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in

Hamdy A. (ed.), Lacirignola C. (ed.), Lamaddalena N. (ed.).
Water valuation and cost recovery mechanisms in the developing countries of the Mediterranean region

Bari : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 49

2002
pages 1-16

Water Pricing in Irrigated Agriculture

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ABSTRACT

Access to water is viewed as a basic human right, a social necessity and a critical environmental resource in spite of the fact that water also has its own financial and economic values. Thus, the selection of set prices and pricing mechanisms addressing these contradicting views is remarkably complicated. On the other hand, water pricing is typically viewed as a good means to cover initial costs and sustain resources invested in water systems development, especially irrigated agriculture. Additionally, the cost of water services needs to be reasonable enough and linked to the amount of water consumed to encourage conservation. This paper illustrates criteria for equitable cost sharing, which include economic justification, efficiency and equity as well as users' acceptance. Elements of agricultural water pricing are also discussed. These elements comprise: the cost of water services, which is the total cost associated with irrigated agricultural systems development; the value of water, which reflects water's economic, social, environmental, cultural and religious values in the society; and the cost recovery mechanisms, which are the organizational and administrative measures to implement agreed upon policies to value water and services and make the collections.

Introduction

The argument that water should be treated purely as an economic good originated at the Dublin conference, Ireland, 1992. However, there are several other views regarding the role of water. Access to water is also viewed as a basic human right, a financial obligation, a social necessity and a critical environmental resource. These various views make the selection of a set of prices and pricing mechanism that adequately address all of the views exceptionally difficult.

Water service charges are potentially important and useful, as they are expected to contribute to the recovery of costs from beneficiaries, which

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will relieve the government of a financial burden and provide revenues to support the operation and maintenance of the water supply system. In addition, linking payment to the services should also encourage higher efficiency in both the provision and the use of the resources. In many cases, water pricing is viewed as a key way to improve water allocation and encourage conservation.

Cost recovery and water pricing are topics that present a distinct and perplexing paradox in the management of irrigation projects. In this paper, the issue of water pricing in irrigated agriculture is addressed. The focus is on irrigated agriculture for several reasons. First, it is the largest consumer of water all over the world, accounting for an average of 65% in developed countries and up to nearly 90% in some developing countries. Secondly, policies governing water use in irrigation based on the value of water are controversial. Should water be treated as a purely private good, as a public good or as a basic human need?

Private Sector Participation in Supplying Water Services

Theoretically, market pressures will induce profit-maximizing firms to produce goods and services at minimum costs in order, first, to pay the costs of operations and, secondly, to compete with other firms for sales (revenues). Revenues generated must cover all costs, including returns to the ownership of the firm. Thus, competitive private markets will assure that firms will produce only those goods and services for which consumers will pay a sufficient amount to cover costs, and that those costs will be the minimum required.

In contrast, public managers who are not dependent on returns from sales of the goods and services they produce, focus instead on increasing constituency support and political power through expanded programme budgets. The consumer response to government management is to try to gain benefits from governmental programmes and decisions through political manipulation while avoiding paying a fair share of costs.

While private sector participation (PSP) in water resources usually has a stated goal of achieving economically efficient water provision, it has also frequently been linked to water conservation. PSP in irrigation water supply will serve two main water conservation goals: first, paying for irrigation water services makes consumers aware of scarcity, which should induce more efficient water use, at least from a condition in which water is free; and secondly, water will be provided in a more cost-efficient manner because of the self-interest in reducing costs. However, there are severa l

other aspects or constraints related to designing and/or implementing PSP in irrigation water supply systems.

Having a mix of public and private ownership and operation in irrigation organizations is quite common. The most common examples of these kinds of agencies are irrigation districts, which combine private ownership of capital (or perhaps joint private and public ownership) with at least a portion of revenue generation from general taxes. I distinguish here between payments from water users for water services and payments of taxes by users and non-users alike. Thus, when revenues from water users are insufficient to pay costs, general taxes must make up the difference in order to sustain adequate services.

