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The Policy of Irrigation Water Pricing in Pakistan: Aims, Assessment and Needed Redirections

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1. INTRODUCTION

Pakistan operates the world's largest well-articulated irrigation system. Individual farms receive water from the gravity flow of a massive network of canals, distributaries and watercourses fed by the Indus River and its tributaries. In recent years public tubewells have become an additional, though somewhat limited, source of irrigation water. The canal system, which has been in operation for more than 100 years, is believed to have become too obsolete to cater for the needs of modern agriculture and is, therefore, in desperate need for rehabilitation. But resource-poor Pakistan cannot undertake the rehabilitation work on its own, and must depend on foreign loans or at least ensure full recovery of annual operation and maintenance (O and M) expenditures [Chaudhry (1985); Duane (1975) and Hotes (1984)]. Apart from generating investment funds, the cost recovery, with higher water charges, would also lead to greater water-use efficiency and an equitable income distribution at the farm level [Chaudhry (1985) and Hotes (1984)].

Can this all be accomplished by simply raising water charges? In this paper, we have attempted to answer this question. To answer the question systematically, we have divided the paper in five sections. The current state of Pakistan's irrigation system, water charges and cost recovery is discussed in Section 2. Section 3 deals with possible impact of rising water charges on cost recovery, investments, efficiency of water use and income distribution under the current system of water pricing. Section 4 presents policy alternatives that would ensure an effective cost recovery, greater water-use efficiency and a more equitable distribution of farm income. Section 5 presents the summary and conclusions of the paper.

2. IRRIGATION SYSTEM, WATER CHARGES AND COSTS

The irrigation system supplies irrigation water through a fixed roster of turns agreed upon by the farmers concerned. The duration of irrigation for each farm

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is determined strictly by the proportion of that farm's commanded area to the total commanded area of the watercourse concerned regardless of the farm's cultivated, uncultivated, cropped or uncropped area. Since the masonry works at the head of a watercourse allow only a fixed discharge of water per unit of time [Wolf (1986)], the distribution of water per canal-commanded acre on farms served by a given watercourse is expected to be more or less equitable. On the other hand it has been argued that large farmers are likely to have greater access to irrigation water per unit area because of favourable location, usurpation of others, water rights and unauthorised tapping of canals. The argument is generally very weak. To begin with, the canals were by no means so laid out as to particularly favour large farms against small and medium farms. And even if a canal did pass by some large farms at the time of its construction, those farms by now have been broken down into smaller units because of the country's inheritance laws, so that the argument that large farms have more favourable locations on canals, even if correct initially, is no longer true. As far as usurpation of others' rights and unauthorised tapping of canals are concerned, it is very unlikely that they can be practised on a large scale, as they are punishable with very heavy fines and imprisonment.

In contrast with negligible differences in water supply to farms located on the same watercourse, there may be large variations in water distribution from watercourse to watercourse. And it is here that watercourses serving the large farmers may carry more water than their due share. This is because, the large farmers as a group are not only politically powerful but also have the means to bribe irrigation officers for securing greater access to irrigation water. As a general rule, average supplies per canal-commanded acre in the Punjab and Sindh are higher than those in the other two provinces of Pakistan [World Bank (1988)]. In fact, the annual supply of water per canal-commanded acre in Balochistan is only half of that in the Punjab or Sindh. This may be due to such factors as topography, inaccessibility and severe shortage of local water resources.

While the extent of canal-commanded area determines the amount of water supply to farms, water charges of individual farms are assessed on the basis of the cropland irrigated. The water rates vary from crop to crop and also from canal to canal. For instance the water rates for non-perennial canals are roughly 80 percent of those for perennial canals [Chaudhry (1985)]. Table 1 presents variations in water rates for various crops for perennial canals of Pakistan's provinces.

