basic component of any combination of modern agricultural inputs and it provides one of the key elements in the increase

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of agricultural production. One of the basic requirements for successful agriculture is the provision of an adequate supply of water from the Indus River. In fact, the Indus River has been a major lifeline to all cultivators.

The concept of an irrigation system refers not only to physical aspect such as channels and control structures but also to the management structure by which the physical system is planned, designed, constructed, and operated. These two aspects are functionally interdependent, and need to be understood as a whole. Management of irrigation beyond the farm level poses an externality problem for farmer, since there is little or nothing they can do on their own to control the distribution of water. The irrigation system, which was developed more than 100 years ago, requires proper maintenance and overhauling especially in the tail-end area where watercourses cannot be maintained by the farmers to the required standard. The consistent provision of water is to be ensured by the irrigation authorities.

In Sindh both irrigation infrastructure design and water-management practices were geared towards bringing more areas under irrigation rather than making more intensive use of land and water. The fact that this was an easier option, however, resulted in many problems, because of economic pressure and the campaign to grow more food and to achieve self sufficiency in food increasing areas have brought under irrigation. For a good part of Pakistan beyond the Sindh Region, it can be generally maintained that land poses relatively less of a bottleneck factor for agricultural development than water. This could have applied to the Sindh Region in the past. Today, both land and water are equally serious bottleneck factors in the Region. Over the years, the cultivable land has been progressively waterlogged and salt-poisoned. This could happen if the scare water resource has been subject to mismanagement, being used as if it were abundant in supply.

In the Sindh Province as a whole there is clearly less supply of water than demand. Sindh receives a fluctuating supply of water from upstream and Tarbela as it is in the tail-end of the Indus River. Generally farmers in the Region are not use to utilizing water according the need of the crops. Head-end farmers in particular over-use the water from the watercourses.

The efficiency of land and water use in the irrigation system however continues to be very low, and this is reflected in the low productivity per unit of water and land. Approximately half the surface supplies reach the crop, and even these flows are not in accord with the crop water requirements. Its inadequate utilization is reflected in the present low average yields of the various crops grown in the country. In order to realize the full potential of this great asset, it is essential that , apart from improving agricultural practices, the irrigation system itself is improved, protected and extended by public

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sector action and that the private sector is encouraged to adopt more efficient irrigation practices.

In Mirwah Command area demand for irrigation water is said to be outstrip supply. This calls for improvements in water management both in the canal system and on-farm. The overall efficiency is rather low because of many reasons. It may be due to the design discharge capacity of canals, defective modeling conditions of watercourses, the existing warabandi system of water distribution among farmers which is subject to manipulation by politically powerful big landlords are main issues which will be addressed in this study to high light the impact of adequate distribution of water in the Mirwah Command Area. To put the water availability position in perspective, it is useful to study the pattern of change in the total cropped area of Mirwah.

It is appropriate to see that the water availability position in the command Area of Mirwah is demand based or not. What is the situation of water and existing warabandi system and its impact on productivity of various crops? For this purpose, three hundred respondent 100 from each category i.e. Main-head, Middle-end and Tail-end growers have been interviewed to know the water supply situation, requirement of water for the leaching various crops (doses of water), cropping patterns, and official entitlement for the cultivation of crops and the role of Managers (Irrigation Staff) in the distribution of water. This practice of irrigation management is not, however, based on close interaction between the demand for and supply of irrigation water. Consequently, on the supply side the predominant concern has been one of diverting water into canals and watercourses without consideration of the efficiency of its use at the farm level. Agent of irrigation management on the supply side have, in fact, been known to be least concerned with the administration of water according to crop requirements and more responsive to the influence of pressure groups form the irrigation community.

In Pakistan early studies used (Carlston, 1953; HTS, 1965; Tipton and Kalabach, 1967; World Bank, 1968); Jepson, *et. al.*, 1969; and Garge, *et. al.* 1970) reported that 10 to 50 per cent of the water passing the *mogha* (outlet) was lost in the watercourses. The average measurement of water losses taken by WAPDA.

Studies giving generally similar results to those already cited were reported by *Early et. al.*, (1975-76) and *Trout et. al.*, (1976).

WAPDA Master Planning and Review Division (1977-78) surveyed 61 sample watercourses in Punjab for the Revised Action Plan (RAP) and found a 55 per cent conveyance efficiency of the watercourses. For SCARP and Non-SCARP areas, it was 44 per cent and 57 per cent respectively. Based on 54 per cent average delivery efficiency of sample 101 watercourses, it was estimated

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that annually 64 billion cubic meter of irrigation water in watercourses would be lost.