Purposes of Water Pricing

It should be clear that any water-pricing programme is aimed at legitimate, useful purposes. However, charging users for water and irrigation water services is a sensitive issue in many parts of the world which involves political, historical, social, religious and economic dimensions. Water beneficiaries, especially farmers, tend to believe low or zero charges are justified and this belief is usually reflected in their political system. On the other side of the problem, when direct revenues from a service are low, the probability that the service will be under-funded is correspondingly high. This is due to the fact that the lost production due to improper irrigation and drainage system performance may exceed the cost of proper operation and maintenance. Where this is true, governments may use non-price measures to encourage consumers to use water more efficiently, including transferring management responsibilities to user groups. This has become the favoured way of improving the financial sustainability of irrigation systems in countries such as Madagascar, Tunisia, Pakistan and Egypt, to name a few (Gorriz *et al.*, 1995). There is general agreement that the three primary purposes of water pricing are the sustainability of services, water conservation and the mitigation of damage.

Sustainability of Services

Typically, each nation has invested a tremendous amount of resources in developing the infrastructure that constitutes the water system. The purpose of that infrastructure is to provide water supplies to meet the many needs of society. This includes: potable water supplies for direct human consumption; appropriate water supplies to meet the needs of

industry; and water supplies to meet society's need for food and fiber production, which is provided by agriculture. The infrastructure consists of water supply, delivery and drainage facilities, and the institutional organizations that must manage those facilities. It is absolutely essential that infrastructure, both physical and institutional, is sustained at levels that ensure the continued provision of those services in order to avoid severe hardships on society.

Sustainability of the water supply and delivery system to ensure continued provision of services is accomplished by generating enough funds to cover the administration, operation, maintenance and replacement of water system facilities. The source of such funds is not critical. They could come entirely from the state budget, entirely from the direct water users or from some combination. However, if none comes from the direct water users there will be no incentive to conserve water and use it rationally.

Water Conservation

If the water charges for the sustainability of services are not sufficient to induce the desired level of water conservation, it will be necessary to impose an additional component of water pricing assigned specifically to the water users. That additional charge should be sufficient to encourage water users to practice the desired level of conservation.

Mitigation of Damage

The purpose of this component of water pricing is to provide funding to mitigate or compensate, at least in part, for secondary damage caused by the water use in question. All beneficiaries should share this charge in proportion to the benefits received from the primary water use.

Water Pricing Influence on Irrigation Efficiencies

The relationship between the cost of goods and their market price is well known in economics. Water would be no exception if it were treated as an economic good and sold in a competitive market. However, that is seldom the case. In many cases, irrigation rates do not have a significant impact on irrigation efficiencies because they represent such a small proportion of total production costs. This situation can encourage an over-use of water.

In many cases, the cost of water may be as low or even less than 5% of total production costs. In order for such costs to have a significant impact on water use, they would have to be increased to perhaps double or more- a trend that would be heavily resisted in most countries.

Concerning the measurement of water quantity as a basis for pricing, it has been found that the costs of installation, operation and maintenance of the measuring devices themselves are rather high, which in turn increases the cost of providing water. In many cases, these costs are prohibitive.

There have been different opinions and understandings concerning the terminology and concept of water pricing. Some have suggested that the pricing should be considered as an additional tax or a fee that covers part of the expenses of modernization, operation and maintenance of the irrigation network. Another concept is that the price should be based upon some value of the irrigation water per unit area, per crop or per cubic meter. It should be noted that one or other of these two concepts is used by many of the developing and developed countries for what is called water pricing.

Irrespective of the value set for the irrigation water fee, it is very important to establish a procedure that governs the farmer-government interrelationship in terms of estimating and collecting the fees and ensuring that they are directed towards the improvement and maintenance of the irrigation system.

Controversially, specialists have handled this matter on the basis of the different economic policies and concepts used in each individual case-study. Nevertheless, in order to put into motion any drastic changes or the establishment of any fee for irrigation water, there should be strong political support, particularly in developing countries where irrigated agriculture is an important economic sector.

