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ISN-49551

ECONOMIC REPORT

ECONOMIC REPORT ER87-2 JANUARY 1987

INADEQUATE MANAGEMENT AND DECLINING INFRASTRUCTURE: THE CRITICAL RECURRING COST PROBLEM FACING IRRIGATION IN ASIA

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Economic Report ER87-2

January 1987

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Preface

This study was commissioned by the Technical Resources Office of the Asia Bureau of USAID and contracted under Water Management Synthesis II (CID/AID-DAN-4127-C-00-2086-00). The report includes a synthesis of four studies done by local consultants in four Asian countries. Each study was done through the country USAID mission. The studies in Sri Lanka, Nepal and the Philippines were country wide studies focussing primarily on government irrigation systems. The study in India was restricted to government projects in the State of Maharashtra. A previously prepared study for Pakistan was also utilized.

The author would like to thank Leslie Small, Norman Uphoff, Mark Svendsen, Doug Merrey, L.S. Cabanilla, Tek Bahadur Shrestha, A.T.M. Silva, Jagannathrao R. Pawar, John Dixon and Maynard Hufschmidt for their helpful comments on earlier drafts. Special thanks goes to Robert Westgate who took the lead in putting together the review of literature which is presented in the appendix. The final content of the report is my responsibility and does not represent the views of USAID or Water Management Synthesis II.

INADEQUATE MANAGEMENT AND DECLINING INFRASTRUCTURE: THE CRITICAL RECURRING COST PROBLEM FACING IRRIGATION IN ASIA

This report reviews the recurring costs situation for irrigation in Asia. These are the costs associated with project operation and maintenance (O&M).[1] As is well documented in the literature many developing countries have neglected project O&M which has resulted in a rapid depreciation of past irrigation investments (Carruthers, 1981). Irrigation systems fail to irrigate their planned or projected command areas and after a few years parts of the systems no longer function (Wade, 1975). The problem is that there are too few farmer or government agency incentives which foster investment of capital and human resources in O&M and assure that irrigation projects operate at a high level of performance over a long period of time. For example, there is a lack of accountability for O&M because of the weak linkage between those providing O&M and those benefitting from O&M.

> "Concern with O&M is not a new issue, and indeed there are precedents in provision of resources to sustain O&M. The new dimension is the apparent scale of the problem and the likely trend. Unease with the scale of deficit operating performance of irrigation schemes

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[1]Operation and maintenance includes the management of water supplies and the upkeep of system facilities from the water source to the farmers' fields. Recurrent costs mean the cost of operation and maintenance of the irrigation system. Operation means the allocation and delivery of water supplies, including the management of any storage facilities, and handling of drainage runoff. Maintenance is the upkeep of irrigation and drainage structures, embankments, dams, outlets, and channels and the removal of silt and vegetation from canals and storage facilities.

> stems from a variety of sources. With the World Bank experience, some indications of the problem come from observations and reports of field investigators at appraisal, supervision and completion phases. Tangible evidence of general need comes from the increasing number of rehabilitation projects being implemented in countries as diverse as Mexico, Nepal and Indonesia" (Carruthers, 1981, p. 53).

To provide a good overview of the problem of recurrent costs, this report is divided into six major sections and an appendix reviewing the literature. First is a discussion of the conceptual water management model used in the study. Second is a discussion of how the water management model is applied to operation and maintenance problems. Third, the water fee collection policies are summarized for the four study areas: Nepal, Sri Lanka, India and the Philippines. Fourth, the four countries are evaluated concerning their performance in dealing with the problems of recurring irrigation costs. The individual consulting reports, on which sections three and four are based, are of uneven quality but do provide a basis for comparing the four countries. However, in terms of irrigation fee collections the record in Nepal and Sri Lanka is quite limited due to the lack of experience. For example, Sri Lanka had just recently launched a major effort to improve collections for irrigation O&M and it was too early to draw any solid conclusion concerning this effort. The India study was also limited by the fact that time and funding restricted it to the large central state of Maharashtra.

Fifth, the alternatives available for increasing investment in O&M are reviewed in the context of the four countries studied. Finally, the criteria for setting water fees are suggested and the problems associated with charging a uniform fee across all projects are highlighted.

WATER MANAGEMENT MODEL

One of the problems associated with providing adequate O&M is the absence of a whole system perception. There is a failure to perceive the vital nature of O&M in the success of a project. Consequently, a conceptual model was adopted for this study which takes a whole system approach. It is based on a water management model developed by Bower and Hufschmidt (1984) which includes three major components: (1) a management process involving five stages, (2) a water management system with three elements and (3) a set of linked activities and tasks. Each component provides different insights into water management problems. For the problem of recurring costs certain parts of the model will be of particular importance.

Management Process

In the first component water management is a process including various stages starting with planning and ending with operation and maintenance (Figure 1). For this report the primary concern is the last stages of operation and maintenance (O&M). It is in these last stages that recurring costs are important. Yet the difficulty involved in providing adequate O&M

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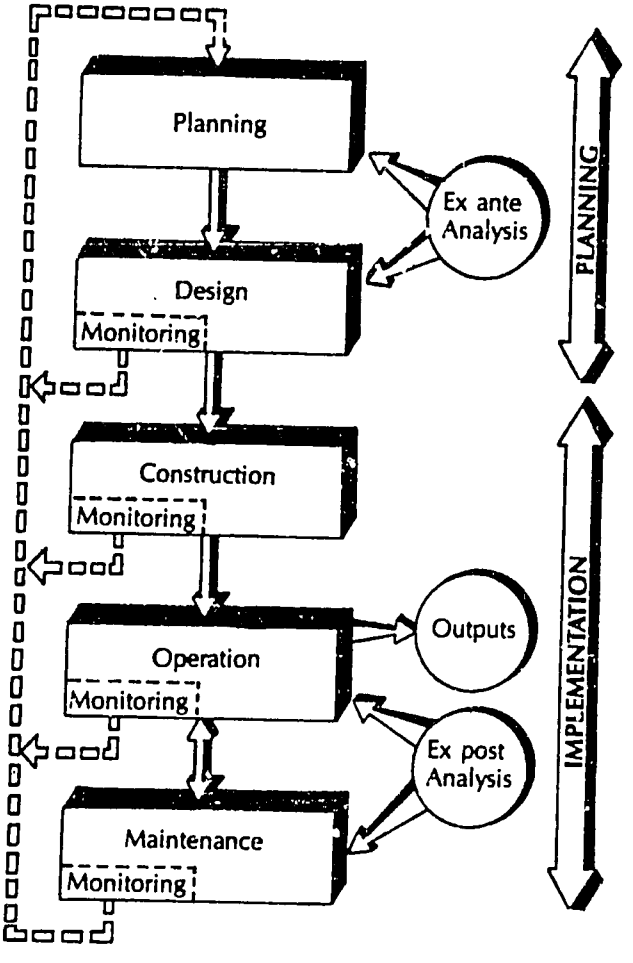


Source: Adapted from Bower and Hufschmidt (1984)

FIGURE 1. The Five Stages of Irrigation Management Process

is dependent on the project design and how well the project is constructed. A well designed and constructed project will require much less effort in O&M to achieve the same level of irrigation efficiency than one which is poorly designed or constructed.

As Carruthers (1981) points out, O&M problems may even start at the planning stage:

> "Many problems with O&M might be traced back to the project planning stage. In principle project appraisal examines the technical, economic, financial, organizational, managerial and operational aspects of the plan. Each of these aspects is not treated equally in relation to O&M and sufficient disaggregated detail of working procedures is seldom provided. The emphasis of appraisal reports is at present mainly upon technical, economic and financial aspects of projects. Indeed, it is also the technical, economic and financial aspects of the initial works which receive most consideration" (p. 56).

Another important characteristic of this management process is that the planning and design work can be more easily done at the central offices located in the major cities such as New Delhi, Bangkok, and Dhaka. In contrast, the operation and maintenance of irrigation systems takes place in rural areas. This means that the better educated and trained people who prefer to locate in the major cities are usually involved in planning and design. Yet in many cases, they do not get the local input so necessary to make the plans and designs fit local conditions. For operation and maintenance work, particularly maintenance, the younger and less experienced people generally get the job. They have to live in the remote areas and often spend a good bit of

their time trying to get back to the major urban areas. Thus, in general, the plans and designs are technically very well done but do not necessarily fit local conditions, while operation and maintenance are done in the local areas but do not receive the same attention and resources.

The same problem shows up in the budget. The planning, design and construction stages are well funded, often by donors, while inadequate funds are allocated for O&M. When the construction budget is cut to reduce project costs the impacts these cuts will have on increasing future O&M costs are usually ignored.

This situation is complicated by the fact that in many Asian countries O&M is done

> "by an organization whose primary function has been construction. That is why few of the professional staff on a particular canal will have had much prior experience of O&M. It is also why they are not especially interested in O&M: because (a) the O&M budget will be a tiny part of the overall Irrigation Department budget, so its allocation and scrutiny will be given little attention; (b) professional reputation will be anchored firmly in construction; and because (c) they will tend to behave, while doing O&M work, in the top-down hierarchical control mode appropriate for construction but inappropriate for O&M" (Wade 1985a, p. 7).

Finally, once feasibility studies are completed, project planners tend to lose interest in evaluation. This means that project managers generally lack an effective reporting or monitoring system which could be used to suggest needed changes in O&M. This lack of data, including who gets water and what crops are produced, also makes it very difficult to set up a

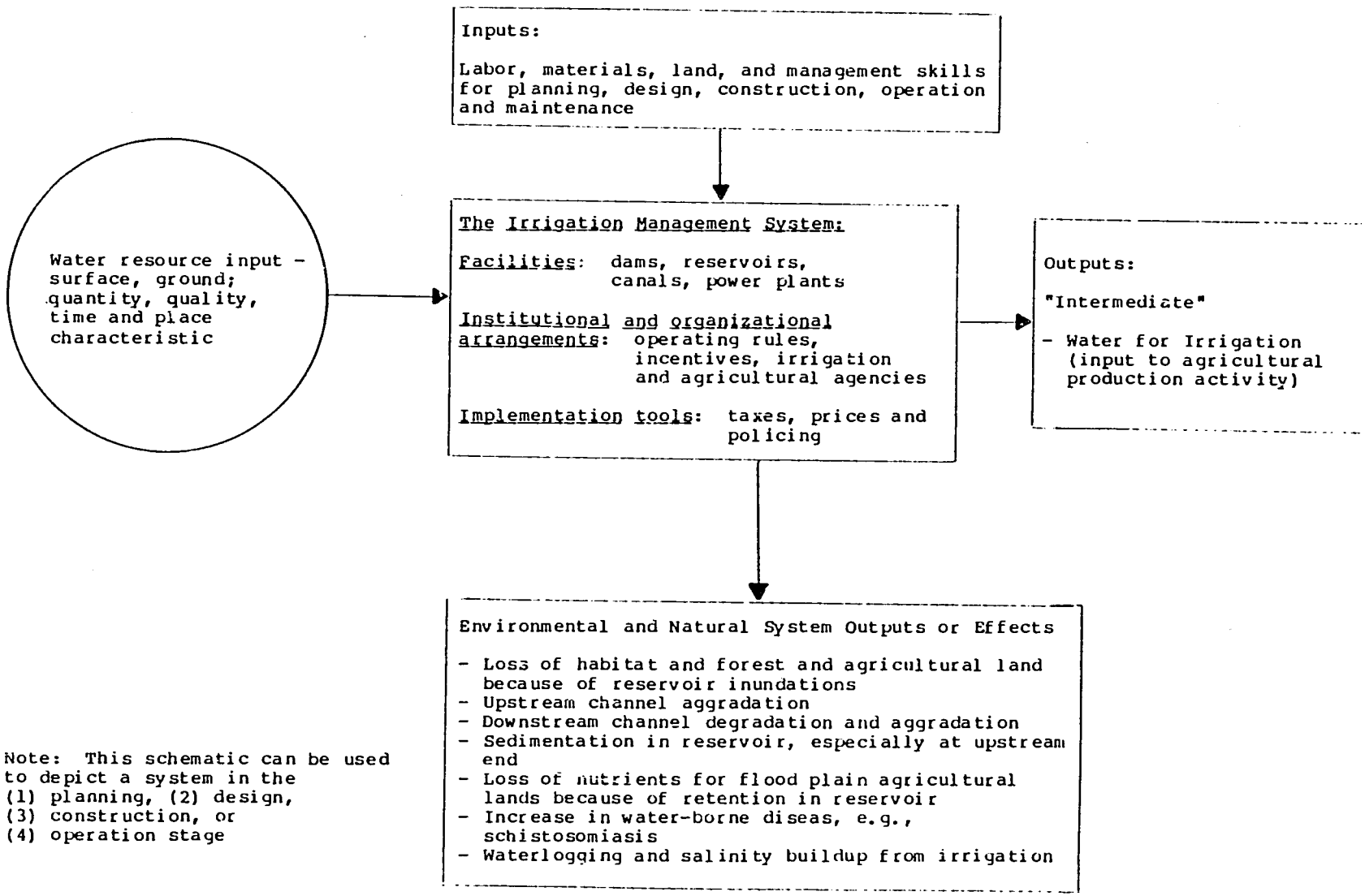
system for collecting water fees or charges. If a government wants to collect water fees from farmers who receive irrigation water from a project, then one basic requirement is an accurate information system which identifies those who actually receive adequate irrigation water.

Water Management System

The second facet of the model involves water management as a system which includes a set of facilities, implementation tools and institutional and organizational arrangements which are used to capture and deliver water to farmers (Figure 2). The system requires inputs of labor, materials, land and management skills which along with the irrigation facilities, institutions, organizations and implementation tools are used to provide the desired output of water. If the system is managed efficiently water is delivered at the time and in the quantity which produces optimum agricultural production with minimal adverse environmental effects.

In terms of the water management system the institutional and organizational arrangements and implementation tools are just as important as the physical parts of the irrigation system. The rules and incentives which govern the collection of irrigation water charges and/or the provision of farmer labor for system maintenance are of central concern for O&M. For example, can institutions be designed to direct the rent-seeking incentives of farmers towards the improvement of the whole irrigation system? A related concern are the incentives of the government agency

FIGURE 2. Irrigation Management System with Inputs and Outputs



Note: This schematic can be used to depict a system in the (1) planning, (2) design, (3) construction, or (4) operation stage

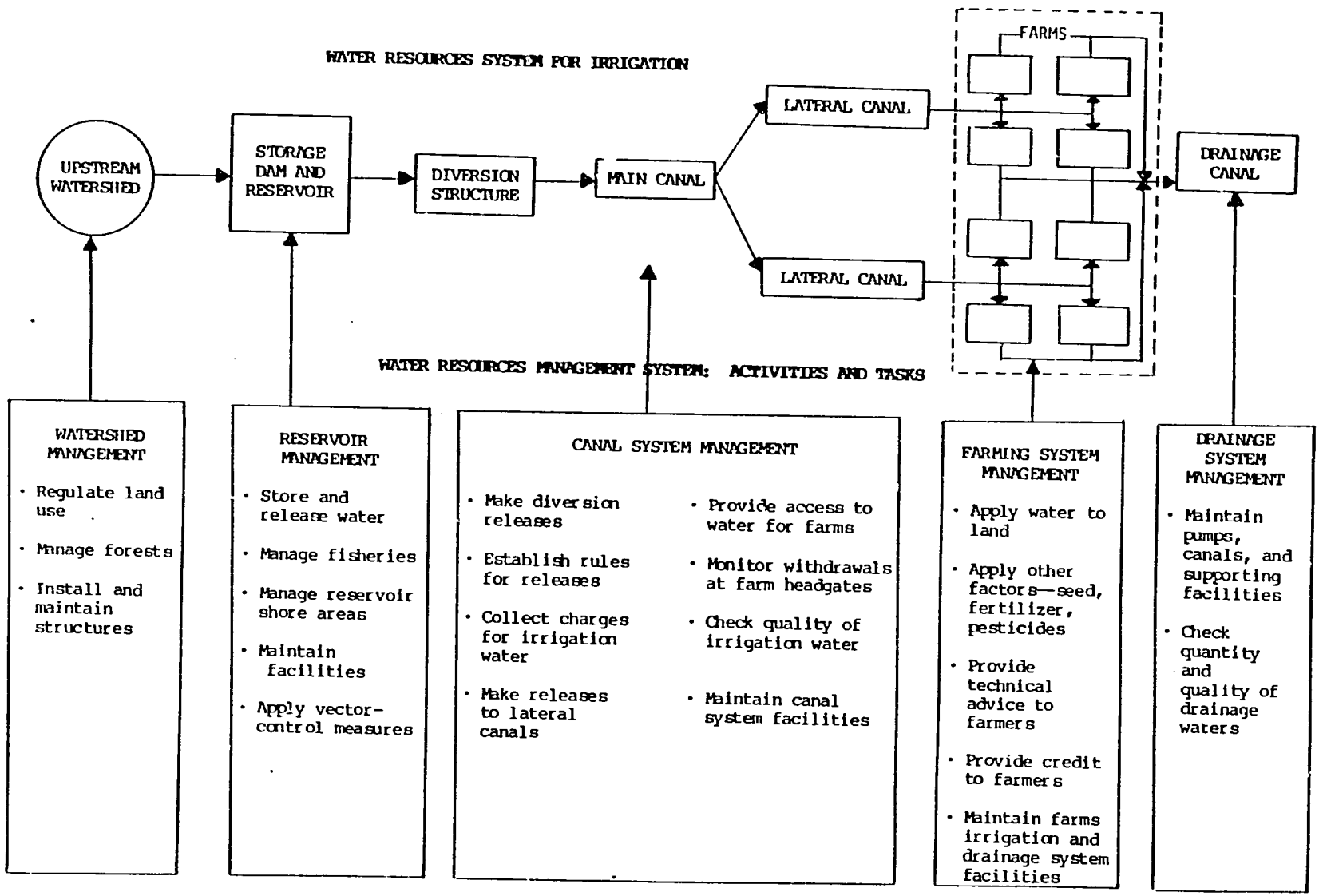
Adapted from Bower and Hufschmidt (1984)

and/or farmer groups which are involved or should be involved in activities related to operating and maintaining the system and in collecting fees. Implementation tools must include mechanism to influence the incentives of bureaucrats and system operators as well as farmers. One possibility is to base system evaluation and staff promotion on the quantity and timing of water delivered to the end of the canal system.