The water rates are the highest for sugarcane in all the provinces and the lowest for Rabi oil-seeds in the Punjab, but for maize in the other three provinces. Among the provinces, the NWFP has the highest water rates for most of the crops and is closely followed by Balochistan and Sindh. The rates were the lowest in the Punjab. While the differences in the rates for various crops have always been there, the inter-provincial diversity has been of recent origin. It is the result of the different extents to which the provinces has complied with the federal government's suggestion of 1984-85 that they raise water rates by 25 percent. As irrigation is a provincial subject, the response of the provinces was not uniform. The Punjab

resisted the revision totally, the NWFP and Balochistan complied fully, but Sindh enhanced the rates by only 10 percent. In both 1980-81 and 1981-82, however, all the provinces readily adopted the federal government's proposals for raising water rates by 25 percent.

Table 1

Province-wise Water Rates for Various Crops Irrigated by Perennial Canals: 1989-90

(Rs per Acre)

Crops	Punjab	Sindh	NWFP	Balochistan
Sugarcane	64.00	70.40	82.00	78.82
Orchards	41.60	55.00	63.00	62.50
Cotton	33.60	36.02	37.00	41.00
Rice	32.00	34.37	37.00	39.06
Kharif Oil-seeds	23.20	33.12	30.00	33.20
Wheat	21.60	20.62	24.00	23.44
Maize	19.20	15.40	24.00	17.58
Rabi Oil-seeds	11.20	20.62	28.00	23.44

Source: Water rates reported in Chaudhry (1985) adjusted for water rate increases since 1985 as given in Government of Pakistan (1990).

It could be seen from the foregoing that the levels of water rates vary for crops on the basis of the water requirements of those crops. However, the relationship is neither systematic nor directly proportional to water consumption of various crops. For example, charges per acre-foot of water for sugarcane, which requires 67 acre-inches of water, vary between Rs 11.5 and Rs 14.7 in various provinces. Against this, the charges per acre-foot of water for *kharif* oil-seeds can go as high as Rs 27.8–39.8. Although the Punjab and Sindh receive more water per unit of canal-commanded area than the NWFP or Balochistan, there is no corresponding adjustment of the water rates. As a result of such a pricing policy, rational producers' tend to maximise water use even though it may be highly scarce.

Nonetheless it should be apparent that irrigation water in Pakistan may be subsized more for certain crops than other crops. What is less clear, however, is the extent of aggregate subsidy on water in absolute or relative terms. In order to quantify these relevant aspects of subsidy, there is the need to look at expenditures on and receipts from irrigation. These are presented in Table 2 for the decade of the Eighties.

Several conclusions emerge from the data in Table 2. Firstly, expenditure on irrigation has always been in excess of receipts from irrigation during the decade, pointing to the existence of subsidies on irrigation water. Second, receipts increased at a slower pace than expenditure and resulted in growing imbalances between the

Table 2

Provincial Budgetary Expenditures on (0 and M) and Receipts from Irrigation: 1979-80 to 1989-90

(Million Rupees)

Years	Expenditure	Receipts	Deficit or Subsidy
1979-80	957.97	661.30	296.67
1980-81	1122.06	783.81	338.25
1981-82	1436.35	1022.09	416.26
1982-83	1522.58	1085.06	437.52
1983-84	1777.03	1116.36	660.67
1984-85	2055.70	1228.10	827.60
1985-86	2325.70	1319.87	1005.83
1986-87	2612.23	1378.42	1233.81
1987-88	2900.56	1548.43	1352.13
1988-89	2880.44	1726.09	1154.35
1989-90	2801.81	1773.33	1028.48

Source: Annual Budget Statements for provincial governments for various years.

two. Finally, the extent of subsidy on irrigation water has been on the increase in both absolute and relative (as percent of expenditure) terms. While the receipts amounted to nearly 70 percent of the expenditure during the early Eighties, the percentage fell to 63 percent by 1989-90. In absolute terms, expenditure on irrigation water rose from nearly Rs 1 billion to almost Rs 3 billion as compared with the irrigation receipts of Rs 0.66 billion to Rs 1.77 billion between the beginning and end of the decade. This shows that absolute subsidies on irrigation water amounted to Rs 300 million in 1979-80 as against Rs 1028 million in 1989-90.