Since irrigation water pricing is the basis for ensuring proper operation and maintenance, it is necessary to review and assess all operation and maintenance practices before considering a change in policy. This should take place in the framework of acceptable management concepts, which differs from one country to another according to their different social and economic conditions. One alternative for lowering the operation and maintenance costs is to transfer some of the responsibilities to the water users themselves. Another is to design and operate the networks in such a way as to ensure their high efficiency and cost-effectiveness. Egypt is now in the process of doing both through the Irrigation Improvement Programme (IIP), Irrigation Management Transfer (IMT) and Matching Irrigation Supply and Demand (MISD).

The Irrigation Improvement Programme

The IIP was initiated in 1984 (Allam, n.d.). Some of the elements included in that programme are:

- increasing water availability in tertiary conveyances (mesqas);
- improvement of the *mesqa* system by introducing alternative designs to the below-grade *mesqas*;
- establishment of water user associations (WUAs) for each improved *mesqa* and encouraging WUAs to participate in the selection of the alternative *mesqa* designs;
- establishment of the Irrigation Advisory Service (IAS) as a permanent component of the Ministry of Water Resources and Irrigation (MWRI).

Irrigation Management Transfer

IMT, which is a logical extension of the IIP, is a relatively new programme (Agriculture Policy Reform Project, 1999). The IIP utilized WUAs to organize water distribution on the *mesqas* more efficiently. The goal of IMT is to extend participation by WUAs in operation and maintenance to the secondary or branch canal level. In the approximately 30 countries where IMT has been introduced so far, the types of reported. impacts include:

- an overall reduction in the cost of irrigation;
- enhanced financial self-reliance of irrigation schemes;
- expansion of service areas;
- greater irrigation water efficiencies;
- higher-quality services to end-users;
- increases in cropping intensity and yields.

Four pilot branch canal areas have been selected to demonstrate the effectiveness of the programme. The private sector entities (WUAs, private irrigation companies, co-operatives and shareholder enterprises) will assume managerial control, but not ownership, over the physical infrastructure and its operations. It is intended that some management transfers will be accompanied by physical rehabilitation of the systems being transferred. The intention is that these private entities will be financially autonomous, within parameters established by enabling statutes or decrees, and will be able to hire or contract out for technical operational and management services. The management transfer may be partial, incremental or total, depending on the capability and willingness of the private entity.

An additional advantage of both the UP and IMT stems from the farmers' feeling of commitment to the efficient operation and maintenance of the system. Participation in operation and maintenance provides them with a sense of ownership and greater direct responsibility for the effectiveness of the delivery system.

The farmers' responsibility in managing part of the network necessitates the precise determination of their duties and rights. A worthwhile consideration is to have them participate in water management decision making that affects them, such as the valuation of services and the collection of fees.

Matching Irrigation Supply and Demand

Prior to the liberalization of agriculture, the MWRI delivered water to farmers on the basis of a cropping pattern and calendar that were determined by the Ministry of Agriculture and Land Reclamation (MALR). However, liberalization and free choice for farmers have resulted in much more uncertainty about actual irrigation water demands. Cases of significant mismatches have occurred, where large amount s of water were delivered, but not used. Sometimes water was not available to farmers when needed and agricultural production was reduced. Accurately estimating crop water demands under liberalized cropping choices in a timely manner and conveying that information to the MWRI has been identified as a major contributor to the mismatch in supply and demand.

The objective of this programme is for the MALR and the MWRI to jointly develop a systematic, coordinated system of routine real-time information transfer on actual irrigation water demands and supplies. Due to the lag in time between the release of water from storage and the delivery to the farmer (which may be up to 2 weeks), the most critical periods for this information exchange are during land preparation and planting.

Criteria for Equitable Cost Sharing

A sound theoretical rationale for sharing the costs of creating, operating and maintaining a water system relies on the satisfaction of criteria for economic justification, economic efficiency and economic equity. In addition, cost sharing must be acceptable by the water users.