Activities and Tasks

The third component of the water management model involves a set of linked activities and tasks which are necessary for water delivery. Water management is subdivided into specific steps which government agencies, farmer organizations or individual farmers must perform if the desired outputs are to be obtained. One can visualize a surface water irrigation system as beginning with a watershed from which water is collected in a storage reservoir (Figure 3). The water is then taken through canals and delivered to farmers' fields. Finally, there is a system of drainage canals which drain off excess water. With each of the components of this simplified system activities and tasks are required to assure effective delivery of water. For example, to operate the canal system effectively rules and enforcement procedures must be established to allocate water among different parts of the system and dates must be set for water release and shut-off. Incentives and assurances need to be designed to elicit cooperative behavior from farmers.

Figure 3. Water Resources Management Activities and Tasks for a Surface Water Irrigation System



SOURCE: Bower and Hufschmidt (1984)

OPERATION AND MAINTENANCE

The focus of this study is on the last part of the water management process: operation and maintenance (O&M) (Figure 1). In addition, watershed management is left out so that the emphasis is on the last four major management activities: reservoir, river or aquifer management, canal management, farming system management and drainage system management. The watershed is excluded because to include it would require a more complex analysis (Easter and Hufschmidt, 1985). However, the importance of the watershed in irrigation is becoming painfully evident as reservoirs silt up at alarming rates. For example, extreme watershed deterioration, above run-of-the-river irrigation systems in countries such as Haiti, is the major cause of their maintenance problems.

The model has also been simplified by leaving out any specific reference to markets or transportation. This is another key part of the "total" irrigation system. Without adequate transportation for products and inputs, and markets in which to sell products, prices will not match expectations. The increased output will greatly depress prices and the net project benefits will be low. This means that the ability of farmers to pay for water will be low and collections will be low. Thus provisions must be made for adequate markets and transportation if the irrigated farmers are to sell their increased production at reasonable prices and inputs are to reach farmers at the appropriate times. Otherwise project benefits should be reduced

in the project evaluation to reflect the lower level of benefits that will be obtained in the project.

For analysis of irrigation problems it is important to be able to link the analytical framework to the specific problems (Figure 4). Here the irrigation problem is shown as being due to deficiencies in operation and/or maintenance. These deficiencies are identified by examining the specific activities and tasks involved with operating and maintaining the system. These various activities and tasks are examined to determine which element of the management system is inadequate (facilities, institutional and organizational arrangements, or implementation tools). Should the emphasis be on building new or improved institutions or should it be on altering the implementation tools or both? The first job is to make a list of problems or issues which are related to recurring costs of irrigation (Table 1).

For each problem, the activities or tasks involved and the implications for facilities, institutions, organizations and implementation tools must be specified. This, however, is not an easy task since problems involved with recurring costs of irrigation tend to be interrelated. For example, inadequate maintenance and lack of farmer participation causes inefficient water deliveries. In turn inefficient deliveries discourage payment of fees which will reduce funds available for maintenance (Philippine Report, p. 38). Thus one must try to deal with a whole set of problems. For example, obtaining farmer participation in project maintenance is going to be difficult

FIGURE 4. Linkages of Irrigation Problems to Operation and Maintenance and the Irrigation Management System

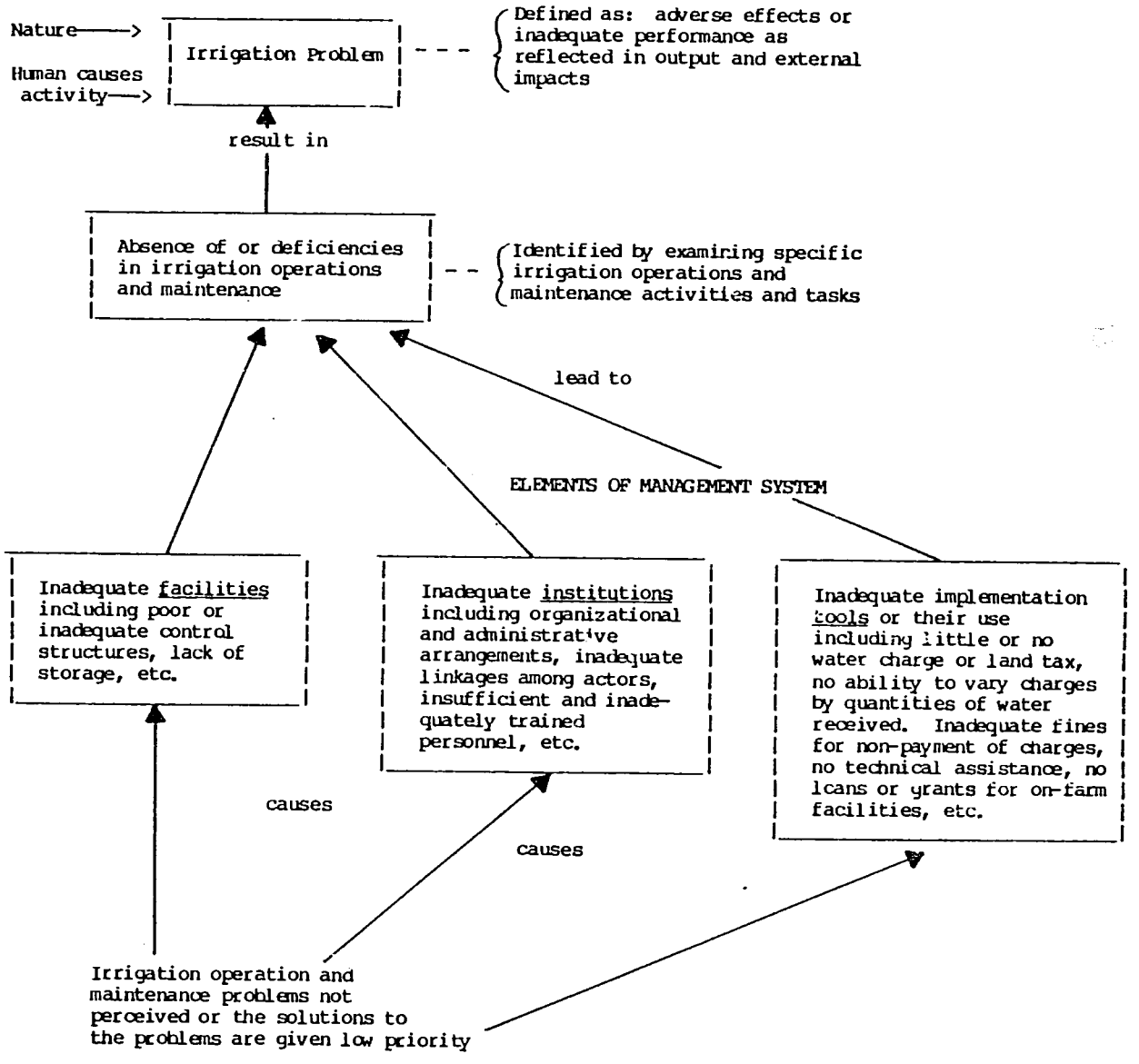


TABLE 1. Issues Associated with the Reoccurring Costs and O & M of Irrigation Projects by Country, 1984

ISSUE	Country			
	Nepal	Sri Lanka	Philippines	Maharashtra (India)
A. Institutional and Organizational Arrangements				
1. Link between fees and funds allocated for O & M	No	After 1984	In communal projects	No
2. High priority for efficient water use	No	Starting 1978-79	Yes	Yes
2. High priority given to maintenance	No	changing	improving	improving
2. High priority given to fee collection	No	Starting 1983-84	Yes	Yes
3. Encourage high farmer participation	No	Yes	Starting 1976	No
3. Good communication among farmers and irrigation officials	No	No	With active WUO	N.C.
4. Uncertain water and land rights	N.C.	N.C.	No	No
5. Adequate organization for fee collection and O & M	No	No	Yes	Yes
5. Clear responsibility for O & M	No	No	improving	Yes[2/]
B. Facilities and Inputs				
1. New projects take resources away from O & M	Yes	N.C.	1/	N.C.
1. Adequate funds and trained staff for O & M	No	No	No	N.C.
2. Adequate project design and/or construction	No	No	No	No
C. Implementation Tools				
1. Adequate data on area irrigated and crops grown by farm	No	No	Most cases	N.C.
2. Penalties for non-payment of fees	not enforced	starting 1984	Yes	Yes
2. Incentive for high rates of collection	No	No	Yes	No
3. Penalties on those not maintaining the project	No	No	In communal projects	Some

N.C. = Not clear from country reports.

1/NIA is considering a shift in its program to emphasize O & M and de-emphasize new construction.
2/Management wing of the Irrigation Department has O & M responsibility for medium and large scale systems above the outlet.

unless there is some assurance that all farmers will contribute. In addition, rules may have to be developed so that water can be delivered effectively to farmers before they are going to be willing to pay fees which can be used for maintenance. They may also have to be shown that these funds will be used to improve and maintain the system (accountability) before they are willing to pay water charges. Finally, if farmers are expected to take over a government irrigation system and do the O&M themselves, they may require it to be in good condition (Philippine Report, p. 40). Therefore, a system may have to be rehabilitated or plans made for rehabilitation before farmers are willing to take over the O&M.

These interrelated problems are just part of the syndrome of anarchy which grows out of and is reinforced by a lack of confidence on both sides.

> "The farmers' lack the confidence that if they refrain from taking water out of turn (from stealing it, breaking the structures, bribing the officials) they will nonetheless get water on time. The officials, for their part, lack the confidence that if they do work conscientiously to get the water on time, farmers will refrain from rule-breaking. It is a 'syndrome' in that the behavior of each party to the relationship now tends to confirm the negative expectations held by the other. Each is the other's headache.
>
> "Breaking this syndrome has to be done primarily from the <u>government</u> side, by means of a sustained demonstration of the ability to deliver reliable and expected amounts of water if the farmers do not interfere. Our question then is: how can public officials assure farmers that if they restrain their taking of irrigation water, they will get the expected amounts?

> "Part of the answer is to be found in the physical design of the system, to make the dependence of farmers on irrigation officials less critical. ....Another part of the answer is to be found in the design of the irrigation management organization" (Wade 1985a, p. 5-6).

Wade goes on to argue that the irrigation associations of Japan, Taiwan and South Korea are an effective way to organize irrigation management. This form of organization which is a watershed-based parastatal (1) emphasizes O&M as opposed to construction, (2) relates water fee collections to O&M expenditures and staff performance, (3) encourages coordination among different agencies involved in irrigation, and (4) fosters communication among irrigation officials and farmers. On the physical design side, smaller operating units possibly established by installing break-point reservoirs, would make the farmers less dependent on the performance of irrigation officials.

WATER FEE COLLECTIONS IN THE FOUR COUNTRIES

All four areas included in this study have had a different experience with establishing and collecting water fees. Nepal and Sri Lanka have had considerable difficulty in collecting enough in water fees to just cover the cost of collection. As pointed out by Bowen and Young the transaction costs involved in collecting irrigation fee can be substantial. For Egypt they estimated the costs would range from a little less than $1 to over $7 per acre depending on the type of water fee imposed.

Maharashtra and the Philippines have been relatively more successful in collecting fees. Water charges collected in Maharashtra range from 70 to 116 percent of the O&M expenses during 1979-84 while in the Philippines irrigation fees and equipment rental fees covered from 37 to 53 percent of the National Irrigation Agency's (NIA) budget during 1978-83 (Maharashtra Report, p. 33 and Philippines Report, p.18). For Maharashtra the percentage of O&M covered has declined while in the Philippines there is no particular trend. Differences in collection are due to the priority given to fee collections, the organization of the agency collecting the fees, the incentives involved, the level of communication with farmers, the information available on who gets irrigation water, the level of irrigation service and the penalties or sanction imposed for non-payment.

Philippines

Because of financial constraints the Philippine government has had an active program to improve water fee collections. The basic government policy is that "NIA should charge fees that are just sufficient to defray cost of operating and maintaining the systems plus repaying the construction costs within 50 years without interest. Thus pump systems which entail higher O&M costs charge higher fees" (The Philippine Report, p. 21 and 24). However, the policy in national systems appears to have been aimed at covering only local O&M costs (correspondence with Mark Svendsen).

To help meet this objective and to account for inflation over time, starting in 1975, NIA tied water fees to a given quantity of rice. Thus as the support price of rice is increased the water fee is also raised. However, as the Philippine Report points out, the price of rice has not kept up with inflation and the water fee has declined in real terms since 1976. For example, the real value of irrigation fees for wet season gravity systems dropped from 120 pesos per ha in 1976 to only 80 pesos per ha in 1984.[2] Given the national policy the problem facing NIA is how to cover increasing O&M costs by raising water fees over time without causing serious farmer complaints and collection problems. The current water fees emphasize farmers' capacity to pay rather then repayment of O&M costs.

Four general fee levels are used in government projects providing water for rice irrigation. There are rates for wet and dry season irrigation and for pump and surface (gravity) irrigation. For gravity systems water fees are 2 cavans of rice per ha in the wet season and 3 cavans of rice per ha in the dry season.[3] The one exception is the Upper Pampanga River Improvement Irrigation System where 2.5 and 3.5 cavans of rice per ha are charged for the wet and dry seasons. The higher fees could be due to the cost related to the reservoir or to a greater management input.

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[2]The banknote rate, November 1984, was 19.5 pesos per U.S. dollar.

[3]Cavan is 50 kg.

The pumping rates are more variable and appear to vary by O&M cost. For example, the farmers served by the Salana and Banga pumps are charged 8 cavans of rice per ha during the wet season and 12 cavans in the dry season. In the Libmanon-Cabusao Pump Irrigation Systems the charge is 6 cavans per ha for both seasons.

In systems serving other crops the rates are also different. For crops such as sugarcane, banana and other annual crops, except in hacienda Luisita, Tarlac where 29,000 pesos per year is charged for irrigation of 2,000 ha (14.5 pesos per ha), 5 cavans of rice per ha per year is charged in gravity systems and 8 cavans in pump systems. Almost all of these payments are made in cash equivalent based on the National Foods Authority rice support price and are collected twice a year, once after each season (Philippine Report, p. 20 and 35).

In general there is suppose to be some consultation with farmers concerning proposed rate changes. This is, in part, because of the general guidelines wh.ch NIA considers in setting fees. The fees should:

(1) be within the farmer's capacity to pay.

(2) not impair the incentive to use water.

(3) not include charges for the repayment costs of power, reforestation, roads and flood control in multi-purpose projects.

The communal systems, which are entirely under farmer control, charge an average of 1 cavan of rice per ha per season.

These fees are used to pay for the amortization of construction and rehabilitation costs of NIA. Farmer-members of communal systems can elect to pay their irrigation fees in labor used for cleaning canals.

The Philippine study considered a number of factors which might influence collection efficiency in their sample of irrigation systems. In general they found that the small and medium-sized systems had higher collection efficiency than those with service areas of 5,000 ha and above, and new systems or newly rehabilitated systems had higher collection efficiency than old unrehabilitated systems. Small-scale farmers and upstream farmers had lower rates of payment than large farmers and mid-stream or tail-reach farmers. The collection efficiency for the sample systems ranged from 27 percent in one pump system to 100 percent in a communal gravity system.

Sri Lanka

The government's policy on water charges has changed over time. Before 1970 the water charge was Rs 5 per acre in most schemes but in some schemes the rate was as low as half a rupee.[4] Even with these low rates collections were less than 2 percent. From 1970 to 1977 the collection of water fees of any form was virtually abandoned. During the early 1980s, new fees of Rs 30 per acre for cropping intensity over 150 percent and Rs 20 per acre for intensity less than 150 percent were introduced for

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[4]The banknote rate, November 1984, was 26.5 rupees per U.S. dollar.

irrigated rice land. Again, collections were insignificant and they were replaced by the current O&M recovery rate.