The above analysis, however, does not truly reflect the benefits and costs of irrigation water to the farmers. There is always a considerable increase in expenditure and a decline in actual receipts before they appear in annual budgets. Although no estimates of the degree of escalation of expenditure in Pakistan are readily available, the Indian experience with a similar irrigation system as in Pakistan shows that the actual irrigation expenditure (O and M) may be only half of that reported in the government budgets [Wade (1982) and Rao (1984)]. As the recent surges in irrigation expenditure may be attributed to the growing illicit practices, steep increases in the maintenance cost of public tubewells and salaries of government employees, it is not clear whether the farmers should be made responsible for financing such expenditures. On the other side, official irrigation receipts may not represent the true costs of water paid by the farmers for several reasons. Firstly, they are net of collection costs of 5 percent. Secondly, there is considerable under-assessment of water rates by the irrigation officials and

estimates vary between 10 percent in Punjab and NWFP, 30 percent in Sindh and 60 percent in Balochistan according to the latest study of water rates [Government of Pakistan (1990)]. Thirdly, although land revenue due to irrigation made significant contributions and was an integral part of irrigation receipts before 1970, it no longer appears under irrigation head [Chaudhry (1973) and Lewis (1969)]. Finally and most importantly, direct payments by farmers to irrigation officials for an assured supply of irrigation water throughout the season may add up to billions of rupees but they have never been a part of the government budget. Accounting for all these factors, one begins to wonder if the farmers were the sole beneficiaries of irrigation subsidies in Pakistan. This becomes all the more important if the effect of governments procurement programme, paying only 50 percent of world prices for major agricultural commodities, is also taken into account [Chaudhry and Kayani (1991)].

3. CONSEQUENCES OF RAISING WATER CHARGES

Contrary to the arguments advanced by the World Bank and others, increases in water charges seem unlikely to result in full cost recovery, greater investment for O and M, increased resource-efficiency, and improvement of income distribution under the current practices of irrigation water supply and the present pricing policy. In fact, it can be argued that steep increases in water charges without suitable changes in other policies might promote opposite tendencies in a large number of cases as should be apparent from the following discussion.

There can be little doubt that full cost-recovery would be achievable provided water charges are sufficiently raised. Unofficial estimates apart, this would require a nearly 50 percent across-the-board increase in the existing water rates in the near future. Such a steep increase, however, is likely to evoke a number of responses from the farm sector. The farmers may curtail their cropping intensities to minimise their oppressive water bills; they may outright refuse to pay the assessed amounts; or they may bribe irrigation officials for an under-assessment of their cropped area and/or water charges. The effect of all these practices would be adverse on the recovery of water charges. Although corrective measures for recovering full rates may be adopted, there is little guarantee that improved cost recovery would necessarily be accompanied by greater allocation of funds for O and M investment. This is because allocation of O and M funds is made independently of water receipts under the current budgetary practices. Even if provided with more funds, most provincial irrigation departments seem to be ill-equipped for making extra efforts for the required maintenance work; they are more likely to continue to do their routine work [Swendsen (1986)]. There is some evidence in Table 2 that indicates that Swendsen's view may well be right, as subsidies on water continued to increase despite the near doubling of water charges during the Eighties. Furthermore, greater public investment made possible by steep increases in water rates, may result in a corresponding reduction in private investment and thus retard private tubewell-development simply because it will no longer be profitable to pay

exorbitant running costs of tubewells as well as enhanced water charges. Although essential investments in O and M are unlikely to be highly profitable as such investments are unlikely to significantly raise productivity in agriculture [Wolf (1986)].

As a matter of principle and in accordance with the established rules of economic theory, increases in water prices should normally lead to improved efficiency of water, provided there is a direct relationship between the quantities delivered and the prices charged [Lazaro *et al.* (1977)]. It should be clear from the previous Section that there is only a weak relationship between the water delivered and water charges in Pakistan as the former is a function of canal-commanded area and the latter that of cropped area. Given this situation, one could have free access to irrigation water if the canal-commanded area is kept fallow or would be subjected to double the water charges if one double-crops the entire canal-commanded area given the fixed supply of water per unit of land. While the example cited above may be an extreme case, the message should be clear; "we do economic theory a grave injustice, though, when we expect it to perform this minor miracle (efficient allocation) on commodities that are not paid for on a per unit basis" [Swendsen (1986)]. What is more important to note is the fact that if the price paid is divorced from the quantities purchased or delivered, the price increases cannot, nor can they be expected to, perform rational allocative functions. In fact imaginative economic thinking would reveal that the effect would tend to be exactly opposite of the intended [Swendsen (1986)]. In view of the widespread inconsistencies between water distribution and its prices in Pakistan, simple increases in water prices are most likely to worsen the problems of efficient water-use rather than alleviate them.