Economic justification

Economic justification is attained when economic benefits, to whomsoever they accrue, are greater than economic costs. This is normally determined in a planning setting by feasibility studies. The standard criteria for justification are: the benefit-cost ratio must be greater than 1; the net present value must be greater than zero; or the internal rate of return must be greater than the opportunity cost of capital.

The 'to whomsoever they accrue' phrase indicates that this criterion is from a national perspective with no consideration of equity. In other words, it does not matter who receives the benefits as long as they materialize within the national economy. In addition, it says nothing about who pays the costs. This criterion assures that there are enough benefits somewhere in the economy to cover the costs. However, it leaves open the possibility of the very inequitable situation where one group receives all of the benefits while another group incurs all of the costs. Therefore, economic justification is a necessary condition for devising an equitable cost recovery scheme, but it is not a sufficient condition.

Economic Efficiency

An allocation of resources is efficient in economic terms if it is not possible to increase the welfare of one individual without decreasing the welfare of at least one other individual. This is a static equilibrium condition that in a dynamic economy is never attained, but a free market economy is always driven in that direction. Therefore, rather than dealing with a single static optimum, resource development usually deals with the comparison of at least two different allocations of resources.

The question is whether a proposed reallocation of resources, such as an irrigation system improvement, is preferred economically to the present allocation and that there is not an economically less costly way of accomplishing the same things. The economic efficiency criterion identifies the alternative that is the most economically efficient out of all of the alternatives being considered to accomplish the goals. This is usually identified during the plan formulation phase of feasibility studies. In an ex post setting where the system has already been constructed, this criterion loses its significance.

It should be noted that economic efficiency begins to introduce a concern for equity that was missing in economic justification, in the specification that the increase in welfare of one individual should not be at the expense of another. However, this still allows for the possibility that

one group or individual could gain all of the benefit as long as no one else ends up with a loss. This is a movement in the right direction, but it is not sufficient to provide a foundation for a cost recovery scheme that shares costs in proportion to benefits. In the view of those parties sharing costs but realizing no net gain, it would not be economically equitable and, therefore, would probably not be acceptable to them even though it caused them no net burden.

Economic Equity

The economic concept of equity is defined as a condition in which costs are commensurate with the benefits. That is, all beneficiaries share in the costs in proportion to the net benefits that they receive. This eliminates the possibility of one person or group realizing all of the gain or even a disproportionate share, which was possible if only the economic justification and economic efficiency criteria were satisfied. In summary, the satisfaction of the economic justification criterion assures that there are enough benefits generated somewhere in the economy to cover all of the costs. The economic efficiency criterion assures that of the alternatives considered, the most economically efficient one will be selected. In addition, the economic equity criterion requires that costs will be allocated in proportion to benefits received. If all of these conditions are met, fair assessments should be acceptable to the water users.

Acceptability

For any water pricing policy to succeed, it must be acceptable to the water users. As stated above, if the economic justification, efficiency and equity conditions are met, water users should be willing to pay fair assessments. This is a sound theoretical presumption, but it does not necessarily reflect the more practical view of water users. Water users in general do not know whether or not there is economic justification, efficiency or equity. What they do know is what they observe, and what they observe is whether or not they receive an adequate water supply, at the places where it is needed and at the times it is needed. If they do not receive such supplies of water, they generally will not be willing to pay. In order for water users to view any water pricing policy as being acceptable, they must feel that they are receiving a reliable service for the prices paid and that the prices paid are clearly understood to represent no more than cost of services rendered. Therefore, it is incumbent upon water supply managers to deliver water supplies, however limited, on a predictable and

efficient basis. To do that, the water supply and delivery system must be in a good operational condition.

Elements of Water Pricing

Cost of Water Services

The total costs associated with irrigation form an upper ceiling on the amount for which recovery is sought, since recovery beyond this amount is more properly considered as general revenue. The costs to be considered involve many categories, including design, construction, operation, maintenance and the cost of revenue collection. In few, if any countries do the direct beneficiaries incur all of these costs except in smaller, totally private systems. In the Philippines farmers are required to pledge 10% of the cost of construction of small communal systems in cash, kind and labour contributions before construction can begin- In China, elaborate systems are employed to mobilize local labour for the construction and rehabilitation of both large and small irrigation facilities. This labour is either donated or paid low market rates (Svendsen, 1995).