Mundorff, *et al.*, (1976) revealed that seepage losses were greatest near the bifurcation points in the upper parts of the Rechana Doabs (Rechana Doab is an area in Punjab Pakistan which is in the centre of the interfluvial area between the Ravi and Chenab rivers). Because of the greater density of canals and rivers the water table was already close to the surface. They concluded that the rising water table is causing the waterlogging and salinity of irrigated agriculture in the Indus Plain.

Murray (1977) concluded after data collected from Mona Reclamation Experimental Project (MREP), and elsewhere in Pakistan that present losses in watercourses from the *mogha* (outlet) to the farmer's field average about 50 per cent. He suggested that 50 per cent of the water lost (i.e. about 25 per cent of the total water leaving the canal) can be saved through the lining of canals and watercourses.

Rahim (1977) estimated that percolation and evaporation losses are as high as one cusec to five cusec per mile of the main canals and distributaries. These losses occurring at the outlets and watercourses to the field discharge point range as high as 40 to 50 per cent. Another study by Gill (1977) revealed that spillage of different kinds such as overtopping, side leakage, and breaches, accounts for major conveyance losses. These losses are due to poor maintenance of watercourses by the farmers, the defective structure of the watercourse, and holes and vegetation in the watercourses.

Qureshi (1978) reported that transmission losses often exceed those assumed at the planning stage. In Pakistan in general and in Sindh in particular, the main canals have diversion losses because most of them follow the old Fatts (natural inundation routes of water from the Indus River) specially the Rice Canal on the Sukkur Barrage, and the Fuleli and Pinyari Feeders on Ghullam Mohammed Barrage. The Mirwah Canals have so many intermediate (awkward) bends (see chapter two), that, where the water is moving rapidly part of the bank is washed away.

The World Bank Lower Sindh LBOD Project (1983) concluded that waterlogging is concentrated mainly along major canal lines. This is due to canal seepage and the better water availability in these areas. It was suggested that the lining of canals and watercourses is a better method for eliminating the waterlogging and salinity problem.

### **Data Collection Methodology**

#### **Results and Discussion**

The following factors have emerged as of possible importance in explaining the inadequate distribution of water and irregular supply that have

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led to loss and deterioration of cultivable land and consequently the economic earnings of the farming community.

- ◆poor maintenance of water courses and channels;
- ◆seepage from canals/watercourses due to greater discharge than designed capacity;
- ◆interference by the big landlords and influential politicians in the distribution of water;
- ◆mismanagement by the irrigation officials;
- ◆poor farming practices (cropping pattern);
- ◆poor maintenance of irrigation network (de-siltation).

The effects of these factors on land loss and agricultural productivity are discussed below:

Farmers were asked about the adequacy of surface or sub-surface drainage in their areas. A majority of the farmers in the sample survey reported that no surface drainage was available and that as a magnitude monsoon rain water (July-August) from their fields could not be drained. Usually excess water standing in their crops decreases productivity, in particular of cotton, which is very sensitive to water. Excess water also badly affects the productivity of sugar-cane and other crops.

A majority of farmers in the sample survey also considered it would be profitable to accept the On-Farm Water Management package (OFWM) if they were offered it by the provincial government, and, they were ready to pay 50 per cent of the cost, or alternatively to pay the required 30 per cent of the cost if they provided labour. In the case of tenanted land, the 50 per cent would be divided equally between the landlord and the tenant; the 30 per cent would be paid by the landlord if the tenant provides the labour. The willingness in almost all cases was conditional on provision of appropriate loans. OFWM covers the lining of watercourses and the levelling of fields. Farmers were hopeful that adequate supply of water could be controlled with the provision of On-farm Water Management and horizontal drainage as had been the case in lower Sindh (LBOD Stage 1).