Although rising prices of irrigation water, as argued by Hotes (1984), have some scope for reducing income disparities between irrigated and unirrigated areas, they would, most certainly, result in sharp deterioration of income distribution between farms of various size-categories in irrigated areas. This is because the intensity-related water rates would impinge heavily on the resources of small farmers who cultivate land more intensively than large farmers. In Table 3 we present intensity of cultivation of various farm size-categories. Their probable impacts on water rates along with their implications for income distribution are discussed below.

It should be clear from the table that the cropping intensity (cropped area as a percentage of cultivated area) varies inversely with farm size. Similar is the case with land-use intensity (that is, cultivated area as a percentage of farm area). The combined effect of the two trends is reflected in cultivation intensity (cropped area as percentage of farm area). As irrigation water supply is related to the canal-commanded area (total area of an irrigated farm), and water charges are assessed on the basis of cropland, the relative burdens of payable water rates per canal-commanded acre for various size categories would be essentially determined by cultivation intensities of those farms. As it is, there can be little doubt that the water-rate burdens per canal-commanded acre decrease with an increase in the farm

Table 3

Land Use, Cropping and Cultivation Intensities by Farm Size: 1980

Farm Size Categories	Land Use Intensity	Cropping Intensity	Intensity of Cultivation
Under 1 Acre	91.44	164.10	150.05
1.0 – 2.5 Acres	90.44	150.76	136.92
2.5 – 5.0 Acres	91.53	144.03	131.83
5.0 – 7.5 Acres	92.68	138.25	128.13
7.5 – 12.5 Acres	91.82	128.90	118.36
12.5 – 25.0 Acres	87.60	120.07	105.18
25.0 – 50.0 Acres	81.85	112.98	92.47
50.0 – 150.0 Acres	72.49	108.02	78.30
150.0 Acres and Above	56.95	100.02	56.96

Source: Calculations based on data given in Government of Pakistan (1983).

size in spite of the probable opposite relationship between farm size and access to irrigation water per unit of land. To make things more clear, it may be pointed out that the smallest farm size category of "under 1.0 acre" would be subjected to at least 2.5 times the water charge per unit of water supply as is payable by the largest category of "150 acres and above". It may also be noted that water rate increases under current pricing practices are likely to further worsen the position of small farmers, as each one-percent increase in water charges would lead to an increase of 1.50 percent for the smallest group but to an increase of only 0.57 percent for the largest size category of farms.

4. NEEDED POLICY REDIRECTIONS

It has been argued in the previous section that increases in water rates alone are unlikely to successfully achieve the desired objectives of cost recovery, resource efficiency and equitable distribution of farm incomes. This, however, is not to say that price levels are irrelevant, but only to suggest that they may be extremely important once the fundamental restructuring of the relationships between (a) water supply and its prices, (b) farmers and the irrigation officials and (c) costs and benefits of the irrigation system have been achieved. It is this goal that has been discussed in this section.

First and foremost, there is a need to restore a direct relationship between irrigation water and its prices. It is for this reason that almost all the major studies on the subject have insisted on charging water on a volumetric basis [Gotsch and Falcon (1970); Hufbauer and Akhtar (1970); Lewis (1969); Sampath (1992) and Swendsen (1986)]. While strict volumetric deliveries have never been tried in

Pakistan owing perhaps to the impracticability and cost-ineffectiveness of meter installations, the proposal can hardly be brushed aside for such reasoning. There are alternative, though somewhat rough, ways for accomplishing the task. For example, a direct relationship between the amounts delivered and chargeable water-rates could be established if the water charges, like canal-water supplies, are assessed on the basis of the canal-commanded area [Government of Pakistan (1988)]. This concurrence of the two bases would be highly desirable in many respects. It would, like strict volumetric pricing, encourage an efficient use of land and water since it would leave the planting decision to farmers, given the available supplies and opportunity costs of irrigation water [Lewis (1969)]. It would also relieve many small farmers of onerous water rates reflected in their high cultivation intensities and would induce positive changes in the distribution of income. Further, investment in private tubewells would be encouraged because of elimination of double charge. It may also lead to an improvement in cost recovery by tying the assessment of water charges to canal-commanded area and by eliminating the need for rural irrigation-staff for maintaining crop records. This is especially important as irrigation departments in Pakistan are overstaffed by nearly 50 percent in comparison with those in other countries of South-East Asia [Wolf (1986)].