However, one should be careful about estimating the costs to be recovered by the direct water users. In India, it is estimated that actual irrigation development costs are typically greater than those estimated at appraisal by a factor of 2 and that a significant portion of these overruns is attributed to private financial leakages. In such cases, it would be advisable to introduce some sort of discounting rate for direct water users, with the rest to be recovered from the general public.

At the present time, even though some projects are partly funded, it is often difficult to justify them economically, at least according to conventional economic criteria. In such cases governments may continue to subsidize the projects for several reasons, e.g. enhancing national security, maintaining political stability, decreasing population density in certain sensitive geographical regions and conserving water. Such subsidy may occur as a transfer of resources from one group of society to another to improve a certain imbalance. Many scholars see such transfers as subsidies that should be avoided whenever possible. However, it is difficult to determine all beneficiaries that gain from irrigation modernization projects and how much they gain, even if the modifications are restricted to the on-farm improvements. It is possible that such transfers could represent cost sharing by the general public for unpriced benefits in the form of enhanced national security and lower food prices, to name two. Consequently, part of the costs should be recovered from the most direct

beneficiaries, and the balance should be recovered from the general public by a broadly based water fee.

Another justification for governments to share in the cost, especially in the initial stage of project execution for national irrigation improvement projects, is that in most cases these projects are typically designed in a highly complex and very expensive manner. It may take a considerable time before they finally become cost-effective. In addition, delays in the scheduling of project execution may lead to additional, unnecessary costs, and it would be unreasonable to charge farmers for such additional project costs.

Cost elements of irrigation service projects could be estimated with no major conflict or disagreement on the procedure of cost calculations if the process is transparent and provides for private sector participation.

Value of Water

Central to the idea of the economically efficient use of inputs is the notion that a producer will use a purchased input until it costs more than it earns for him, and will then buy and use no more. Water serves many different objectives and has properties that make it both a private and a public good. The value of water should reflect the economic, social, environmental, cultural and religious values of society. If water were to be treated as a pure private good in a competitive market, then, if the poor could not pay as much for a unit of water as the rich, they would get less water even if the marginal value to them in terms of the other values was greater. For the other side, where water is treated as a public good, safe water is a basic human right and need that should be available at reasonable levels to everyone. The dilemma is basically whether it is a private good that can reasonably be left to free market forces, or a public good that requires some amount of extra-market management to meet social objectives effectively and efficiently.

While environmentalists and ecologists believe that water serves important environmental, ecological and aesthetic functions and should not be transferred from one use to the other on the basis of financial interest only (Perry *et al.*, 1997), the benefits of irrigation water availability have been lower food prices for all consumers, higher employment and more rapid agricultural and economic development. Water used for agriculture is portrayed as a powerful means of reducing food costs to the general public: therefore, the general public should participate in sharing the cost of developing and sustaining the water system.

However, irrigation water development can also cause social and environmental problems. These include soil degradation through salinity, the pollution of aquifers by increased use of agricultural chemicals, the loss of wildlife habitat and the enforced resettlement of those previously living in areas submerged by reservoirs. Environmentalists have focused their attack on large dam projects such as the Narmada project in India and the Three Gorges dam in China. There are valid arguments to support the views of both the promoters and the detractors. The long-term, diverse and complex nature of water developments, and the value of water, which differs from one place to another and even over time, makes it especially hard to balance these views within a simple cost-benefit framework. However, rational alternatives to both extremes exist and must be adapted (Seckler *et al.*, 1998).

- In setting water charges /prices /cost recovery, the price level should be such that:
- it will ensure efficient water and lead to water conservation;
- it will ensure an adequate return to fully cover operation and maintenance and to cover capital cost to the extent possible;
- it will be within the capacity of the farmers to pay;
- it will reduce the burden on the general taxpayer;
- it will be simple to administer;
- it will be consistent with the socio-economic development policy of the country;
- it is agreeable to all stakeholders (Emam & Elassiuti, 1987).