The new water charge policy is that farmers in all the major irrigation systems should pay Rs 100 per acre of paddy land per year. In the first year of implementation, 1984, farmers were required to pay only 50 percent of the estimated O&M cost of Rs 200 per acre. The O&M collections were credited to a special O&M fund in each scheme and were available for annual O&M. The O&M work is to be planned in consultation with farmers in each scheme. In the first year of operation the government matched the farmers' Rs 100 per acre contribution. The contribution by farmers for O&M is supposed to be progressively increased by 20 percent each year so that at the end of the fifth year the entire sum of Rs 200 per acre will be paid by farmers. The government's contribution to the special O&M fund not spent in the year received will be returned to the general revenue fund at the end of the year. There can be no carry over of this contribution from year to year (Sri Lanka Report, p. 63-64).

The amounts collected up to October 15, 1984 were only above 2 percent in seven of the seventeen districts. Only Polonnoruwa District with 22 percent and Manner District with 53 percent had rates over 15 percent. The Mahaweli project had collection rates ranging from 15 percent to 57 percent. Although these collections are higher than the less than 2 percent collections found before 1984, it is too early to tell how effective the new program will be. However, these increases in water fee

collections will be difficult to continue if there is a general farmer attitude that water is a gift from the government (Sri Lanka Report, p. 57).

Maharashtra (India)

The primary Maharashtra government objective for collecting water charges is to obtain revenue to cover the cost of O&M and to provide a 1 percent return to the government to cover project depreciation costs. Although Maharashtra has been doing better in this regard than the other areas studied, it has not yet reached this objective. Part of the reason for this shortfall is that the government sets water fees for a 10 year period. Thus the present fees have been constant since 1975 for all surface water irrigation systems. With the real value of fees dropping, total collections cannot keep up with O&M.

The water charges are levied on the basis of the area of different crops irrigated in any year. The water fees for surface irrigation range from Rs 50 per ha for kharif (wet) season crops to Rs 750 per ha for sugarcane and plantation crops.[5] In between rates include Rs 75 per ha for rabi (dry) season crops and Rs 150 per ha for many hot season crops. Cotton and groundnut, in the hot season, have rates ranging from Rs 200 to 400 per ha while pre-season watering is only Rs 20 to 75 per ha (Maharashtra Report, Table 4.3, p. 18). Thus charges are varied by crop and season based mainly on crop irrigation

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[5]The banknote rate, November 1984, was 15 rupees per U.S. dollar.

requirements, the amount of rainfall likely to occur during the season and average gross income from the crop.

The Maharashtra State Irrigation Commission has prescribed three principles for determining water fees or charges.

(1) The total recoveries through water charges should be equal to or greater than the annual cost incurred by the state in providing the water.

(2) The water charge for a crop should be related to the ability to pay from crop returns.

(3) The water charge should not be set at a level which would leave any of the irrigation potential unutilized.

The water fees for surface irrigation on food and non-cash crops are set roughly equal to 6 percent of the average yearly gross income from these crops. In the case of cash crops the charge is set at about 12 percent of the average gross income (Maharashtra Report, p. 17).

In addition to the water fees, farmers are required to pay extra charges for the Employment Guarantee Scheme and for education. These fees are imposed by the state government and are in the proportion of 1 percent and 10 percent of the water fees, respectively. The payments for these charges are made to the Revenue Department when they collect the land revenue taxes on the land owned by the farmers. This is in contrast to the water fees which are collected by the Irrigation Department.

In the sample from the Maharashtra study, 58 percent of the farmers in minor irrigation systems paid their water fees while 64 and 67 percent paid them in medium and major systems. The

water fees collected were 66, 62 and 89 percent of the O&M costs in the minor, medium and major irrigation systems, respectively.

The study found the following factors important in successful efforts to collect water fees:

(1) Government sanctions against farmers who do not pay their water fees at the time of their annual application for irrigation water.

(2) Fines for non-payment of water fees by a fixed date.

(3) Good irrigation service.

(4) Good communication among irrigation officials and farmers (Maharashtra Report, p. 55).

Nepal

The general responsibility for collecting water charges has been shifted from the District Land Revenue Office to the individual irrigation offices. The Department of Agriculture is also involved in collecting water charges particularly in tubewell projects.

For medium and large scale irrigation projects there are no criteria for setting the level of water charges. Generally the water charges are fixed on a flat basis by an individual project board or the Department of Irrigation, Hydrology and Meteorology with approval by the Ministry of Finance. Thus the water charge for the Narayani, Kankai and Morang-Sunsari projects is Rs 100 per ha per crop while it is Rs 60 in the Jhanj, Manusmara, Chitwan and Patharaiya projects.[6] Higher water charges are

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[6]The banknote rate, November 1984, was 18 rupees per U.S. dollar.

assessed in the large projects as compared to medium-sized projects. Chitwan is the one exception as it is a large project with a lower fee. Pumping projects tend to have charges based on hours and cost of pumping. The Narayani pump with an 80 cusec discharge has charges of Rs 100 per ha per season for all crops except sugarcane. The Farm Irrigation and Water Utilization Division (FIWUD) which manage groundwater irrigation projects charges Rs 16 per hour. In artesian wells operated by FIWUD the charges are based on discharge levels. These charges range from Rs 1 to Rs 4 per hour (Nepal Report, p. 29-30).

In Bara district the communal irrigation systems are charging an annual fee of Rs 46 per ha for irrigation. In times of emergency a fund is also raised to support the repair work.

The percent of O&M costs covered by water fees collected in the sample projects ranges from less then 1 percent in the Kankai and Manusmara projects to almost 19 percent in the Jhanjh project. Among these projects the medium-sized projects covered a higher proportion of O&M costs than did the large projects (Nepal Report, p. 53). The low rate of cost recovery is primarily the result of the inability to collect established fees particularly for the wet season. Many farmers seem willing to pay for dry season irrigation but not for wet season irrigation. They argue that in the wet season they have traditionally grown a rice crop without any projects.

O&M PROBLEMS IN THE FOUR COUNTRIES

The problems or issues associated with recurring costs of irrigation projects can be grouped into three general categories taken from Figure 2. These three categories include: (1) institutional and organizational arrangements, (2) facilities and inputs, and (3) implementation tools. They correspond to the elements of the management system plus the resource inputs needed for system O&M. The largest number of issues are in the institutional and organizational arrangements category while the smallest number is under facilities and inputs. This lends support to the proposition that institutional and organizational arrangements have not been adequately considered and in some cases have been ignored in planning irrigation projects.

For example, the Nepal study reports that the Energy Commission Chairman criticized those developing water projects for having "the erroneous view that a project is completed once construction has ended." The report goes on to say "that there has been a failure in public sector projects to ensure that mechanisms ... requiring legal and institutional reform ... are created for the farm management of water distribution and for the collection of necessary project operational resources from the beneficiaries" (p. 35). Howe and Dixon (1983) found that "Maintenance is often done poorly because the difficulty of organizing effective maintenance programs is likely to be underestimated by both donor and recipient countries" (p. 22).

Thus, the need for institutional and organizational arrangements may be the least understood aspects of O&M.

Institutional and Organizational Arrangements

In the four countries studied emphasis was on government operated systems particularly larger systems. Only in the Philippines study was there a good mix of small-scale and communal irrigation systems included in the sample of projects. Because of their importance in government projects, a good starting point for evaluating O&M is to consider institutional and organizational questions. Do the countries' institutional arrangements establish those important linkages and incentives for a high level of O&M?

(1) Link between water fees collected and the amount spent on O&M.

To make this link, fees collected from farmers for O&M should be used to finance improvements on their irrigation project. In 1984 Sri Lanka made an important institutional change to do just that by setting up O&M accounts for each major irrigation system (Table 1). In addition farmers are supposed to actually help determine how these O&M funds are to be used in their projects. The farmer contributions to the funds can be carried over from one year to the next while the government contributions cannot. It is too early to determine how this incentive will work.

> "The successful collection of O&M depends to a large extent on the interest taken by the collectors and the supervisory work done by the project coordinator appointed for that purpose to each irrigation project. The senior level officers in the districts of Manner and Kilinochchi have devoted considerable time to exolaining the O&M programme to farmers and winning their cooperation to secure collections" (Sri Lanka Report, p. 67-69).

Their 1984 collection rates were 53 and 15 percent, respectively, which ranked them one and three in collections among the 17 districts (Sri Lanka Report, p. 68).

In the Philippine case NIA has had responsibility for collecting water fees and O&M for many years. However, until recently the central government has provided supplemental funds for O&M which reduced the pressure on NIA to collect fees and provide quality O&M. With supplemental funds no longer available NIA has had strong incentives to provide better service, so they can collect more fees, and to transfer O&M responsibilities to water user organizations (WUO). This transfer of more responsibility to WUO for both O&M and fee collection seems to provide an important feedback link. The WUO have an incentive to reach higher collection levels since they obtain bonuses for achieving certain collection performance levels (Philippine Report, p. 37). In addition, they have an incentive to provide adequate O&M. If adequate O&M is not provided irrigation service will decline and fees will be more difficult to collect.

Nepal and India do not have any direct link between fees collected and funds spent on O&M. Yet in 1976 the Irrigation

Department in Maharashtra, India, was given responsibility for collecting water fees. This means that the management wing of the Irrigation Department is responsible for both collecting fees and providing O&M. Thus the Irrigation Department would have an incentive to provide adequate O&M, that of making fee collection easier.

As Bottrall (1984, p. 4) points out in his review of a paper on Mediterranean irrigation schemes that accountability of management for providing adequate services is the key requirement. It "is not the fact that key decisions are taken by water users' representatives or by others, nor is it some independently fostered 'cooperative spirit'; it is the need for the managers (whoever they may be) to provide a satisfactory service to their clients in order to ensure a sufficient financial return to cover those service costs". Able (1976) also found that accountability of water managers to the irrigators was an important reason for the efficient operation of Taiwan's irrigation projects.

(2) <u>Priority given to efficient water use, maintenance and water fee collections</u>.

These issues are all very closely related and arise from the lack of government recognition of the importance of water use efficiency and O&M problems. Once water resources and O&M are given high priority the necessary organizational and administrative changes are more easily made so that an effective

O&M program can be implemented. However, this is not an easy task.

The Philippines has made progress by focusing on organizing and training farmers to do more O&M. Yet the Philippine study suggests that there could be some problems with the budget priorities within O&M. "The bulk of O&M expenditures of NIA have been on salaries and wages of personnel most of whom are not directly involved in O&M" (Philippine Report, p. 45-46). However, the lack of supplemental funds from the central government has increased the priority NIA is giving to fee collections and maintenance.

In Sri Lanka the government has given irrigation, water use efficiency and O&M high priority and has recognized some of the organizational problems (Sri Lanka Report, p. 33). The important question is whether or not the new policy thrust can be implemented and the organizational problems resolved. Nepal is still in the position of not giving efficient water use, O&M or water fee collection a high priority. This acts as a serious constraint on efforts to improve implementation of irrigation projects. Irrigation service remains poor, resources for O&M are limited and farmers do not pay water fees.

In Maharashtra, due to the relative scarcity of water, irrigation development has had a high priority since independence. Even improved water use was given high priority during the 1970s. This does not mean that operation and maintenance expenditures have matched requirements. The existing

efforts to improve water use do not seem to be sufficient to bring about all the desired changes. However, in the case of new projects separate provisions have been made for O&M (Maharashtra Report, p. 23).

The state has a well established centralized bureaucracy which does both the O&M and collects water charges. Collections were 70 percent in 1980-81 and 83 percent in 1981-82 which is good compared to Nepal and Sri Lanka (Maharashtra Report, p. 16). In addition, expenditures for O&M in the sample of major and medium irrigation systems were Rs 261 and 210 per hectare, respectively (Maharashtra Report, p. 56).

(3) Farmer participation and communication between farmers and irrigation officials.

Obtaining farmer participation all the way from project planning to maintenance is now a key strategy being tried in a number of Asian countries. This can be an effective way of building links among the farming system, canal system and reservoir management segments of an irrigation project, and in improving communications between farmers and irrigation officials (Figure 3). Starting in 1976 the Philippines has made the most concerted effort to increase farmer participation of the four countries studied. Their program can be seen as one example which should be considered by other countries. However, in the large Philippine government operated systems without WUO, communication is not very good. In the sample system having the

lowest collection efficiency farmers complained that they had not been visited by the irrigation officials during the past two crop seasons (Philippine Report, p. 40).

A good example of farmer participation and accountability is found in the government-assisted communal projects of the Philippines. "Where water user organizations are responsible for repayment of a portion of the government's construction costs, farmers have sometimes shown a keen interest in assuring that the use of items such as fuel for jeeps is limited to direct support of the construction activities. They have also sometimes exerted pressure to eliminate the construction of structures which they see as unimportant" (Small, et al., 1986, pp. 33-34).

The Irrigation Department in Maharashtra has relied on a centralized operation of their irrigation systems. There are no formal WUO but a few informal WUO are active in maintaining field channels. The main communication between farmers and the Irrigation Department seems to be through the Canal Advisory Committees.[7] Canal inspectors are the only irrigation officials which most farmers have any contact with.

In the Nepal report the need for farmer participation is spelled out but the strategy has not been effectively implemented. In most government-built irrigation systems there is no effective communication between the farmers and the

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[7]The committee includes the executive engineer as chairman, one representative from each of the following: the Agricultural Department, the Revenue Department and the sugar factories, and two members from each of the following: local irrigators and local members of the Legislative Assembly or Legislative Council.

irrigation officials particularly regarding maintenance of the tertiary networks (Nepal Report, p. 9).

Sri Lanka will need to improve communications and farmer involvement if the new strategy of improving O&M and collecting fees from farmers is to be effective. Without more farmer involvement it will be difficult to change farmer behavioral patterns of not paying for water which exists in most government irrigation schemes.

> "Since the emphasis had been on the design and construction of the major irrigation schemes and the settling of as large a number of farm families as possible, very little attention was paid to the position of the farmer himself as the principal agent of agricultural production. His participation was not sought for and his perceptions were not solicited and given due recognition in managing schemes. The role of the officials, particularly the officials of the Irrigation Department, were all important. Very often the relationship between the farmers and the official hierarchy in an irrigation scheme was one of confrontation rather than collaboration. The officials invariably blamed the farmers for excesssive use of water, water piracy, failure to observe cultivation calendars and even willful damage to irrigation structures during times of water scarcity. The farmers on the other hand blamed the officials for not supplying quantities of water on their farms at the times they most wanted it, due to inefficiency, lack of interest, etc.
>
> "There was hardly an emphasis on the management of the irrigation system as a whole and on the need for continuous effort at operating and maintaining the scheme at optimum levels of efficiency. After some years when an irrigation system was beginning to malfunction the remedy was to ask for further investments in rehabilitating the scheme or parts of the scheme as may seem necessary. Once such rehabilitation was done, the maintenance of the system continued to be well below the required standards. The farmers were not encouraged to participate in any of these matters" (Sri Lanka Report, p. 23-24).

They are now trying to change this situation. However, this will require a behavioral change for both the irrigation officials and the farmers. The formation of WUO is still in its infancy. The most progress has been made in the Gal Oya system. Uphoff finds:

> "encouragement in the fact that a situation as unpromising as Gal Oya .... was changed rather remarkably in just a few years, including changes in the Irrigation Department that constitute an important degree of 'bureaucratic reorientation.' A 'learning process' approach is not guaranteed to succeed, but our experience with this approach suggests that it can lead to behavioral changes and improved performance not only as the part of 'the public' but also with 'the public' service" (1985, p. 46).

The key to these productive changes was the catalysts or institutional organizers who had appropriate training, philosophy and support (Uphoff, 1985). In contrast the Minipe Water Management Experiment appears to have lost some of its earlier momentum. There is a policy commitment to building WUO but its implementation will take continued support and resources (Sri Lanka Report, p. 162-63).

Achieving effective farmer participation is not easy and will likely vary from community to community. What works in one place may not work elsewhere. However, for farmer participation to be effective three levels must be involved:

(1) The national policy level where the participatory approach is made legitimate.

(2) The agency level where government officials must develop a close working relationship with farmers.

(3) The village level where villagers organize to solve local problems and become more involved in implementating "their" irrigation project.

Obstacles to participation can be found at all three levels. At the national level participation means recognizing the needs of people whose opinions are usually not sought. At the agency level participation means decentralizing decisions -- making and sharing control over resources. Agency people need to become enablers of local action. Finally, at the village level participation involves developing water user organizations (WUO) and leadership while preventing the more powerful groups from dominating the WUO. In the case of Gal Oya the institutional organizers seem to have brought about changes in the second two levels once the decision to encourage farmer participation was made at the first level.