Furthermore, while a change in the water-rate base is a primary requirement, it remains an inadequate measure for achieving all the objectives in the presence of gross inefficiencies of the irrigation system and must therefore be accompanied by appropriate structural changes. For example, an equitable distribution of water across the water-courses would enhance the efficiency of water-use and would thus lead to an equitable income distribution. Irrigation officers may be made more accountable if water-users' associations are formed on each water-course with powers to ensure due share of water deliveries and collection and spending of water receipts. As public tubewells account for most of the O and M expenditure, disinvestment in them would be highly desirable, especially as they are the costliest means of drainage and irrigation [Muhammad (1970)]. Budgets should be so prepared as to present a more realistic picture of receipts from and expenditures on irrigation. In the presence of widespread distortions in the prices of agricultural inputs and commodities, corrective actions in respect of water prices alone are unlikely to ensure an efficient resource-allocation and remedial measures must be undertaken to create an environment of distortion-free prices.

Finally, should the prices of water be raised to ensure greater efficiency and cost recovery? once the basic relationship between water supply and chargeable amounts is restored, higher prices might be consistent with greater efficiency as long as they do not exceed the marginal costs or the value of marginal product of water. Because of the measurement problems and seasonal and intertemporal fluctuations in the value of marginal products and long-run marginal cots, there is a growing consensus in the literature on recovery of, at least, short-run marginal costs. As shown in Section 3, recovery of short-run marginal costs would require a 50-percent increase in water rates under the present conditions. If, however, the

government carries out its contemplated divestiture of public tubewells, it can totally eliminate the need for raising the water rates. Further reductions in irrigation expenditure may also result from greater accountability of irrigation officers and rigorous checks and balances in budget preparation.

5. CONCLUDING REMARKS

The purpose of this paper has been to investigate the benefits of cost-recovery strategy in terms of investment, resource efficiency and income distribution. Contrary to what is generally argued, a raising of water charges is unlikely to have a positive effect on the above variables because of operational inefficiencies of irrigation departments and lack of any direct relationship between water supply and chargeable prices. In fact, the paper notes that increases in intensity-related water rates may lead to a deterioration in resource efficiency and in income distribution: the former because of lack of relationship between the water delivered and the amounts charged and the latter because of the inverse relationship between cultivation intensity and farm size.

Given the present situation, a concurrence of the base of water rates with that of water deliveries, should ensure a greater use efficiency of land and water, provide greater relief to smaller farmers and allow cost reductions by eliminating the irrigation staff required for keeping crop records. While a change in the water-rate base sets the stage to achieve the desired objectives, it must be accompanied by an equitable distribution of water, greater accountability of irrigation officials, divestiture of public tubewells and creation of distortion-free environment for agricultural inputs and commodities to ensure further gains in efficiency, equity and cost recovery. Although many of the above recommendations should allow full cost-recovery through reduction of annual O and M expenditures, any deficits in cost recovery could be met with corresponding increases in water rates. In view of the changed base such increases should conduce to an improved resource allocation and a more equitable distribution of income.

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Comments on "The Policy of Irrigation Water Pricing in Pakistan: Aims, Assessment and Needed Redirections"

The paper by Dr M. Ghaffar Chaudhry and colleagues provides a stimulating analysis of alternative directions for irrigation water pricing policies in Pakistan. The paper correctly identifies the problem of increasing subsidies to irrigation, even on operations and maintenance; combined with the serious incentive failure arising from low water charges, which induce inefficient overuse of irrigation water.