#### **Mismanagement by the Irrigation Department**

Water shortage occurs quite frequently during both summer and winter. Most farmers have access only to canal water for their agricultural land. However, in the Sukkur Region this resource does not meet the water requirement of farmers. Every farmer wants to irrigate the whole of his land, but the actual cropping intensity for *Rabi* crops (winter crops) is 46 per cent, and for *Kharif* crops (summer crops) 60 per cent. Agricultural land faces an acute shortage of water, and policy makers, without considering the provision

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of water, encourage the farmers to bring more and more land under cultivation. Without an adequate supply of water, the farmers are not able to irrigate land properly and hence adopt illegal methods such as stealing and acquiring it through bribing officials. These practices, which are reportedly common, make tail-end farmers vulnerable as stated by MacDonald. Farmers in the survey stated that irrigation staff are involved in the malpractice and charge extra money for water. They further revealed that it is a general practice of paying a certain fixed amount per acre extra above the legal charge. Without this extra payment and gifts which they pay in kind in the form of food, grain, and animals, they would not receive their legal share of water. Farmers stated during the survey that they are heavily burdened through paying various taxes which provincial and local governments impose on them from time to time, such as drainage cess, mosque cess, sugar-cane cess, Iqra charges, Town committee fees, Union council fees, and Usher charges which between them amount to about 10 per cent of the value of agricultural products [survey result].

It has been estimated that, even if all the planned hydro projects are completed well on time, there would still be a supply shortfall of water of at least 5,000 MH (50 billion cubic meters) in the year 2,000. This estimate appears to imply that the requirement would be about 230-240 billion cubic meters. If that is so, the country has to explore and develop alternative water resources or use supplies less wastefully to meet future demand [Arshad, 1989].

#### **Interference by the Big Landlords and Influential Politicians in the Distribution of Water.**

Respondent in the survey showed evidence on the ground that some big landlords had illegal connections to canals. Big farmers have strong links with the irrigation officials and this helps them to get more water supplies on a preferential basis. It also appears from the survey results that the farmers in the head-end with large land size have better access to water and earn more per acre than middle-end and tail-end farmers. Tail-end farmers have an ever smaller share of water and it is common knowledge, supported by the farmers' testimony, that their land is more subject to salinity. It seems likely that worsening water resources for the tail-end farmers provide one of the reasons why the productivity of some crops is falling.

#### **Options for Solving the Problem**

For the long-term sustainability of agricultural land, significant and permanent improvement is required in irrigation and drainage as also in conservation and management of water resources. The following possible long-

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term and short-term (i.e. structural and managerial) preventive measures for the adequate water availability should be introduced to provide permanent relief to cultivable land in Sukkur Region.

*Long-term Solutions*

The following are the main possible long-term (structural) devices directed at improving the water-delivery and removal efficiency of watercourses, canals and drains:

- a) to protect cultivable land and infra-structure from floods by completing *small irrigation schemes and reservoirs*;
- b) to save water loss through lining of canals;
- c) to reduce conveyance loss with remodelling canals/watercourses;
- d) to achieve high irrigation efficiency by reducing water losses through (i) precision land levelling (ii) lining watercourse extension of the On-Farm Water Management Programme;
- e) to introduce micro irrigation schemes.

The irrigation and drainage system, over the years, has deteriorated because of inadequate allocation of funds for its operation and maintenance. The direct financial revenue to the government would come mainly from water rates (Abiana), land revenue and drainage cess. Although other land-based taxes such as usher, sugar-cane cess, Mosque cess etc. are also being collected, these are more of the nature of local taxes and as such, they are directed to local welfare services and development schemes. Water revenue is collected on the basis of a schedule of water rates proposed by IPD (Irrigation Planning Development) government of Sindh. The current schedule was fixed in 1985 by IPD and since then it has not changed so that the revenue has fallen considerably in real value. It may be that the fall in the delivery efficiency of the system depends in part of shortage of funds. Downstream of Sukkur Barrage the major works needed are the remodelling of internal canals to carry additional water from external sources and improvements of the operation of all the main canals, particularly the Rohri and Nara canals.

Extensive field surveys indicate that, out of the total 60 per cent losses of irrigation water in the system, about 35-40 per cent of water entering the system is lost during its conveyance. These exceptionally high losses not only create water shortages for crops, but also give rise to waterlogging. Appropriate importance should therefore be given to remodelling of canals and watercourses in order to arrest the water losses, as well as surface drainage for removing excess water. Improvement of delivery will reduce water loss to provide more water where it is needed. It is an important supplement to drainage in reducing

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waterlogging and salinity.

In view of these facts, a multi-pronged approach for reducing mismanagement of water should be planned as a matter of urgency to provide initial relief to the farming communities. In the light of the information and discussion carried out so far following steps are suggested to combat loss and consequently shortage of water from the Khairpur District.

A necessary condition for tube wells to be effective for drainage is that the land concerned must be underlain by suitable fresh water whose aquifer can be used for cultivation, and also that the aquifer must be hydrologically connected with the water table above it.