However, as Hunt points out, establishing WUO based on the communal or community irrigation experience requires the transfer of rights as well as duties. "WUO members cannot reasonably be expected to do the work planned for them for free. There has to be some reward for doing the dirty work. Two kinds of payment seem acceptable -- a wage for the labor involved in maintenance or local control over much of the process, especially control over water. Probably the most effective reward is control over water.

> "If my analysis of irrigation communities is sound, then there are at least three reasons why the WUO are not working. The first is that there is no component of policy recognizing that there are systematic connections among the

various tasks to be performed. The second consideration is the social and organizational context in which the WUO finds itself. Irrigation communities, it will be remembered, form a single line of authority up to the headgate of the system. Rights and duties form an unbroken chain from top to bottom. In the bureaucratic context this condition usually does not apply. Third, the benefits which are an integral part of the irrigation community are simply not mentioned for these WUO. It seems obvious that WUO will not produce bottom-up leaders and the farmers will not do the dirty work without access to sufficient rewards. The principal reward to be gathered from the whole process is real control over a predictable delivery of water. And this incentive, for so I believe it to be, will be difficult to achieve without the farmers themselves having strong control over the distribution of the water" (Hunt, 1985, p. 30-31).

(4) Uncertain water and land rights.

The institutional arrangements involving land and water rights play a key role in determining the irrigation incentives. For example, security of land tenure and water rights is important for farmers if they are to invest in improving the irrigation system. In some cases private ownership will be necessary to obtain the desired incentives but in others community ownership may work best. In fact some community ownership of irrigation facilities is being tried as a way to improve O&M. Whether these efforts will be successful depends on the community's experience in providing public goods as well as the general condition of the facilities. Technical assistance may be necessary to help farmers in maintaining the system. In addition, government investment may be needed to make major repairs and to deal with damage caused by major floods. However, when the system is in good condition and farmers have control over local management and understand the maintenance

requirements, there is a good chance that they will maintain "their irrigation system."

The individual country studies did not adequately address this question. However, water rights in government projects appear to be more uncertain in Nepal and Sri Lanka than they do in the Philippines and Maharashtra. For example, in many of the irrigation projects in Sri Lanka there is a significant amount of illegal irrigation. Farmers illegally occupy government land and use irrigation water. Since they are illegal their lands are not registered and, therefore, they are not charged for O&M or other fees. The farmers legally using the water feel that this is unfair and that the illegal users should have to pay the O&M fee since they use irrigation water.

(5) Organization and responsibility for fee collection and O&M.

In O&M, as well as fee collection, one is dealing with a problem of implementation (Figure 1). Generally little or no time is spent planning the important implementation tasks for operation and maintenance. In addition, few planners ask how the government should organize to collect water fees and what project design changes might make it easier to collect fees.

In terms of organization, one needs to know if a sympathetic agency or agencies will be in charge of O&M and fee collections. Does this agency have good management and adequate resources to get the job done? Finally, will the agency be able to obtain cooperation from the various other sectors involved, such as the

Department of Agriculture? A 'no' to any one of these questions suggests that recurrent costs will continue to be a problem and the cost of collecting fees will be high.

Both Nepal and Sri Lanka still face organizational problems while the Philippines is making progress in dealing with these problems as NIA gives more responsibility to WUO. In Nepal, organizational problems even allow maintenance work to be delayed by contracting procedures. Sri Lanka created the irrigation management division with a specific goal of efficient O&M. Yet collections and O&M depend on actions taken at the district and project level where changes have been minimal. Thus responsibility for O&M is still fragmented.

For Maharashtra the centralized approach to collecting fees and providing O&M seems to have worked relatively well. The Irrigation Department seems to be fairly well organized and committed to providing irrigation water and collecting fees. Because of the high priority given to irrigation within the state, the Irrigation Department has the resources to do the job. However, it is not clear whether these resources are being used efficiently and if actions are being effectively coordinated with other departments such as agriculture. The underutilization of irrigation potential would suggest there are some problems. "Almost 65 percent of the irrigation potential remained unused during the year 1982-83" (Maharashtra Report, p. 11).

Facilities and Inputs

Two of the three problems or issues which are included under this heading relate to adequate financial resources (Table 1). Both are concerned with the basic question of providing more resources for O&M.

(1) New projects and their impact on resources available for O&M and the need for adequate funding and training of staff.

It is quite clear from the case studies and the review of literature that the resources committed to O&M are not adequate. This has caused funding agencies and host governments such as Sri Lanka to try to get farmers to pay more of the costs of irrigation. Whether increased collections from farmers can help reduce the financial constraint on O&M will depend on the answers to the questions raised above. There is a significant gap between imposing water charges and collecting them. Of the four areas studied, only in Maharashtra and the Philippines did fees collected come close to covering O&M costs.

Another alternative is to spend less on new projects and devote the funds to O&M. The National Irrigation Administration (NIA) in the Philippines is considering a shift in its programs to emphasize O&M and reduce new construction (Philippine Study, p. 16). The Nepal study suggests that new projects are putting a real strain on the country's ability to operate and maintain existing projects. The best staff are used on the new projects while inadequate and poorly trained staff are left to perform O&M

on existing projects. "The targets for irrigation development have increased over the years resulting in a steady decrease in the budgetary allocation for regular and recurrent expenditures" (Nepal Report, p. 38).

In Pakistan over ten years ago, the Provincial Irrigation Departments (PIDs) began to shift emphasis from construction of new irrigation facilities to rehabilitation and improving water management on lands already irrigated. However, this has involved an effort to increase cropping intensity which has required the PIDs to increase water flows through the system. The impact has been higher than normal maintenance and repair costs due to the added strain on the system. Thus the shift has not necessarily improved O&M (Development Alternatives, 1984, p. 5).

(2) Project design and/or construction.

The primary facility question involved with O&M is the adequacy of project design and/or construction. Howe and Dixon (n.d.) point out that design failures "commit the future to difficult or impossible programs of operation, maintenance and replacement" (p. 9). They also suggest that "the most common failure during construction is poor quality of materials used and faulty procedures. These saddle the future with high maintenance and poor or unreliable output" (p. 9).

Ian Rule (1984) finds that:

> "from an operator's point of view a designer would be given three priorities - simplicity, ease of access and longevity

> .... Most dams, particularly in Africa, are in remote areas and emphasis must be given to the maximum of maintenance being handled by on-site staff or possibly a modular approach whereby a faculty or damaged item may be removed and dispatched for repair, in both cases avoiding the use of scarce and expensive contractors on site. Ease of access would appear obvious but too often the end construction results in cramped conditions for inspection, maintenance and repair. It is understood that financial pressures dictate cost savings but this policy can result in overly expensive recurrent maintenance and is, therefore, short sighted" (p. 2).

He goes on to suggest that when building a dam the resident engineers usually have at their disposal contractors and equipment for the construction. But they do not fully prepare for the normal maintenance problems which will arise after the equipment is gone. "Whenever maintenance aids are built into a site they are seldom used in the original installations" (p. 3). Thus he recommends that, despite possible delays, any maintenance aid should be tested under normal maintenance conditions before the contractors leave "i.e. without the use of any construction equipment, to ensure that it will do the work intended" (p. 3).

Carruthers (1981) argues that:

> "Vital components of projects may be missing. For example, drains, or even field channels, may not be included in designs. Technically poor designs occur all too frequently...although in principle only the unforeseen defects should survive technical scrutiny in the appraisal process. Designs may follow traditional practice, even though key components of the system have radically shifted. For example, canal closure periods for maintenance may neglect new short-duration crops with quite different irrigation requirements to traditional long-duration crops. Local pressure to provide water during closure period may then result in reduced maintenance standards" (p. 58).

Thus inadequate facilities can act as a constraint to both adequate O&M and fee collections. A first step in correcting the recurring cost problems may have to be rehabilitation of poorly designed facilities so that water deliveries are improved. For example, in the Philippine study new systems and newly rehabilitated systems had an average collection efficiency of 77 percent as compared to 38 percent for old systems.

Inadequate project design and construction will be a more serious problem when little or no information from farmers concerning local conditions is used during project planning and implementation.

> "One example of the consequences of ignoring local technical input is the case of a major irrigation supply canal north of the town of Solo in Central Java. When the Ministry of Public Works and foreign consultants publicized the intended location of the canal, local leaders told them that the proposed route was unstable and that a canal would quickly rupture and wash out in that location. Nonetheless, the canal was built and within six months ruptured in several places due to expansion of the soil. It had to be relocated" (Howe and Dixon, n.d., p. 18).

Thus by involving WUO in more irrigation decisions the Philippines is taking an important step to reduce the opportunities for improper project construction and design. Still there are examples in all four countries where improper design and construction have made O&M very difficult and rehabilitation necessary. To illustrate, in the large irrigation systems of Nepal there is inadequate provision of drainage and water control structures. There are also cases where secondary

canals were converted to tertiary canals and where pipe outlets are idle due to poor location (Nepal Report, p. 37).

Implementation Tools

A very limited range of tools has been used to implement project O&M and to collect water fees. The general approach has been to use direct government action for O&M on the main and lateral canal systems and assume that farmers will take care of the smaller channels (Figure 3). In collecting fees penalties have been the major incentive used. But the problem should be approached by asking how might incentives be changed to achieve the desired results, i.e. high rates of collection. Penalties are only one way of changing incentives. Another alternative might be to improve services or transfer ownership of systems to farmers. Still another possibility would be to tie the salaries of the project personnel to the percentage of fees collected. If their service proved to be inadequate they would have a hard time collecting fees and their salaries would be low (see Abel, 1976, for a discussion of how this worked in Taiwan).

It will be difficult to achieve improvements in O&M without doing something about incentives. Generally farmers have strong rent-seeking incentives to capture as much water as possible and avoid paying water fees. There is nothing magic about collecting irrigation fees. Either one makes the necessary plans and investments to do it or the cost of collection will exceed collections as it nearly does in both Sri Lanka and Nepal. As Hotes (1964) pointed out, "most feasibilities have paid little or

no attention to development of realistic O&M plans and organization <u>let alone plan for collecting water fees"</u>* (p. 7).

(1) <u>Information concerning area irrigated and crops grown.</u>

One critical requirement is an information system which is up-to-date concerning the area and crops irrigated by farm.

> "The margin of error used to measure canal performance is commonly so large that one must be wary of any statements about actual performance, or capacity utilization ... Since, even with a good capacity, large canal facilities ... are amongst the most complex of public enterprises to manage, it may be presumed that the absence of reliable performance data is an important reason for poor performance" (Wade, 1985b, p. 2).

The irrigation agency needs to know who gets irrigation water. Government cannot expect farmers to pay very much for a service they do not receive. Pakistan found this out in the Sind after they shifted to a flat rate system of water charges where the fee was assessed on the entire land holding of the farmer irrespective of whether or not the land was cultivated or irrigated. In 1980 they had to return to the old water charge system based on acreage irrigated, matured and harvested. A general land tax should be used to pay for irrigation only when one does not know who receives water. When such information is lacking the best that can be done is to charge some low level land, product or input tax. This could be justified on the basis that even those who do not receive water are better off because

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*Underline added.

of the generally higher economic activity and employment created by irrigation in the area.

The British, running irrigation systems in India during the early 1900s, understood very well the need for good records concerning who irrigated how many acres of various crops (Development Alternatives, 1984, p. 15-17). They developed excellent information systems in India. However, many of these systems have not been kept up-to-date and lack of information is now a constraint to improving fee collections in parts of the Indian subcontinent. Maharashtra seems to be an exception as they have maintained centralized control and are trying to improve their information system (Maharashtra Report, p. 22). Pakistan has also maintained its centralized system of information and control which has allowed them to maintain high rates of collection in the Punjab and the Sind. However, one must view reports of successful fee collections with some caution. They may not include a sizeable unreported acreage of irrigated land for which farmers were not charged (Wade, 1985b).

Lack of information is a particular problem in Nepal and Sri Lanka (Nepal Report, p. 28). Their inadequate information systems are a constraint to efforts to obtain high collection rates. For example, in Sri Lanka collection of O&M fees is based on a specification register for each irrigation system prepared under the supervision of the Government Agent of the district. The register is supposed to give the name of the legal allottee and tenant cultivators, the extent of their paddy holdings in the

scheme and their location (Sri Lanka Report, p. 61). However, the register is out of date and fails to identify accurately those who receive water and as discussed above does not include any land on which illegal cropping has occurred (Sri Lanka Report, pp. 71-72).

If the responsibility for fee collections is turned over to water user organizations (WUO), then the farmers will probably be able to obtain adequate information on which to base collections. However, they may need some assistance in establishing such a local information system (Easter and Hufschmidt, 1985, p. 37-38). In the Philippines some of the WUO appear to have enough information to achieve high rates of collection. The NIA also claims it has reliable data on both crops grown and irrigated area. Yet some of the farmers surveyed in the Philippines said they were billed for irrigation water which they never received.

(2) Penalties for non-payment of water fees and incentives for higher collection rates.

These two issues relate to the need to have both negative and positive incentives to help with collection of water fees. The Philippines is the only country of the four which has used direct incentives to obtain payments from a higher percentage of farmers. Where farmer associations are deputized to collect fees from members they are usually offered a graduated bonus for achieving certain collection efficiencies.

> "If collection efficiency (on current account) is 100%, the association is given 5% of the total collected fees; 4% if collection efficiency is 90%; 3% if collection efficiency is 80%, and 2% if 70% efficiency. The deputized associations are also given as much as 25% of all back accounts collected" (Philippine Report, p. 37).

The Philippines also has penalties for non-payment of water fees particularly for tubewell irrigation. In fact, a number of wells in the Philippines have been shut down since the farmers were unable or unwilling to pay operating costs, particularly electricity fees. In contrast, the cut-off rule is not enforced in gravity-fed surface systems. "A 1% per month interest is charged on overdue accounts (with 3 months grace period)." However, the water supply cut-off or legal sanctions are not imposed because they are difficult to enforce. For example, the water control is not adequate to allow the shut-off of water to only one farmer on a canal. Legal sanctions are also difficult to enforce because many delinquent farmers are economically powerful (Philippines Report, p. 44).

In the Nepal case it is also impossible to enforce the cut-off rule for gravity-fed surface irrigation. For tubewell irrigation it is not clear whether or not the cut-off rule is enforced. According to the Nepal report "the supply can be stopped for non-payment cases" (p. 29). However, in the farmer survey none of the farmers reported any penalty for non-payment of water charges nor were they ever approached by project officials for their help in repair and maintenance of the project (Nepal Report, p. 58).

Penalties and sanction have been a regular part of the system of collecting water fees in Maharashtra. If water charges are not paid by the due date an extra penalty of 10 percent of the amount due is added to the charges. Sanction can also be imposed such as rejection of a farmer's application for irrigation water. As a final resort the government can use coercive measures provided for under the Maharashtra Land Revenue Code (Maharashtra Report, p. 26-27). The delinquent payments are added to the land tax and collected along with the regular land revenue by revenue authorities.

Penalties for non-payment of water charges have been introduced in Sri Lanka's new program to increase water fee collections. The law has been amended to allow action to be taken against non-paying farmers. If farmers do not pay they can be prosecuted and fined. Prior to 1984 no penalties or sanctions were imposed on defaulting farmers. As one might expect the water charges were rarely paid.

(3) Penalties on those who do not maintain project.

In general, the individuals adversely affected by inadequate maintenance are farmers in the tail-reaches and possibly in the middle of the irrigation system. Farmers in the head-reaches usually get adequate water with or without maintenance. In addition, irrigation officials who fail to do maintenance work are not penalized. This is true, generally, for government operated projects in all four case studies. "The officials were not accountable to the farmers for the manner in which they

operated and managed the irrigation system" (Sri Lanka Report, p. 158). Thus there is a lack of incentive to perform the maintenance task. Usually only farmers in the tail-reaches have a strong incentive to see that maintenance gets done. For government agencies the only incentive arises from requirements that the irrigation agency obtain its funds for O&M from user payments.

"One frequently finds there are no penalties for those who allow O&M to deteriorate. Systems are large and it may be difficult to fix the blame for inefficiency" (Howe and Dixon, n.d., p. 23). The fact that many projects do not depend on user payments to cover wages and salaries breaks an important accountability or feedback link. As discussed above, this link has recently been reestablished in a number of Philippine systems. "The communally operated subak irrigation systems in Bali are well known for their efficient allocation of water. In this case, the communal organization does not preclude accountability and fines and other measures are used to ensure that operation and maintenance duties are performed by the subak members" (Howe & Dixon, n.d., p. 9). This accountability is also present in a number of communal systems in the Philippines and Nepal.