One should recognize that the relevance and importance of values and facts can vary substantially over different conditions of time and place. Each country is at liberty to decide upon the value of water and to establish terms that best serve its cultural setting.

Cost Recovery Mechanisms

Cost recovery mechanisms are organizational and administrative measures for carrying out agreed policies for assessing the liability for water system costs and for making the collections. The principles and criteria identified earlier provide a basis for examining different cost recovery mechanisms. Administrative considerations are important, particularly with respect to the ease with which the different mechanisms can be administered, but more important is the ability of the administrative processes to maintain the intended equity.

This section deals with the advantages and disadvantages of methods for assessing charges that are applied throughout the world, with some case-by-case variation. These methods include:

- fees according to the volume of water delivered; the fee might also vary by season;
- fees according to the area served;
- crop-based pricing.

Volumetric Pricing

This method is usually the one preferred by economists, since it is the one that offers the best opportunity for obtaining economic efficiency and encouraging conservation. Pricing water according to the quantity used makes water users give strong consideration to the cost of water as a factor in how much is used. This leads to the more efficient use of water. Often a major problem with this approach in many developing countries is that there is no practical way to measure and monitor the diversion of water from the distribution system to the user. Both infrastructure and administration costs can be very high. This might be an important reason for the widespread use of area pricing.

Area-based Pricing

This approach involves pricing water according to the locations of areas served, with minimal control of the amount of water supplied. If any semblance of efficiency and equity is to be achieved, this approach must be considered in the light of the delivery system and the ability to control the amount of water diverted to users in different parts of each area. Especially in times of water shortage, there is a need to limit the amount of water each user can obtain. Control in an irrigation scheme that uses area-based assessments is usually achieved through arrangements among farmers to alternate in skipping a turn or to cut back on the time allowed to receive water. Equity depends upon farmers' discipline in adhering to the control schedules.

Many countries do not generally adjust charges by region, even though the costs of supplying water may vary greatly across regions. However, there are very few, if any, large, publicly operated irrigation systems in the world that can deliver water uniformly to all parts of a large service area without incurring a great deal of cost. This creates a dilemma. If the costs are incurred to ensure equal water delivery to distant points, the equity criterion suggests that these added costs should be assessed for the distant farmers.

Crop-based Pricing

Crop-based water pricing sets prices for each crop on the basis of the crop water requirements. This mechanism is not as easy to administer as the area-based method, but it does have some of the effects of volumetric pricing in that an element of efficiency can be introduced by inducing shifts in cropping patterns towards more water-efficient crops.

A flat rate cost recovery mechanism is relatively easy to apply, but it will not satisfy the purpose of increasing water use efficiency and will not encourage conservation.

Cases of true volumetric delivery of irrigation by public agencies in the developing world are extremely rare. On the other hand, it is also uncommon to find water delivered by publicly managed systems for a flat fee that is constant for all users. In practice, pricing mechanisms fall between these endpoints on a continuum that ranges between metered and flat rate services. The application of a nominal flat rate schedule is usually based on the area irrigated. Subsequently, crop type, season and source of water (e.g. pumped or gravity) may be taken into account. There also may be special discounts or exemptions granted for crop failure due to natural disasters. In some cases, discounted rates are applied to encourage the creation of water user organizations.

A necessary condition for functionally linking the collection of irrigation service costs and effective irrigation performance under these circumstances is that the agency involved in providing the service must be financially autonomous. Financial autonomy is defined as a condition where (1) the irrigation agency must rely on user charges for a significant portion of the resources used for operation and maintenance and (2) the agency has expenditure control over the use of the funds generated from these charges (Abu-Zeid, 1995).