The paper also correctly shows that attempts to achieve full cost recovery through steep increases in flat-rate water charges are unlikely to meet the cost-recovery goal; and are likewise unlikely to foster increased resource-efficiency or equitable income distribution.

The paper further points out the need to establish a firmer relationship between water supplied and water prices, and suggests a pricing system which would approximate volumetric water charges.

I would like to extend this argument a bit, and suggest an alternative approach to water resource allocation which, I believe may promote efficiency in water resource use. This approach is the development of markets in tradeable property rights for water.

Markets in Water Rights vs. Water Pricing .

Rosegrant and Binswanger (1992) argue that the establishment of administered efficiency-based pricing of water, as suggested in the paper, is an intermediate policy between managed quantity allocation and water markets. Efficient allocation of resources usually requires that marginal units of water are priced at their marginal cost. Although complications arise due to the economies of scale and lumpiness of investment in irrigation it is theoretically possible to design and implement a system of administered prices which would lead to efficient allocation of water. However, the information requirements for an efficient system of administered prices are demanding and much of this information would necessarily be gathered by trial-and-error experimentation. Information is expensive and mistakes made in the trial-and-error process may be costly. If prices are set too low, demand for water would be excessive, and if prices are set too high, water would be wasted to drainage.

Perhaps even more important, in existing irrigation systems, the value of prevailing water rights (formal or informal) has already been capitalised into the value of irrigation land. Imposition of administered pricing is correctly perceived by rights holders as expropriation of those rights, which would create capital losses in established irrigation farms. Attempts to establish administered efficiency prices are

thus met with strong opposition from established irrigators, which makes it difficult to institute and maintain an efficiency-oriented system of administered prices.

Markets in tradeable water rights have two major advantages compared to administrated efficiency pricing. First, has noted above, information costs would be reduced, because the market, composed of irrigators with expert knowledge of the value of water as an input in the production process, would bear the costs and generate the necessary information on the value of marginal product and opportunity costs of water. Second, establishment of transferable property rights would formalise existing rights to water, rather than being seen as an expropriation of these rights, and is therefore politically more feasible.

Although water markets exist in Pakistan and other developing countries, a relatively low value of water and high transactions costs have slowed development of markets in tradeable rights to water in the past. However, the growing scarcity of water as economic growth proceeds will be conducive to market development. Existing property rights systems are restrictive of water transfers, because they limit the use of water to adjacent or overlying lands, or build in a bias toward maintaining existing, possibly inefficient uses of water. As water becomes scarcer, markets in tradeable water rights will have several major advantages over alternative allocation mechanisms: establishment of well-defined tradeable rights formalises and secures the existing water rights held by farmers; markets economise on transactions costs, reducing the information costs of a centralised managing institution, with the market generating the necessary information and market users bearing the information costs; markets in tradeable rights induce irrigators to consider the full opportunity cost of water, including its value in alternative uses, and provide incentives for irrigators to internalise many of the externalities inherent in irrigation. [Rosegrant and Binswanger (1992).]

It is therefore appropriate to begin the process of research and policy analysis to better understand the possible benefits from establishing well-defined tradeable property rights to water in Pakistan and other developing countries. The benefits of water market development will not be uniform across regions. Further research should be done to establish in what regions (in terms of agroclimatic zones, relative water supply, level of agriculture intensification, etc.) the highest payoff would come in reforming laws, institutions, and policies to remove constraints to development of water markets.

In the process of establishing markets in tradeable water rights, a number of serious issues must be addressed. Laws, institutions, and contracts must be reformed or developed to deal with variability of water delivery, to protect the poor against the development of market power, and to protect against third-party impairment from water trades. However, it should be noted that any water allocation regime must deal with these problems, and it is not at all clear that solutions are more difficult to achieve under a tradeable property rights regime. Existing water allocation regimes have not been effective in managing variability in streamflow or in protecting the rights of poor farmers or protecting against third-party

externalities. It must finally be stressed that development of markets cannot proceed in an isolated fashion from the real-world institutional and technological context of developing-country irrigation. Effective development of markets in tradeable property rights will require continued improvement in irrigation technology for conveyance, diversion, and metering; institutional improvement in management of the irrigation systems; and in many cases, development of community organisations to manage water allocation.

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