CHOICES FOR O&M

What can be done to reduce the rapid rate of deterioration in irrigation investments? As the list of problems or issues above indicates, we already know many of the problems and what

their links are with O&M (Figure 4). However, alternative solutions need to be tried under different conditions. For example, the Philippines seems to be making headway in its policy of improving fee collections and O&M by giving WUO more responsibility for O&M and water fee collection. Compared to Sri Lanka and Nepal its record is good. In contrast, Maharashtra appears to have done a comparable job of O&M and water fee collection using a centralized approach with a separate cadre of staff for O&M. "The responsibility of the Irrigation Department does not cease at the outlet but continues till water is supplied to the variety of crops grown in the command at required irrigation intervals and in required quantities" (Maharashtra Report, p. 15). Farmers appear to have a very limited involvement in decisions concerning water management. Yet collection rates are reported as being relatively high. But the underutilization of the irrigation potential and the possibility of unreported irrigated acres raises some questions concerning project effectiveness.

There are four general approaches or some combination of these approaches which can be used to provide additional resources to meet recurrent costs. All of the following approaches have been tried at different times in the past:

(1) Increased investment by government.

(2) Collect more fees from users to invest in O&M.

(3) Turn systems or parts of the systems over to groups of farmers and let them do the O&M.

(4) Have farmers contribute the labor part of O&M.

First, increasing government investment will be difficult for many countries such as Nepal since they have a serious budget constraint. In many cases it involves the hard choice between maintaining old projects or building new ones. In the future governments need to decide more frequently in favor of the old projects. In addition, they will need to be more concerned about how government investment encourages or discourages local investment and farmer participation.

Second, to collect higher water fees or just increase collection efficiency requires a major effort. In some countries, such as Sri Lanka, with a history of providing many free goods and services, increased collection of water fees will require a significant behavioral change. As pointed out above, a well planned collection program with current records on who receives water is a necessary condition for success.

The cost of improving water fee collections is no small matter. In the Philippines the costs of collection are about $.84/ha or 8 percent of total collections (Small, et al., 1986). The costs are even higher for the centralized system in Maharashtra where collection costs range from 15 to 20 percent of the O&M costs or from $1 to $3 per ha. Finally Nepal, with its low success rate for water fee collections, has to use over 78 percent of the fees collected to just cover collection costs.

The third strategy is being used in the Philippines, that of turning more responsibility for collections and O&M over to farmers through WUO. This has worked fairly well in some projects since NIA has made a major effort to organize farmers into WUO. In one system collections went up 15 percentage points after the formation of the WUO (Philippine Report, p. 14). For smaller irrigation systems and larger ones which can be divided into smaller units this approach seems to be working. However, for certain groups and larger indivisible systems, farmer organizations will not be the complete answer. In addition, organizing farmers is not an easy task. Farmers usually need some incentive to organize, such as better service, training, technical assistance and/or rehabilitation of the irrigation system. In addition, certain well located farmers will have a strong rent-seeking incentive to maintain the status quo.

The strategy of giving farmers more responsibility for "their" irrigation systems is partly based on the success of communal systems. These communal systems are generally small in size and are operated and maintained by the water users served by the system. Farmers have rights and duties with local control over the systems which provides them with adequate incentives to do the O&M. In both the Nepal and Philippines studies communal systems generally had better success in collecting fees for O&M than did government systems. For example, the Nepal study reports that community managed schemes had no difficulty in levying water charges to meet O&M expenses.

Farmers may also be more likely to pay specific fees for specific purposes rather than general water fees which suggests a strategy of local collection and utilization of fees.

> "In some communal irrigation systems, several different fees for specific purposes have been established. Although this adds complexity to the process of collecting and accounting for the funds for irrigation, the farmers involved apparently feel that the benefits associated with the greater incentives for payment outweigh these problems" (Small, 1982, p. 7).

Fourth, many early irrigation projects particularly in India, used labor provided by irrigated farmers to maintain the system. In Nepal 42 to 95 percent of the farmers sampled in three projects indicated a willingness to contribute free labor to repair and maintain tertiary canals if they received a timely water supply (Nepal Report, p. 46). Since labor is a major part of the maintenance cost it could be provided by farmers. To increase farmer labor input into systems maintenance will require organizing farmers. If farmers are not well organized the "free-rider" problem is likely to cause this approach to fail. Only the tail-end farmer will contribute labor since they receive the most benefits. This approach is not too different from having farmers take over more responsibility for O&M. Yet a well-organized irrigation department with good connections and communications with farmers could use more farmer labor in O&M. In fact, mobilizing farmers to provide labor in an irrigation project can reduce government costs across the board and could be

looked upon as an augmentation to the farmer's repayment capacity (United Nations, 1968).

A fifth alternative would be to have O&M provided by a third party which could be either a private or state assisted company. Fees could be paid directly to the company by farmers. The important institutional arrangement would be to establish a financial relationship between the company and farmers which obliges the company to be responsive to their clients' needs. The third party approach is quite different from the usual alternatives of a state irrigation bureaucracy or a WUO.

> Bottrall (1984) suggests that "one might hypothesize that where irrigation schemes are large, require specialized management skills and/or have good communications with urban areas ... a third party approach may be the most cost-effective: if farmers have the option of transferring scheme management responsibilities to a competent third party, why would one assume that they would see many attractions in a more 'participative' approach?" (p. 5).

A sixth alternative would be for donor agencies to set aside funds just for O&M. All new projects could have an O&M budget provided for by the agency or agencies funding the project. The O&M commitment might be limited to five years with the possibility of renewal for another five years. Along with the O&M commitment, a training program will also be necessary in countries such as Nepal to provide trained staff to do O&M. This approach does not fit donor agency bias towards construction. "Donors generally have short budget periods that call for getting the money spent and seeing the results quickly. Construction is visible while non-construction programs may not be" (Howe and

Dixon, n.d., p. 12). A shift away from new construction is what is needed. It does not make much sense to build a new project to increase crop production while losing more production in other projects because of poor O&M. In addition the donor's desire for quick solutions and results may be at variance with long-run environmental costs. This may mean that the negative effects of the irrigation project will be greater then necessary (see Figure 2 for examples of the possible negative environmental outputs).

Many donor agencies have particular reservations about external recurrent financial support.

> "Their unease stems from concern about accountability, fungibility and the risk that O&M support will only defer the time when financial responsibilities and financial maturity, through self-discipline, will be reached. Furthermore, there are fairly obvious political problems associated with external assistance to operation of schemes. Most of these political difficulties are absent or of a much lower order in the case of capital aid" (Carruthers, 1981, p. 61).

Because of these reservations an alternative approach might be used where new irrigation projects go through a commissioning period. The transition from construction to O&M is probably one of the most critical periods in project development (United Nations, 1968, p. 81). As Howe and Dixon (n.d.) point out most new systems go through a shake-down period during which time construction and design mistakes are discovered and hopefully corrected. Having a commissioning or shake-down phase

> "would require those accountable for design and construction to retain responsibility for a much longer period, possibly as long as five years after operation is initiated. Perhaps financial support for the commissioning phase could be provided by the aid agency at the time of main capital outlay. This might be held in an earmarked reserve and disbursed to assist O&M expenditures over a five year or even ten year period. For example, suppose a surface irrigation project costing $100 million had a further $15 million provided to be disbursed for O&M with 100 percent of O&M in the first year coming from aid, gradually reducing to zero percent in the sixth year. In such a case the aid agency would have a legitimate and direct interest in the operation efficiency and the recipient government would gradually assume full financial responsibility for operation as the irrigation project built up toward its potential technical efficiency. A transfer of funds for O&M as a grant or loan to a locally held reserve at the period of main disbursement might help overcome the donor's political objections to "continuing" O&M obligations" (Carruthers, 1981, p. 64).

The transition period points out the importance of monitoring during project implementation (Figure 1). Without the appropriate monitoring systems, accountability for lower than planned output cannot be maintained. Thus donor agencies could do more to fund project monitoring and ex-post analysis.

Providing adequate funding for O&M may not be enough to raise the level of operation of irrigation projects above the general level of efficiency in the rest of the economy. Furthermore, irrigation "by its nature spread over a large area, serving a biological based industry to some extent depending on weather effects, serving large numbers of independent small-scale producers, has particular difficulties in maintaining efficient production, even if financial resources are readily available" (Carruthers, 1981, p. 63). Carruthers goes on to point out that people seldom fully appreciated the difficulties involved in

mobilizing resources in a low-income economy. These countries are faced with the disadvantages of pervasive external diseconomies which are associated with widespread poverty.

Finally, governments could consider a package approach for extracting benefits from various beneficiaries. Direct taxes could be assessed against direct beneficiaries and production-related indirect beneficiaries while indirect taxes are collected from the general public who enjoy low priced irrigated agricultural commodities. The water pricing system should also match the conditions facing a particular country and project and should change with development. Indirect water charges coupled with close administrative control over water distribution may be best in the initial phase of a project when farmers are inexperienced in irrigation. As farmers gain more experience the systems could be converted to a system of fixed and variable water charges (Doppler, 1977).

Although there is support for water charges, to ensure efficient and equitable distribution of water, such a charge is impractical without the necessary infrastructure to accompany it. Rules have to be established and the prices for water and irrigation services estimated. An organization is required to determine and enforce these regulations and collect the water charges. The inability to collect water charges from higher income farmers has led some to argue against water charges of any kind in a number of developing countries. A rough measure of the volume of water delivered is also necessary if water fees are to

be used to help improve water allocation. Such measurement often requires devices that are expensive and prohibitive in many schemes. Thus all three elements of the irrigation management system are involved in establishing an effective system of water fees and collection (Figure 2).

A possible solution to this dilemma is to locate measuring devices at the head of each branch canal and to charge a "branch canal water user association" an aggregate fee for water delivered to that point. This would necessitate strong leadership and effective organization in the form of a formal or informal WUO. They would be responsible for delivering the water in the branch canal and for collecting the fees from each user.

India is experimenting with this approach in Gujarat. Bulk amounts of water are being sold at a tertiary distributary to all farmers served by that distributary as a unit. The farmers organize the distribution of water and the collection of fees (Wade, 1985a).

Fee collections by farmers might also be combined with Wade's idea of break-point reservoirs. He argues that

> "some kind of break-point reservoir is a fundamental feature of good design in large-scale systems .... The break-point reservoir permits a basic distinction to be made between the task and organization of water conveyance, which is properly the concern of experts in hydraulics and that of irrigation which should be the concern primarily of agriculturalists. Above the break-point reservoir the water supply agency delivers plugs of water according to simple transparent rules" (1985a, p. 16-17).

Plugs of water could then be sold to farmers as a group, served by the break-point reservoir just as it is at the tertiary distributaries in Gujarat. Again, farmers would organize to collect fees. This requires that the area served by the break-point reservoirs is not so large that it is difficult to organize farmers.

THE LEVEL OF WATER CHARGE

The level and type of charge to be collected from farmers will depend on the government's objectives which usually include the desire to increase future investments in development projects (Ray, et al., 1976). For irrigation projects this involves capturing the economic surplus generated by irrigation so that it can be reinvested in other development projects. In addition, it may mean reinvesting the surplus in O&M to keep the old investment viable. Capturing the economic surplus also involves income distribution objectives since irrigated farmers have higher incomes than rain-fed farmers. Finally, the economic efficiency objective is served when water fees are related to the quantity of water received.

Fees that are related to the quantity of water used can also help reduce some important environmental impacts. As shown in Figure 2, irrigation projects can cause significant negative environmental effects such as schistosomiasis, waterlogging and salinity buildup. High fees which are related to the quantity of water use can help reduce the latter two effects by providing farmers with an incentive to use water more efficiently.

Thus, a number of objectives influence government officials when they establish water charges including the following: (1) improve income distribution, (2) promote efficient allocation of scarce resources, (3) increase government investment funds, (4) conserve water, (5) maintain plentiful food supplies, and (6) promote agricultural development in certain priority areas. However, these objectives tend to be narrowed down to two considerations. First, farmers' ability to pay based on the magnitude of net benefits farmers obtain from irrigation. Second, the desire to recover costs to finance O&M and to, at least, repay some of the capital investment? Thus the overriding objectives seem to be some degree of fairness and the need to recover funds from the irrigation investment. Although governments are concerned about income distribution, they have found that large irrigation projects are generally an inefficient and inequitable way to transfer income to low income farmers.[8]

Both the O&M costs and net benefits will vary among projects because of differences in farm level resources and project investments. The service provided by most irrigation systems, particularly large ones, will vary from place to place thus the value of the irrigation service to each farmer will vary. The head-end farmers usually receive much better service than

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[8]This assumes that farmers actually receive irrigation water. Provisions are usually made for cases of crop failure due to the lack of water or other natural disasters. For example in the Philippines, farmers who get yields below 40 cavans per hectare are exempt from the irrigation fee but no such cases were reported by farmers in the survey (Philippines Report, p. 37).

tail-end farmers. The total value of water will also vary from place to place since the other resources combined with the water are not the same, i.e. better land or management on certain farms. The value of water will also vary depending on the quantity of water available in an area relative to the land. The more varied the farm resource conditions and irrigation services provided, the more difficult it is to charge a uniform rate.

It would therefore appear that a pricing policy based on one uniform fee for all projects, such as Sri Lanka has initiated, would run into some difficulties. This fee is based on the amount required to recover O&M. Yet this is going to vary from project to project and some of the farmers may feel they are being overcharged. Consequently one would expect quite a variation in collection efficiency among projects which seemed to be the case in Sri Lanka in 1984.

As many authors have pointed out, one cannot expect farmers to pay fees which exceed their net farm benefits (NB) from irrigation.[9] However, Small, et al. (1986) in their study of five Asian countries, found that the O&M costs could be covered with a range of 5 to 33 percent of net irrigation benefits to farmers. For Nepal it took only 5 percent of net benefits while in the Philippines it was 10 percent. Thus it is not surprising that donors and government officials feel that farmers should at least pay O&M costs. Still these two positions may be

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[9]The net farm benefits from irrigation are only net of farm production costs. Irrigation water charges are not subtracted out.

inconsistent, i.e. NB < O&M costs, if the cost of collecting fees is quite high, the project benefits do not match expectations (bad investment) or there is a great variation in benefits among farmers.[10] These possibilities make it impossible to establish one rule for setting the level of water charges.

The economic guidance which can be given decision makers, concerning the level of water charges, depends on project objectives. In other words, for who and why was the project built? If, as is the case in most western democracies, the projects are built at the active request of farmers, business interests and local politicians from the area to be irrigated, the beneficiaries should pay. Farmers are seeking to increase their economic rents by increasing agricultural production with irrigation. When the beneficiaries know they must pay for a project they will only request help from government if the net benefits exceed project costs. They will also expect to have an input into project design and construction so that no unnecessary expenses are incurred.

However, in many developing countries this is not the case as farmers have done little to demand irrigation projects. In fact in a number of cases farmers have not wanted to irrigate and even refused to use the water (Nair, 1961). The national politicians and a few local leaders are generally the big promoters of such projects although international donor agencies

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[10]Cost of collecting water fees is considered as part of the O&M costs.

are also sometimes important advocates. Thus there are two extremes in a possible range of recommendations concerning the level of water charges.

In the first case direct beneficiaries actively demand the project and should pay for it. Thus water charges should be set so that total payments equal O&M costs plus the capital costs discounted at an appropriate rate over a 30 to 40 year period. Fees should be collected from both irrigated farmers and other business interests which benefit from the project. Water charges should be collected from all farmers receiving water, preferably based on the volume obtained, such that total collections equal O&M costs plus a charge for capital. Indirect charges possibly on inputs and outputs can be used to collect fees from other businesses. A land or commercial building tax could also be used. The total fees collected from all sources should be set so that they cover total project costs.

In the second case where farmers did not want or evince any demand for the project a more indirect approach has to be used to pay for the project. As a first step in determining water charges for farmers, decision makers should estimate net farm benefits (NB) from irrigation and O&M costs and determine if they are consistent. When they are consistent, i.e. NB > O&M, a good start is to charge the full cost of O&M and possibly a charge for capital recovery. The actual level will depend on government and project objectives. If economic efficiency is the major objective then the water charge should at least cover O&M costs.

Yet in this type of project other objectives are usually important and it may be difficult if not impossible to achieve even such a modest level of water charges. In countries where the cost of collecting fees is high, attempts to raise enough in water charges to match O&M costs may act as a real disincentive for irrigation.[11] At a minimum water charges must be set low enough so that most farmers have an adequate incentive to use the irrigation water (see Carruthers and Clark (1981), Chapter 7 for more details).

If NB < O&M, then the decision makers have to determine how much of the NB they feel they should and can reasonably expect to collect. This will again depend on government and project objectives as well as agency experience with collections in other projects. Hopefully, through project improvements, net benefits for farmers will be raised so that eventually farmers will be able to pay for O&M costs. But just as it was a political and not an economic decision to build a project where net benefits do not even cover project O&M costs, the level of water charges will also be a political decision. Still, decision makers should keep in mind what Howe and Dixon conclude concerning water fees:

> "Too little dependence of project financing on direct user payments results in a loss of valuable feedback and user leverage. When users pay directly for a service, they can withhold payment when service is inadequate. If salaries of the O&M personnel are directly dependent on those payments, a direct motivation for good performance is provided. If

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[11]Governments should not extend their efforts to increase fee collections beyond the point where the marginal cost of collection exceeds the additional revenue collected.

salaries and perquisites of office are paid from the central treasury, independent of system performance, motivation is lost."