When financial autonomy is present, several incentive forces come into play, which are otherwise absent. First, there is incentive to increase agency income. Increased income implies the maintenance of jobs, higher salaries, incentive payments, greater staff mobility, new vehicles, quarters and facilities and the like. If fees are levied on an area basis, this means that the irrigation agency has a strong vested interest in expanding the area receiving an adequate irrigation service, increasing fee collection rates, increasing the value of agricultural output per unit of water (e.g. avoiding system failures during the irrigation season, and minimizing missed irrigations) and increasing farm incomes (to increase ability to pay). Secondly, there is an incentive to reduce costs.

Working together, these two motives generate a demand for better agency relations with cultivators, greater accuracy in information collection and record keeping, new technology to manage information more effectively, better water control and greater farmer involvement in system maintenance and fee collection. Thus, the incentive for greater efficiency in resource use made possible in a context of financial autonomy affects the providers of irrigation services at least as powerfully as the consumers of those services. Overall, a relationship of mutual dependency is established between the two, whereby the agency provides an essential service to farmers, and farmers, in turn, provide the agency with the financial resources it needs to operate. This relationship of mutual dependence and accountability is at the heart of an effectively managed irrigation system.

While it is vital to establish mechanisms to enable cost recovery, the needs of the poor have to be protected. It is the responsibility of government to provide that protection. When subsidies need to be provided, it should be done in a transparent manner. Therefore, it is up to governments in co-ordination with major stakeholders to choose the proper mechanisms to provide the funds necessary for sustaining the system and meeting the needs of the poor.

Conclusions

In general, the pricing of irrigation water involves three things.

- The cost of the water system infrastructure (dams, canals, water pipes and drainage facilities, etc.) and the cost of operating and maintaining that system at a level that will assure sustainable services.
- The value of the water service should reflect the economic, social, environmental, cultural and religious values of society. Each country is at liberty to decide upon the value of water and to establish terms that best serve its cultural setting.
- While it is vital to establish mechanisms to enable cost recovery, the needs of the poor have to be protected. Providing that protection is a government responsibility. When subsidies need to be provided, it should be done in a transparent manner. Therefore, it is up to governments, in co-operation with major stakeholders, to choose the proper mechanisms to provide the funds necessary for sustaining the system and meeting the needs of the poor.

References

Abu-Zeid, M. (1995) Recovery of irrigation costs through water charges, advanced short course on 'Farm water management: socio-economic and environmental aspects', Faculty of Agriculture, University of Cukurova, Adana, Turkey, 4-18 June.

Agriculture Policy Reform Project (1999) *Water Policy Tranche IV Benchmark Work Plan*, Report No. 24, Ministry of Water Resources and Irrigation/USAID.

Allam, M.N. (n.d.) *Analysis of Surface Irrigation Improvement in Egypt.*

Dinar, A. & Subramanian, A. (1997) *Water Pricing Experiences: An International Perspective*, World Bank Technical Paper No. 386 (Washington, DC, World Bank).

Emam, E.H. & Elassiuti, 1. (1987) Pricing of irrigation water in Egypt: fulfillment of objectives, in: *Proceedings of the 6th ICID-Afro-Asian Regional Conference, Water Management in Arid and Semi-Arid Areas*, Vol. II (Cairo, The International Commission on Irrigation and Drainage).

Gorriz, C., Subramanian, A. & Simas, J. (1995) *Irrigation Management Transfer in Mexico: Process and Progress*, Water Bank Technical Paper No. 292 (Washington, DC, World Bank).

Perry, C.J., Rock, M. & Seckier, D. (1997) *Water as an Economic Good: A Solution, or a Problem?*, Research Report No. 14 (Colombo, International Irrigation Management Institute).

Seckler, D., Amarasinghe, U., Molden, D., Silva, R. de & Barker, R. (1998) *Water Demand and Supply, 1990 to 2025: Scenarios and Issues*, Research Report No. 19 (Colombo, International Irrigation Management Institute).

Svendsen, M. (1995) Recovery of irrigation costs through water charges, paper presented at workshop on Irrigation Service Cost Recovery, International Irrigation Management Institute, Alexandria, Egypt.