With the benefit of several years experience, of the LBOD project stage 1, which covers cultivable land of Mirpurkhas, Sanghar, and Nawab Shah Districts, it is recommended that priority should be given to horizontal drainage in Khairpur District for the following reasons:

In view of the features of the loss of water because of the mismanagement discussed in chapter 2, horizontal drainage would appear to be a necessary part of the solution to the problem in Sindh. It is therefore necessary to discuss in brief the technical and economic aspects of horizontal drainage.

**(a) Technical Aspects**

◆ Horizontal drainage is needed for Sindh Province because the major part of cultivable land (4.88 million hectares) is underlain with saline water, whereas for vertical drainage to be useful fresh water is needed so that it can be used for irrigation as in upper Punjab;

◆ Scarp tube wells have been used for a fairly long period (since 1969) in Khairpur and Kotdiji. However, to judge by their performance in these tehsils reliance should not be placed on tube wells as the sole means of reducing waterlogging and salinity;

**(b) Economic Aspects**

◆ The volunteer participation of farmers and big landlords in the digging of drains, reduces the cost to government of surface drainage;

◆ A majority of farmers surveyed showed their willingness to opt for provision of surface drainage if offered it by the Provincial government, apparently on the assumption that they would bear the total cost through rates;

◆ Hence, it may well be economically viable to take this option. In the lower Sindh productivity, of crops increased and land was reclaimed as a result of surface drainage.

Since groundwater is normal (700-100 ppm) in the Khairpur District, it is proposed here that surface drainage should be treated as an essential element

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in the elaboration of a permanent solution to the shortage of water there.

#### *Small Irrigation Schemes and Reservoirs*

Investment in a large number of small schemes which aim at diverting and storing flood waters for irrigation in Sindh is important to protect lands and infra-structure from floods. Examples are the proposed reservoirs at Munchur Lake, Chotiari and the construction of the Barrage at Sehwen.

#### **Conclusion**

It is concluded that to get rid of malpractices in the distribution of water from the survey area the irrigation system requires the following classes of measure:

- (i) More finance;
- (ii) Better administration;
- (iii) A surface-drainage system;
- (iv) Economic water-pricing at the margin;
- (v) More economic watercourse management and farm practices.

It is concluded that the first two of the above objectives might be achieved through the formation of an autonomous irrigation administration for each command under the arrangements discussed in chapter 4. (6.2.1 below); the second (6.2.2 below); the third (6.2.3 below) in part by uptake of the OFWM scheme, in part by the institutional reforms and possibly in part by better information and credit arrangements for farmers, and the fourth potentially by making water rights tradable (7.2.4 below).

#### **Managerial, Legal Institution Reforms**

The increase of finance and improvement of administration require the following measures:

(i) Decentralization of the irrigation administration should be undertaken, as currently contemplated by Sindh policy, so that each command is autonomous, with a Chief Engineer, acting in consultation with farmers' associations, who would have responsibility under law for decisions on irrigation in the command, and that the arrangements should go further in that he would be responsible for the use of revenue raised in the command, so that the Chief Engineer's decisions could be over-ridden only by legal action or other extraordinary procedure;

- (ii) There Chief Engineer and each Water Users' Association should

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have statutory obligations (such as distributing the water according to rules) which they could be sued for infringing or neglecting to enforce;

(iii) There should be a water-ombudsman office, possibly in each district, to investigate alleged infringements of rules in revenue collection and water distribution;

(iv) There should be readily accessible, probably mobile, judicial tribunals for suing or prosecuting for infringements of the water regime.

If the *warabandi* system were properly enforced, that would be a considerable advance, in both efficiency and equity, on what now exists. It is not technically difficult or costly. But it probably requires institutions such as Water Users' Associations (WUAs) with adequate power to enforce the rules properly by being competent to sue any breacher of the law, together with institutions by which the WUAs themselves may be held to account. WUAs thus require a legal framework. Moreover, for a fully enforced *warabandi* actually to give equal distribution requires proper maintenance of the watercourses. This is also a vital function for the WUAs. The purposes of these associations should thus be to improve and maintain the watercourses, to ensure fair and lawful distribution of water, and to resolve disputes between farmers regarding the distribution of water, So WUAs along each watercourse should be formed with full legal rights of enforcement and full legal obligations to ensure that the enforcement of the *warabandi* is carried out.

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