"The attitude of project users or beneficiaries is strongly affected by the mode of payment. When paying directly, they know they have leverage on the project management and that leverage is likely to be used. If the service is provided free (e.g. irrigation water) the beneficiaries seem to accept supply failure much more readily as if to say: 'what can you expect from a zero price?' or 'if they first brought us the water, they will eventually bring us adequate maintenance of the system.' This attitude is often called the 'cargo-cult belief and it seems strikingly prevalent in irrigation systems and village water supply systems" (Howe and Dixon, n.d., p. 27).

CONCLUSIONS

The basic constraint is the lack of resource committed to O&M. Irrigation agencies tend not to take a whole system approach to irrigation and do not plan for or design programs for O&M until after projects are built. Thus water pricing policy and/or ability to collect fees is not adequate in many Asian countries. The lack of resources for O&M can also be attributed to the following factors: national budget constraints, emphasis on new projects, the unwillingness of donor agencies to provide O&M support and the low status of O&M in irrigation departments. Only one of the seven possibilities for dealing with the resource constraint involves government collecting more from farmers. However, in all but two of the strategies farmers must be involved more effectively in O&M. Even for the first strategy, increased government investment, to be effective, more farmer input will be necessary. However, if the strategy selected involves increased collections of water fees from farmers one

needs to understand what will be required. There are at least four conditions which appear to be necessary if collections are to be significantly increased. They will also be, in some cases, sufficient conditions and include the following:

(1) An up-to-date information system with data concerning who receives water (legally or illegally) and how it was used (crop yields and acreages).

(2) A reasonably dependable delivery system.

(3) A willing and able agency with enough resources (human and financial) to collect the fees (could be a WUO).

(4) Use of funds collected to improve or maintain the irrigation system.

Another condition which may be necessary in some countries is that collections start either when the project is new or has just been rehabilitated. There are two reasons for this condition. One is the need to start collecting some of the economic surplus before it is capitalized into land values. The second is that farmers are more willing to pay for a new service or improved service than they are for one which has been free. The latter requires a major change in behavior and one which Sri Lanka is finding difficult to achieve.

A sixth condition which will also be necessary in many communities is a penalty for non-payment. Pakistan is a good example of irrigation with high penalties which have been used as an effective incentive to maintain high collection rates. In areas where there are strong community pressures to pay water fees, i.e. communal systems, a penalty may not be necessary.

However in many cases a penalty, along with a means of collecting it, will be necessary to assure high collection rates.

Penalties might also be imposed on those responsible for managing the irrigation system who do not provide adequate O&M. This could be done by making salaries dependent on system performance. Another possibility would be for farmers to have more of a say about who manages the system and what they are paid.

When any of the four above necessary conditions do not hold, the best that can be done is to collect some general land tax, input tax or production tax. We tend to have unrealistic expectations concerning the collection of water fees. Even when these conditions hold and collections are fairly good, the government may have to cover some of the O&M costs. This is particularly true in projects where the irrigation system generates low returns due to poor soils, farmers inexperience with irrigation, and/or government pricing policies. Finally, farmers should not be expected to pay for past government mistakes in building non-economic projects. Thus it is unreasonable to expect that a government should collect the same level of fees from all projects or that the fee should cover O&M in all projects.

Alternatives other than improving collections from farmers will have to be considered. The Philippines' approach of turning more responsibility over to the farmers is one good alternative. Farmers will first have to be organized so that they are capable

of doing more of the O&M and receive some rewards from doing it. Otherwise giving them the responsibility without the necessary means or rewards will not get the O&M done. Once WUO are effectively operating they can provide important links between the different parts of the irrigation system (Figure 3).

Increased government or donor agency investment in rehabilitation or maintenance may be necessary before more input can be expected from farmers. The irrigation system may have to be improved and operated effectively for a period of several years before collections can be increased and/or more farmer involvement in O&M can be expected. A direct tie needs to be established between additional resources provided by farmers and improved irrigation service. To help provide the necessary resources government should consider diverting funds from potential new projects to rehabilitation of existing projects. This could then be followed by a reallocation of funds from new projects to O&M.

Finally. donor agencies should consider different ways of establishing a good system of O&M before a project's funding is completely turned over to the government. One example is funding a five year shake-down period of operation. They might also try innovative ways for encouraging governments to take O&M more seriously at the planning and design stages such as tying new funding to performance of existing projects. This would probably involve more donor funding for project monitoring and ex post analysis. Another possibility might be a special O&M fund for

periods of temporary cash flow crises or during adjustment periods of structural change (Carruthers, 1981). During such periods O&M seems to be one of the first casualties.

One additional conclusion which can be drawn from the study is the lack of non-government sponsored country case studies of water charges and levels of collections. There is very limited information concerning the impact of different types of water charges on water use and collection efficiency. For example, what is the relative cost of collecting X dollars of water fees in the large scale systems of Maharashtra as compared to those of Orissa state?

This study shows that there is a wide variation in the levels of collections ranging from almost zero in a number of systems in Sri Lanka to 90 percent in a few Philippine systems. Also there is little information concerning the cost and efficiency of collecting water charges. How much does it cost to raise the rates of collection by 10 percent? At what point is it uneconomic to try to raise the level of collections by another 5 percent. During a period when developing countries are struggling to find ways to increase fee collections from irrigation, it is time that researchers began to ask these questions.

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APPENDIX: REVIEW OF LITERATURE

THE IMPORTANCE OF THE O&M PROBLEM

Irrigation is a major component of investment in the improvement of food production in Asia, where there is little additional land to cultivate. Irrigation projects attract development banks and aid agencies because they utilize large amounts of capital, result in highly visible infrastructure, and provide a service that nearly everyone agrees is a requirement for development in Asia (Herdt, 1979).

Once an irrigation system is functioning, its operation and maintenance play a critical role in determining the short and long term success of the project. Yet, although $6 or $7 billion in total is being spent annually on new water systems in developing countries, investments in maintenance are so negligible that they are not even recorded separately (General Accounting Office, 1981).

Poor O&M practices are seriously limiting the efficiency of irrigation systems. Inadequate O&M will have a direct impact upon the productivity of agriculture, the cost of the irrigation agency and indirect effects elsewhere in the economy. Carruthers (1981) notes:

> "In agriculture, poor O&M will lead to below-capacity working and/or to erratic water supplies which will in turn lower the area cultivated; it will depress yields; it will result in a shift to lower value crops; it will lower investment in yield enhancing variable inputs such as fertilizer; it will reduce on-farm investment to drains and suchlike, which may in time contribute to increased soil salinization and if water is in short supply as a consequence of poor O&M, it may exacerbate social tensions between head and tail-reach farmers or between powerful or big and small farmers.
>
> Irrigation system operating costs may be deferred by a low level of O&M, but in time there will be an inevitable increase in average cost per unit of water delivered; a risk of major cost from, say, canal or dam failure; and in alternative systems, such as high-cost, private water lifting or groundwater delivery systems, a rise in social cost of irrigation provision.
>
> Elsewhere in the economy, the incidence of increased cost will also fall upon other projects deprived of resources if and when irrigation rehabilitation is undertaken and upon potential consumers of the lost products of the project" (p. 55).

Bottrall (1981) concurs:

> "Perhaps the worst aspect of poor system operation is the fact that it ensures poor performance in the future. Most irrigation schemes depend on the farmers to help maintain the physical structures. Farmers pay water charges to support maintenance costs, and may be expected to organize to do much of the work on the on- and off-farm distribution system. If the system does not provide reliable water deliveries, it is difficult to motivate the farmers to aid in the provision of the system's support. Consequently, the physical structures are not maintained properly and the system deteriorates, becoming less and less able to provide adequate irrigation" (p. 11 in Faeth, 1984).

The largest reason potential progress in irrigation is not being realized is directly attributable to shortages of recurrent financial resources and the neglect of O&M. Efficient operation of water resources projects necessitates an adequate funding

program, well-established standard operating procedures and comprehensive recordkeeping and reporting procedures. A U.N. publication notes:

> "Funds were usually the limiting factor in the operation of projects. They had to be budgeted, reported, appropriated or collected, and expended carefully if projects were to function properly. Standard operating procedures setting forth details of the routine daily operation of projects simplified its management. Records had to be kept on which to base future funding, water charges, water distribution, crop production and the many activities of operation" (U.N., 1968, p. 83).

Many problems with O&M can be traced back to the project planning stage. Widstrand (1978) makes a number of points:

> "The provision of water supplies has been almost exclusively in the domain of engineers, with a light sprinkling of economists. This in turn meant an initial emphasis on the production of technical installations. Size and quantity were important, there were so many people to provide water for. Questions about operation and maintenance were put off until the future. Furthermore, the provision of water was seen as a donor-to-government operation rather than donor-to-people. This in turn meant that the planning and siting of supplies was planned from above and the local people had no say whatsoever. This, of course, makes things easier for the donors who can bundle the provision of engineers, pipes, pumps, drilling rigs, taps and nuts into a neat package with a fixed price. The propensity for quick technological fixes was very obvious in the early and middle sixties, and little thought went into finding out what people wanted to have.
>
> Now, 10-15 years later, we are suffering from this lack of minimal vision about the future. Operation and maintenance should ideally have been a local responsibility. But this costs money which wasn't there, nor was it forthcoming from donors, where interest in this respect has been negligible. So, maintenance has been the responsibility of a small group of overworked and underfunded local engineers and a motley of dedicated volunteers" (p. 280).

Additionally, although countries are often able to attract external resources for development, there has been virtually no international support for recurring expenditure (Schultzberg, 1978 and Jayaraman, 1982). A recent GAO report on O&M (1983) found that:

> "Donors have assumed that recipient countries would provide recurrent budget support to effectively operate and maintain projects, but this has not happened. For example, AID project loan agreements have specified that recipient countries will provide adequate O&M funding.
>
> And as required by Section 611(e) of the Foreign Assistance Act, AID has certified that these countries have the economic and human resources to operate and maintain specific irrigation projects. Notwithstanding such agreements and certifications, recipient countries have not provided adequate recurrent cost support and recipients and donors continue to invest in rehabilitating neglected systems and in new systems" (p. ii).

Hotes (1984) reports similarly on the World Bank's experience:

> "The Bank's experience makes it clear that operation and maintenance (O&M) is a major issue. A review of 30 audits by the Bank's Operations Evaluation Department in 1981 revealed that most project agencies were not prepared to undertake system operations after completion of construction. Government authorities often have erroneously viewed maintenance efforts as a low.priority and easily postponable, so that budget allocations are negligible, and the best staff are assigned to design and construction. The result is that O&M assignments are rarely considered desirable" (p. 7).

Carruthers (1981) provides the reason for the lack of O&M support by donor agencies:

> "Aid agencies are essentially resource-transferring agencies. The main focus of activity is good projects. The main test of a good project is plausible assumptions and good design. Project planning and implementation are in

practice a two-part process: the first part a modeling exercise and the second a construction/supervision phase. There are standards of performance relating to quantity of lendings and to the quality of the plan. Those related to quality of operation are minimal as this is largely outside the control of the external agency and O&M arises largely after disbursement is complete" (p. 57).

Donor agencies, Carruthers (1981) finds, have contributed to the problem in other ways.

"One well-understood piece of feedback which is not acted upon is the new-project bias. In many countries, particularly in the poorest, aid donors virtually scramble for new projects. There is often an excess supply of donors with effective demand for good poverty-oriented projects. In consequence, local professionals and administrators respond by devoting time, talent and effort to new project preparation and neglect O&M of existing projects. It is a sad fact that the poorer the country, the more difficult it is to raise recurrent resources locally; the greater the competition among donors for new projects; the greater the problems in preparing and implementing projects and the greater the likelihood of neglect of O&M. It is not facetious to note that the economic management of certain countries appears to rely more on the stimulus from the multiplier effect of new projects than the efficient running of existing projects. The high rates of return to keeping existing projects going are widely appreciated and yet by and large the system promotes new projects which directly and indirectly, in the aggregate, add to the O&M and general development problems" (p. 58).

Finally, Howe and Dixon (n.d.) neatly summarize a number of the factors that contribute to distortions in donor-supported projects in Table 1A.

As a result of these "distortions," the financial burden from O&M is rapidly increasing in those countries which have undertaken rural water development as a social service. It appears that raising funds for, at least, the cost of O&M at the local level is a must, or systems will be going out of service

TABLE 1A. Distortions in the project process

Donor-Lender Factors	Host Country Factors
PROJECT IDENTIFICATION	
Bias toward construction	Desire for prestige
Priorities that differ from host country	Opportunities for corruption
PROJECT DESIGN	
Desire to sell available technology	Opportunities for corruption
Desire to maximize aid flow	Lack of input from local people and businesses
Misperception of relation between capital intensity and durability	
PROCUREMENT AND CONSTRUCTION	
Desire to export components	Local contractors lack skills
Use of construction technologies inconsistent with host factor endowments	Opportunities for corruption
OPERATION AND MAINTENANCE	
Failure to exert leverage on host country to improve operations and maintenance	Lack of incentives for good O&M
Failure to provide aid for operations and maintenance	Corruption and lack of accountability
Failure to carry out ex post analyses of projects	Lack of local participation
	Lack of feedback from users
	Absence of whole system perception
	Lack of budget provision
	Lack of user payments base

SOURCE: Howe and Dixon, n.d., p. 33.

almost at the same rate as they are being constructed (Schultzberg, 1978).

The literature is consistent in criticizing project implementation and the neglect of O&M. However, only recently have the major international donor agencies realized that it is not sufficient to build massive dams and extensive irrigation schemes. It has also become evident that host country governments are unwilling or unable to supply adequate funds for O&M. In addition, funds will be necessary to improve the water delivery efficiency and to increase the degree of sophistication of on-farm water management if existing systems are to approach their potential (Johnson, Early and Lowdermilk, 1977). A recent general accounting office report[1] to USAID (1983) recommended that:

> "The Administrator of AID, as an integral part of project planning and as a condition for project approval, require that recurrent cost plans be developed in conjunction with recipient governments and other donors. This financial plan would
>
> -- recognize the principle of cost recovery, to the extent feasible, from all beneficiaries;
>
> -- project the annual life-of-system O&M costs;
>
> -- identify the sources of O&M funds and the O&M funding options available to the country and the donors, recognizing that system user fees, while an objective to be worked toward, have yet to be established as a reliable source of income;
>
> -- include specific plans to strengthen each recipient country's capability to budget for O&M funding and to account for O&M expenditures on a project basis; and

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[1]See also General Accounting Office (GAO), 1981.

-- institutionalize management monitoring and evaluation of plan implementation including identification of O&M shortfalls" (p. 22-23).

That same report also urged AID's administrator to encourage other donors to define their recurrent cost financing options:

> "Because of the magnitude of the O&M financing problem and the need for donors to work in unison, we believe other donors, such as the World Bank and the Asian Development Bank, should be encouraged to further define their policies toward recurrent cost financing. The Administrator, in his role as coordinator of U.S. assistance programs and in conjunction with the Secretary of the Treasury, should encourage the multilateral development banks to further define their recurrent cost financing options as they relate to future financing of irrigation project development" (p. 23).

Steps in this direction, by donors will help to develop self sustaining irrigation systems by focusing attention on the institutional and financial weaknesses which affect recipient countries' ability to effectively use and maintain irrigation systems. The immediate aim of donor agencies should be to strengthen developing country institutions and organizations that are involved in planning, designing, operating, maintaining, monitoring and evaluating irrigation systems. The ultimate goal is to improve technical efficiency, productivity and economic performance of irrigated agricultural systems (Svendsen, Merrey and Fitzgerald, 1983).

FINANCING RECURRENT IRRIGATION COSTS

Operation and maintenance problems present a substantial obstacle to the success of irrigation projects in developing

countries. Ways must be found by external donors and governments of these countries to assure that viable projects are built which will provide lasting benefits to the world's poor (GAO, 1981).

Recent steps taken by donor agencies in assisting the development of self sustaining irrigation systems by focusing attention on the institutional and financial weaknesses which affect recipient countries' ability to effectively use and maintain irrigation systems is a start. It is increasingly clear, though, that within government more careful planning of recurrent budget implications of capital expenditure is badly needed (Carruthers, 1981):

> "Water revenue policy, whether it is designed primarily to satisfy social, financial, economic or purely political goals needs to be reassessed in the light of emerging needs for more O&M resources" (p. 64).

A good starting point for any judgment on cost recovery is price policy: What should be the level and structure of prices of the output from the project (Ray, 1975). Advising on plans for cost recovery is an important and controversial step in the appraisal of irrigation projects (Duane, 1975). It is generally recognized that there is more scope for an upward revision of irrigation charges so that the irrigation system can be maintained more efficiently and a higher return obtained from them (Asopa, 1977). Jayaraman (1982):

> "The Finance Commission (India) also made a significant point that each irrigation project should run such that the water rates charged to the irrigators should not only cover working expenses but also provide for a return by way of

> interest at 1% on the total capital invested by the State. When making this point, the Commission rejected the argument made by certain state governments in the country that irrigation systems were "social services" and therefore, returns on investments should not be insisted upon. Very interestingly a similar argument was voiced by some participants in a seminar conducted by the Asian Development Bank on irrigation management in the Asian region. The consensus of the proceedings was that though it may be taken that the capital costs were sunk costs, it would be worthwhile to recover at least the costs of operation as far as possible through raising the water rates wherever they are in force or introducing the levy of water rates, if feasible, in those countries where such rates are not presently levied" (p. 407; also see Jain, 1977, p. 45).

Asopa (1977) notes that the main force guiding evolution of a water pricing policy is the financial performance of the irrigation project. Carruthers and Clark (1981) define the financial function as being where:

> "The water rates should cover the costs of the service. These costs include capital costs, O&M costs and revenue collection costs" (p. 184).

Easter and Welsch (1983) found that:

> "Government objectives for levying water charges usually include recovering some or all of the cost of providing water and influencing the allocation of water over time and among farmers" (p. 31).

They note that in many cases because of inadequate project implementation, the best that can be achieved is to collect enough fees to cover O&M costs. This appears to be the methodology employed by the Asian Development Bank (1980).

There are a number of methods by which water charges can be levied to cover the variable and/or fixed costs of the irrigation

system and they can be divided into two specific groups: direct and indirect. Each method has its own set of appropriate conditions (Seagraves and Easter, 1983). An equally important set of considerations covers the rules and procedures for water prices:

> "Rules and procedures for water prices or charges will affect both the distribution of water and benefits. Charges for water can serve as instruments to resolve some of the conflicts related to the equitable distribution of irrigation services. In addition, water prices can help improve the efficiency of water distribution" (Easter 1986, p. 50).

A number of factors which influence cost recovery practices should also be considered in the context of setting water charges (Asian Development Bank, 1980):

> "First, official rates of irrigation assessments may not accurately reflect payments which beneficiaries make for water. Discrepancies between the two may arise because indicated nominal water rates are not collected in full or because some payments for water are indirect or informal. Second, water rates should be considered in the context of overall financial policies for development. Since payments for water do not necessarily have to be in the form of water rates, charges for water cannot be considered meaningful outside the overall perspective of a country's development goals and strategies. Third, policies for financing irrigation infrastructure and services should consider the full range of irrigation beneficiaries. Direct beneficiaries of irrigation are landowners whose land increases in value because of its access to water, and farm operators who produce more because of more assured water supply. Indirect beneficiaries include government and the general food-consuming public, as well as manufacturers, agricultural businessmen, retail business merchants, and laborers. Fourth, higher water charges cannot be expected to provide incentives for more efficient water use unless they are assessed in relation to the quantity of water used. Fifth, changes in financial policies for irrigation may entail additional system cost. A decision to charge substantially higher water rates involves an implicit

> understanding that a more assured supply of water would be provided to farmers. If an existing irrigation system cannot provide reasonably guaranteed water delivery, additional expenditures are probably needed for infrastructure, operation and maintenance, or both. Introducing a new form of water charge may also entail additional administrative costs for collection and enforcement which need to be evaluated in relation to the increased revenue or water use efficiency expected from the new policies. Sixth, encouraging international adoption of common financial policies for irrigation has serious shortcomings. The economic-financial-institutional environments of irrigation in different countries are too diverse to warrant broad generalizations concerning desirable financial policies" (p. 35-36).

Finally, Howe and Dixon (n.d.) sound a cautionary note concerning the failure to collect fees to pay O&M costs:

> "When project revenues fail to cover O&M costs, the project becomes a permanent drain on the national treasury. Project beneficiaries become lax in their expectations of the project. Only by requiring project direct revenues to cover <u>at least</u> the O&M costs is the project likely to become 'self-monitoring' with enforceable performance standards in the form of revenue production" (p. 28).

ISSUES IN DETERMINING WATER RATES

A policy of levying water charges cannot pave the way for reaching all objectives simultaneously. The suitability of different criteria for determining water charges will depend on the priority given to different objectives (Doppler, 1977). Jain (1977) entertains a host of questions relating to quantum, mode of assessment, structure and the uniformity and diversity aspects of water rates.

> "The foremost questions are those that relate to quantum of water rates. These would include: (i) how high must the water rates be; (ii) how should these be related to the

paying capacity of the farmers; and (iii) whether or not the States should subsidize irrigation?

The second set of questions relating to the mode of assessment of water rates, would include: (i) what must be the method of changing for irrigation per unit of land or per unit of water; and (ii) if the assessment is to be per unit of land, whether the rate should be related to the command area (irrespective of the crops raised or irrigated) and realized as a part of the land revenue or should it be assessed on irrigated crop-area basis separately for different crops?

The third phase of inquiry pertaining to the structure of water rates would be concerned with questions such as: (i) whether there should be a single charge per unit of crop area irrigated or per unit of volume of water supplied or a two-way tariff including a fixed compulsory charge on the command area and a variable charge related to the actual crop-area irrigated or the volume of water supplied; and (ii) whether there should be an additional tax in the form of betterment levy to tap a share of the unearned increment in the land values consequent upon the advent of irrigation and, if so, whether it should be realized as a separate item or in the form of surcharge on the water rates?

Finally, the subject must deal with aspects relating to uniformity/diversity in the water rates as pertinent to different regions, different types of irrigation projects in a region and different crops in a project. Issues such as whether there should be a concessional rate during the gestation period of an irrigation project and how the irrigation rates may keep pace with increasing cost of irrigation over a period of time, would also be covered under this phase" (p. 42).

Selection of an approach that determines the level of charges provides the foundation upon which subsequent decisions must be based. The National Council of Applied Economic Research (NCAER 1959) advocates <u>benefit pricing</u>[2] as a basis for rate fixing.

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[2]See also Doppler (1977).

> "What is relevant for fixation of water rates is not cost but benefits. In a way, the benefits of irrigation are available to many persons. The state cannot make any levy on many of the indirect benefits by way of water rates. The only sound and justifiable basis for the irrigation rate should be the additional net benefit available to the cultivators from the use of the water supplied. Since the demand for water depends on the willingness of the cultivators to make use of it, the amount of net profits of the newly added farm products available to the cultivators can only be charged in the form of water rates. This amount of net profits to cultivators will depend, from time to time, upon changes in land assessments, the prices of agricultural products, the excise duty imposed on farm products, etc. This is the maximum which can be charged on the cultivators. It should be noted that the net profits on the newly added farm products are to be arrived at with reference to the immediate alternative to the use of irrigation water and this immediate alternative may be dry farming or wet farming by the use of water from tanks or wells" (p. 70).

As the NCAER (1954) recognizes it is difficult to measure the amount of additional net benefit available to all cultivators in a precise manner because each farmer faces a different resource and net benefit situation. Easter (1980) notes that:

> "Net returns per unit of water provide an upper limit on water charges since they reflect the maximum amount a farmer would be willing to pay. Net returns could be estimated as the difference in net income with and without irrigation. Alternatively net returns could be the residual after costs, other than water charges, have been subtracted from gross returns. Net returns will vary among farmers and may be difficult to calculate. The inefficiency involved in having different charges among farmers usually leads to a single fee based on the average net benefits in a region or area" (p. 18).

Benefit pricing and charges based on net returns are not the only approaches that can be followed in determining the level of water charges. Easter (1980) describes three other approaches:[3]

> "Fees could be set to meet a given target revenue. This could be enough revenue to cover operating and maintenance costs or possibly enough to cover the full cost of the project. Once the target revenue is set then it can be divided by acres irrigated or average volume of water delivered to obtain a per acre or per cubic meter charge.
>
> Total cost pricing is another alternative which could result in fees very similar to those obtained by target revenues. In total cost pricing, operating and maintenance costs plus a charge for capital costs are divided among individual farmers. The water fee then becomes the sum of these costs divided by the acres irrigated. Thus the level of the charge is based on how much of the project costs are to be covered by the irrigated farmers.
>
> Marginal cost charges are in theory based on the cost of adding another unit of water to the irrigation project or system. In actual practice this may not be possible because of the large lumpy investments required to increase irrigation water supplies. At best one may be able to talk about incremental changes of several thousand cubic meters of water. The cost of adding another unit would be the appropriate fee when present facilities are being used to full capacity" (p. 17-19).

Whatever the approach used in charging for water, other variables should also be considered. These considerations include, among others (NCAER, 1959; Doppler, 1977; and Easter, 1980):

1. Elasticity of demand: charges for water will have a greater impact on water use the more elastic the demand.

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[3]See also Bergman and Boussard (1976), Doppler (19), Neghassi and Seagraves (1978), Carruthers and Clark ( ), and Seagraves and Easter (1983), among others.

2. Dependability of supply: if the value of water fluctuates widely, it may be too much trouble administratively to vary the charge:

"Hence, a low charge is assigned to encourage full use in periods of abundance, and then quotas or regulations are used to allocate water among farmers in times of shortage" (Easter, 1980, p. 11).

3. System capacity:

"Even though the total social benefits of new irrigation projects exceed the total costs, it may be difficult for governments to recover from users the fixed costs of the installations. One reason is that many irrigation systems are designed so that they will have excess capacity most months of the year. Since it is difficult to pred ct such periods and administer the required price flexibility, there is a tendency to cover the capital costs from general revenues" (Easter, 1980, p. 13).

4. Return flow and drainage: Reuse of water downstream can increase the total value of water supplied by an irrigation project. Drainage problems are the negative side of the return flow situation.

5. Staff training: without a trained staff it is very difficult to deliver water to farmers at the time and in the quantities demanded.

6. Level of information: if farmers do not have information on when and how much water they will receive they cannot be expected to make the best use of the water involved. The irrigation authorities also need information concerning who receives water and what is grown. Otherwise it is impossible to relate the water charge to the service provided.

7. Risk distribution:

Where total costs are used as a basis of calculating water charges, the risk entailed by the initial capital investment will be borne entirely by the farmers, even though generally they will have had no say in the investment decisions. On the other hand, where water charges are calculated on the basis of benefit pricing or of operating and maintenance costs, the risk will fall upon the irrigation authority and so upon society as a whole or the rest of the agricultural sector" (Doppler, 1977, p. 124-125).

8. Traditions of ownership and water law: rights and customs concerning who owns the water should influence the fees charged and will likely influence the direct and indirect economic activity created by irrigation.

9. Links with other agricultural taxes: including input and product taxes.

10. Long and short term objectives: at the national, regional, state and local levels.

11. The value of water: to the user and society should help determine the level and type of water rate and how much effort should be expended in collecting the fees.

12. Market conditions for agricultural products and inputs: these conditions will determine the distribution of irrigation benefits among producers, consumers and agricultural service suppliers.

Finally, no discussion on water pricing issues is complete without an examination of the reasons for the use of irrigation subsidies. Neghassi and Seagraves (1978), in a review which summarizes the extent of irrigation subsidies, found that irrigation projects are generally highly subsidized, implying that the direct beneficiaries do not pay for the complete cost of irrigation (Table 2A). However, they go on to note that there are other users and beneficiaries of water projects which should be taken into account in determining actual subsidies:

> "Since irrigation projects also generate indirect benefits and irrigation is one of several project purposes, it is reasonable that other beneficiaries bear a share of the costs of the irrigation infrastructure and operation and maintenance. In this sense, repayment commensurate with the benefits realized by other beneficiaries should be deducted from overall project costs before the extent of subsidy to direct beneficiaries can be inferred" (p. 60).

TABLE 2A. Level of subsidy of irrigation water in selected countries (regions)

Country (region)	Nature and level of subsidy
India	80 percent or more of annual equivalent costs of construction (major projects)
Japan	40 to 80 percent of capital construction, improvement, and reclamation costs
Democratic Kampuchea	100 percent
Lao P.D.R.	100 percent
Malaysia	100 percent of capital construction and over 50 percent of O&M costs
Pakistan	In lower Indus region, cost of irrigation is only 10 percent of the returns to irrigation
Philippines	40 percent of operation and management costs in the Santa Cruz system
Republic of China	50 to 70 percent of capital construction
Dem. People's Rep. of Korea	70 percent of capital construction costs
Dem. Rep. of Viet-Nam	100 percent
Australia	All capital construction costs and part of operation and management costs
Canada	More than 50 percent of capital construction costs
Europe	Generally 40 percent of costs of irrigation
USA	Up to 60 percent in U.S. Bureau of Reclamation projects; mostly by other uses, mainly power

SOURCE: Neghassi and Seagraves, 1978, p. 60.

Gole, Amble and Chopra (1977) report a somewhat different reason for the use of irrigation subsidies and explore the inherent conflict in rate determination:

> "The irrigation rate has then to be determined balancing two opposing considerations. On the one hand, it is necessary to recover the costs and even a share of the benefit received by the irrigator in the interest of resource mobilization for further development as the benefit of irrigation accrues only to a small section of the population. On the other hand, the producer has to be provided the incentive for increasing production through greater utilization of irrigation" (p. 31).

Carruthers and Clark (1981) outline some additional reasons for irrigation subsidies and provide support for Neghassi and Seagraves (1978):

> "There are at least five possible economic reasons that might be used to support subsidized irrigation rates. Firstly, where increasing returns to scale in construction (decreasing average cost) have encouraged installation of a high level of installed capacity, which for one or more reasons is under-utilized, rates at, or close to, short-run marginal costs are optimal. Secondly, and more generally, it can be argued that the beneficiaries of irrigation include not just the farmers but also, indirectly, many others. For example, there are firms supplying farm inputs and firms processing and marketing the outputs who will benefit from increased turnover. Similarly, it is possible that the incidence of benefits will lie in part with consumers of the output. It is possible to argue that the incidence of costs for irrigation should lie not just with the users but with all the beneficiaries.
>
> Thirdly, the reason for financial subsidies is that often there are major distortions in the market prices for factors of production and outputs because of government interference, e.g. import duties, export taxes, or minimum wage legislation. The overall effect of these distortions is to make the financial costs higher than their real (economic) costs. Various financial subsidies can be justified to help correct market distortions and to provide the appropriate economic signals to producers. A subsidized water tariff may be desirable in these circumstances.

Fourthly, very low irrigation rates may be found in countries with many old-established schemes. Costs of these schemes were initially low and, because they are now fully depreciated, only operation and maintenance costs have to be covered by rates. In these circumstances, it is usually not politically practicable to set very different rates for new, high-cost projects. Water rates within a country tend to be equal no matter what the cost of supplying water to the individual scheme (postage stamp pricing principle).

Fifthly, betterment levies, which are discussed later, are sometimes placed on the increase in capital value of irrigable land. In this case it would be double taxation to levy annual irrigation rates on a full cost basis.

The NCAER (1959) provides a case for the gradual upward revision of water rates which is similarly supported by Doppler (1977).

> "In the case of areas covered by new projects, where the peasantry is not fully conversant with wet farming methods and a switch-over from dry farming to wet farming requires supplementary investment, an imposition of the full irrigation rates might be a discouraging factor in the development of irrigation. Hence, it would be desirable either to allow the free use of water or to levy the rate at a low level in the initial few years, depending on the actual conditions prevalent in the particular area at a given time. At present, when there are cases of irrigation projects, new as well as old, where the available facilities are to a great extent underutilized, a reduction in the water rates could be an important factor in the popularization of irrigation.
>
> Water rates should be periodically revised in the light of changes in the general price-level which affect the value of the returns as well as the various items entering the cost of cultivation. Too frequent revisions involve additional expenditure to the state and promote a feeling of insecurity among the farmers. On the other hand, the continuation of old rates for too long might throw them out of their intended relationship with the benefits" (NCAER, 1959, p. 75).

Whatever their justification, extreme caution must be exercised when using subsidies to support irrigation.

Promotional-type pricing policies are very difficult to revise later unless the operating agency has considerable political support. In fact, even minor increases in water fees can cause a political crisis particularly if farmers are use to receiving water free or almost free of charge. Recognition of this point is essential if subsidies are to decline over time. With continued high subsidies, the long run O&M would suffer and project efficiency decline.

METHODS OF CHARGING FOR IRRIGATION

There are a number of direct and indirect ways to assess farmers' water charges. Each type of charge has a different effect on water allocation efficiency, ease of collection, inputs use, cropping patterns, adoption of irrigation and cost of implementation (Easter, 1980; Seagraves and Easter, 1983).

Direct Charges

The methods available to directly charge farmers can be broken down further into five groups: (1) charges based on water shares or number of irrigations, (2) charges based on acreage irrigated, (3) charges based on the area of different crops irrigated, (4) charges based on the volume of water received and, (5) charges based on the need to promote irrigation. In some cases, only one type of fee/charge is used while in others a combination of fees may be used in an effort to meet project objectives (Easter, 1980).

Charges based on shares received is a system that provides farmers an incentive to use water efficiently by relating fees to the amount of water individual farmers receive. One example is to charge farmers for the amount of time water flows into their fields (Easter, 1980). Charges could also be based on the number of irrigations farmers receive. This would produce the same results if each irrigation was of equal time. Easter (1980) outlines the limitations and advantages of these methods of charging:

> "The actual amount of water received will depend on the flow in the canal or river (which will vary over time) as well as with the time allowed for each share of irrigation. Thus, the amount of water delivered per share may vary among farms and time of the season.
>
> Charges based on shares is best suited for rotating irrigations where water is delivered to the users along a canal in turns according to some prearranged schedule. Rotation systems are usually based on proportional division of stream or canal flows so that farmers receive shares of an annual flow rather than a certain volume. Volumes associated with such shares may be unknown. A fixed delivery schedule makes it difficult for a farmer to delay receipt of water or to transfer it to someone else along a different canal. A flexible schedule, however, would also cause problems, by making it necessary to inform users of changes in the time of arrival of water at their farms. Thus a good communications system would be necessary to implement a flexible schedule" (p. 4-5).

Charges based on area irrigated are collected from farmers based on the area irrigated per year or per season. Charges assessed on a land unit basis furnish no incentives for the efficient use of water. Easter (1980, p. 6) comments:

> "Fixed charges per acre are primarily a means to collect funds and repay project costs. It is a way to collect some

of the economic surplus created by irrigation without causing too many distortions. It tends to work best if the same crop is grown throughout the irrigated area for each season...

The fixed charge per acre is best suited for continuous flow irrigation, where water flows continually through a canal on certain days and each farmer is free to take whatever quantity he or she needs. In some systems water flows continuously in the canals throughout the cropping season. The water itself may have little value at the margin even through the delivery system may be costly. Farmers usually pay annual fees for access to the water and/or contribute labor toward the maintenance of the canal. It is not practical to estimate the amount of water used. However, if the quantity and timeliness of water delivered varies by location on the canal this could become the basis for varying charges."

The charge may also be based on the acres farmed or owned in the command area whether or not water is actually used or received for irrigation.

"This method of assessment provides the irrigation authority with a reliable and steady source of income regardless of seasonal or year-to-year fluctuations of water use. Its effect on farmers will be that they have to work according to fixed expenses. They will consequently be concerned to use as much water as possible, with the risk that they will do so uneconomically" (Doppler, 1977, p. 126).

Farmers who receive water will tend to apply more than is economically desirable for society. Those in the head-reaches substitute water for management and apply water up to the level where its marginal value is close to zero.

"A fixed irrigation charge results in the farmers applying more water to their lands than is economically desirable. This in turn results in the excessive use of other complementary inputs. In the forward end of the distributary, water is wasted and sufficient attention is not given to its proper management and conservation. In

> consequence, the tail-enders suffer an acute shortage of water and thus receive low yields" (Asopa, 1977, p. 60).

One clear advantage to this method, though, is simplicity of administration which Bottrall (1981) identified as an important criterion with regard to methods of water charge payment and collection. Bergmann and Boussard (1976) also note that "increasing the fixed charge by a reasonable fixed annual amount independent of the subscribed capacity is simple and effective, and is an incentive to farmers to use the water made available to them" (p. 108). However, this may turn out to be a perverse incentive as more farmers find new ways to avoid paying the charges and/or to use excessive amounts of water.

Charges based on the area of different crops irrigated are collected in the same manner as the simple area based charges. The only difference is that charges are varied by the type of crops grown. Usually charges are highest for high water consuming crops such as rice. Fees in this case may be used to encourage crops that use less water per season. To implement such a charge irrigation officials need to have accurate records concerning who grows what irrigated crops.

Additionally, one can assign crop priorities during periods of water shortage.

> "In this type of system crops are assigned orders of priority which are normally based on the economic value or importance of the crop. When water is in short supply, priority crops receive water first. If water remains after irrigating priority crops then it is distributed to other crops. It basically allows some crops to be saved during periods of drought. Water charges would be set highest on

the crops assured of getting water (high priority) and lowest on those crops that have least priority and least assurance of obtaining water" (Easter, 1980, p. 6-7).

Although charges based on the type of crop irrigated can meet certain project objectives it may not be closely related to farmers' ability to pay.

"In practice, a high valued crop coupled with a high cost of cultivation might leave a lower net benefit than a low valued crop with relatively much lower cost of cultivation. To illustrate this point from our Sarda Canal study, the value of output per irrigated acre of wheat is Rs. 168 while the extra net benefit is nearly Rs. 45, which is approximately 27 percent of the value of the output. In the case of paddy, the value of the output is Rs. 166 and the extra net benefit is nearly 30 percent of the value of the output. In sugarcane, the extra net benefit is 40 percent of the value of the output...

"The value of output from wheat or paddy is more or less the same ... If 10 percent of the value of the output is accepted as the reasonable amount for the water, the water rate for wheat and paddy will be the same, i.e. about Rs. 17. But the extra net benefits in both the cases are different. In wheat the cultivator will get nearly Rs. 28 per acre as additional net benefit; whereas in paddy his additional net benefit will be Rs. 34 after paying water rates. In sugarcane, the cultivator has to pay only Rs. 30 as water rate but his extra net benefit will be Rs. 91" (NCAER, 1959, p. 79).

<u>Volumetric pricing</u> offers the greatest incentives to farmers for efficient water use. Farmers are charged for the actual amount of water delivered to their farm headgate (Easter, 1980).

"Individual farmers will be able to determining their own irrigation expenses by controlling consumption. They will be acutely aware whenever upper or lower economic water charge thresholds are reached: when they cease to obtain returns on irrigation, they will do without it; if water charges are too low, they will use water wastefully" (Doppler, 1977, p. 126).

Unfortunately, one of the key problems with volumetric based fees is the cost of measurement devises required to implement the system (Easter, 1980). Gole, Amble and Chopra (1977) note:

> "It's application for irrigation systems other than tubewells involves a large investment for installing meters and supervisory staff which may be beyond the present resources" (p. 37).

As a result, volumetric charges are best suited for water which has a high value to the country and needs to be allocated efficiently (Easter, 1980).

> "Where metering is too difficult or costly to allow volumetric pricing, it may sometimes be feasible to use alternative charging schemes that have similar efficiency effects. However, unless proxies for volumetric pricing, for example, differential taxes on crop production related to the water consumption of the crops, are carefully const ucted, they may induce uneconomic cropping patterns and water use" (Ray, Bruce and Hotes, 1976, p. 4).

<u>A promotional or developmental fee</u> is generally used in the early stages of a project.

> "This has been used in projects that are underutilized when they are first opened. The idea is to encourage greater water utilization with lower fees at the start of the project. Once an irrigation system is in place and there is excess water, the cost of adding another farmer within the irrigated area is very low. The fees are usually scheduled to increase over a 4 to 5 year period until they reach the desired level. However, increasing the fees once farmers are using the project has proven not to be an easy task. A system of promotional fees would probably be used in an area that has had no previous irrigation and should be combined with experimental plots and technical assistance for the farmers. The technical assistance and experimental plots are probably more important than the promotional fees" (Easter, 1980, p. 7-8).

Indirect Charges

Under some conditions, indirect methods for levying water charges are used. These methods can take the following forms: (1) a betterment levy, (2) a general land tax and (3) a tax on farm inputs and/or outputs.

Low water prices result in the capitalization of irrigation benefits into land values. In this case, landowners are the major beneficiaries (Torres, 1973). A betterment levy is a tax on part of the increase in the capital value of land that occurs following provision of an assured irrigation supply (Carruthers and Clark, 1981). Ray, Bruce and Hotes (1976, p. 4) note that:

> "The most robust form of benefit tax is a land betterment tax spread over, say, the life of the project. As long as the tax base is an accurate measure of the benefits conveyed, which implies careful revaluation of land values at reasonably frequent intervals, it should meet the test of user acceptability.
>
> The level of benefit taxes should preferably incorporate a degree of progressivity, subject to the constraints of disincentives to work and tax evasion propensities. Thus, it may be desirable to charge very poor farmers at a low rate, while those beneficiaries whose income are higher might be taxed progressively up to the limit of their rent. Imparting a degree of progressivity into benefit taxes should lead to higher levels of cost recovery than otherwise would be the case."

Two interesting aspects of the betterment levy are brought forward by Carruthers and Clark:

> "For some uncertain reason there is often expected to be less reaction by beneficiaries to a betterment levy than to high annual water-rates. Perhaps landowners are thought to be in close touch with land values and therefore to realize that a betterment levy, if fixed at a realistic level, still

allows part of the increased land value to accrue to the owner..."

"If there is strong government enforcement of the betterment levy, there may be other advantages besides the obvious financial ones. The need for finance may encourage land sales. Land use is typically less intensive on large holdings. Given a ceiling upon ownership of land, if a more vigorous market in land can be developed, this will provide a shift of irrigated land ownership to smaller farmers, and more productive holdings will occur" (p. 192-93).

Similar to the betterment levy is a general tax on all land or property in the county or district served a large irrigation project.

"The idea behind such a tax is that the irrigation increases economic activity throughout the area and everyone benefits. It is not clear that this always happens but in some cases the benefits from the irrigation project have spread throughout the area benefiting businessmen, workers and farmers. If this is the case, then the economic surplus should be collected from businessmen and farmers alike. Thus, a general tax on land or property can be used to pay at least part of the project's cost. Other fees may also be imposed on farmers either because they gain the most or to improve water use efficiency." ...

"The land tax or property tax like the charge per acre will have no direct effect on water use efficiency although a high land tax will encourage the highest valued use of the land. Still land taxes are primarily a method of collecting revenue from those benefiting from the project. It does allow for a larger tax base to support irrigation projects and will allow local areas or district to fund some of their own irrigation development.

"If the tax is based on differences in land and property productivity, lack of information may make it difficult to implement. Many countries lack the data required to differentiate among various land and other property values. Thus a property tax to pay for an irrigation project may require a whole new data system for estimating property values.

"Taxing power may also be limited to the bare land. This would prevent the tax from focusing on early improvers,

> intensive farmers and prevent the tax from retarding development (Easter, 1980, p. 8-9).

Finally, taxes on inputs and/or outputs are another means to collect funds to repay project capital costs and cover O&M costs (Easter, 1980). Ease of collection appears to be the main reason for using a system of this type. Unfortunately, it has no impact on the efficiency with which farmers allocate water, a problem inherent with indirect water charges.

> "It gives farmers distorted incentives concerning what crops to produce and provides no incentive for efficient water use. If the fee is only placed on cotton, farmers may produce less cotton and more clover or other crops. The government will lose both revenues for water and cotton export sales. When inputs such as fertilizer are taxed to pay for water this will discourage farmers from applying fertilizer and lower production. Thus, with indirect charges governments must be aware of the signals such charges are giving farmers" (Easter, 1980, p. 7).

Doppler (1977, p. 127) summarizes the administrative response to these problems:

> "The system of indirect charging encourages project managements to adopt policies of close control over farmers' activities:
>
> Crop rotations are specified beforehand to ensure a certain volume of production of the crops on which charges are made. Fertilizers are supplied directly to the farmer to preclude a fall in production intensity. Specific quantities of irrigation water are allocated to each farm. The production process is closely supervised."

INSTITUTIONAL AND ORGANIZATIONAL REQUIREMENT FOR O&M

Unfortunately, the institutional and organizational environment in which irrigation takes place has received little analytical attention by those concerned with irrigation (Bromley, 1982; Holloran, et al., 1982; and Svendsen, Merrey and Fitzgerald, 1983). Combined with financial weaknesses, institutional and organizational deficiencies seriously undermine a developing countries' ability to effectively operate and maintain irrigation systems. By addressing institutional, organizational and financial constraints, which have a tendency to be mutually dependent in relation to O&M deficiencies, it should be possible to achieve the development of self-sustaining irrigation systems.

A recent GAO study (1981) found that:

> "Developing countries' problems frequently are caused by fragmentation of responsibility for water resources development among several agencies in different ministries, and limited cooperation between the governments and aid donors" (p. 25).

A direct result of these problems is that the level of management in irrigation is generally poor, as is evidenced by a recent case study of Sri Lankan irrigation (Moore, 1981):

> "A functioning system of water management is a fragile plant from both the physical and institutional point of view. If one element in the system does not work then this tends to have adverse effects on others and a series of vicious circles can quickly come into operation (p. 121).

The Participatory Approach

The literature indicates that the most efficient form of irrigation administration, especially for large projects, is one in which all of the project management activities are coordinated by a single agency. It is also widely agreed that in many cases the effective organization and management of irrigation systems at the local level can best be achieved through formal or informal WUO (Easter and Welsch, 1983). Water user organizations or associations (WUO) are advocated by every donor agency, including AID and the FAO (U.N., 1968; Bergmann and Boussard, 1976; U.N., 1980; Anonymous, 1982; and GAO, 1983):

> "AID project designs have assumed that water user associations would be established and provide on-farm maintenance, ensure equitable water distribution, and maintain discipline among users" (GAO, 1983, p. iv).

These agencies argue that WUO provide the optimal administrative structure to ensure property O&M and to accomplish the efficient and equitable distribution of water to farmers' fields. Many developing countries, such as the Philippines, also support the concept (Steinberg, et al., 1980; de los Reyes, 1981; Korten, 1982; Asopa and Tripathi, 1978; and Singh, 1981).

In India, WUO have been used to support the use of Warabandi systems[4] (Singh, 1981), and to aid in the development of command areas (Singh, 1983).[5] In the Philippines, WUO are formally called irrigator service associations (ISA). Steinberg, et al. (1980) define ISA further:

> "The ISA are legal entities that borrow money and repay loans, cover costs of electricity, arrange for the equitable distribution of water among the membership, organize voluntary labor to build canals, and provide for adequate maintenance of the systems. Small farmers work together because that is the only way the irrigation system will be effective. The government, on its part, provides the capital and a type of extension service, and arranges, where necessary, for electricity to be brought to the area" (p.1).

Irrigation service associations were developed in the Philippines in response to the government's desire to increase production and improve the farmers' livelihood. The development of communal associations of this type in the Philippines has been greatly aided by government support through the National Irrigation Administration (de los Reyes, 1981).

Water user organizations are based on the premise that irrigated agriculture cannot be successful if it is not actively supported by the irrigators themselves (Papadopoulo, 1969). With this premise in mind, the GAO (1983) compiled a list of

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[4]Singh (1981) defines Warabandi:

> "Warabandi is a system of equitable water distribution by turns according to a pre-determined schedule specifying the day, time and duration of supply to each irrigator in proportion to land holdings in the outlet command" (p. 46).

[5]See also Wade (1975).

prerequisites for establishing WUO based on discussions with donor agencies, consultants, and government representatives as well as their own analyses. Water user organizations should:

-- be "tailored" to meet the specific needs of the locality; for example, ethnic background, religion, local custom, size, and local organizational structures should be carefully considered.

-- have a strong organizational structure that can establish discipline and ensure equitable water distribution.

-- be convinced of the benefits and advantages of the irrigation system and the importance of operating it efficiently and maintaining it regularly.

-- participate in the system's design and construction to help establish a sense of ownership (p. 37-38).

Steinberg, Clapp-Wincek and Turner (1983) note also that:

> "There is a marked difference between organizations whose primary purpose is to distribute water, and those devoted to other ends. To be effective, water-user associations must have virtually compulsory or complete membership, otherwise they cannot accomplish their objectives. This makes them quite different from other local institutions, which generally need to be voluntary to be successful" (p. 73).
>
> "If it is generally agreed that water-user associations in some form are vital to effective irrigation systems, there is a diverse and growing body of opinions that they should be in place before construction or rehabilitation of systems" (p. 75).

Korten (cited in Steinberg, Clapp-Wincek and Turner, 1983, p. 75-76) adds three other factors based on lessons from the Philippine experience:

-- water-user associations must have clear authority and responsibility.

-- existing organizations should be used.

-- water-user associations must make substantial contributions to the costs of system development.

The Overseas Development Institute (1978, p. 1) adds to the list with their observations:

> "For some activities the most effective unit for a farmers' organization may be the village, but water users' organizations are likely to be most effective if they are channel-based. Their main initial concern should be with operating and maintaining the watercourse but, if successful in that, they are also likely to provide convenient focal points for contact with the official administration and sharing common resources. A precondition for their initial success is that reliable water supplies be delivered to the watercourse outlet."

It is significant to consider the problems that have occurred when and where local participation has not taken place, as identified in the literature. Howe and Dixon (n.d.) remark:

> "Failure to enlist the appropriate public in the planning and construction phases often has lingering detrimental effects on project O&M. Poffenberger has noted some of the consequences of this failure in Indonesia: (a) failure to incorporate local knowledge of soil types, drainage problems, land instabilities, etc. into the design; (b) failure to take local social relationships into account in connection with water distribution; (c) generation of an attitude of "their (government's) project, their responsibility". The last of these points is probabl/ the most important from the maintenance point of view, for maintenance of tertiary and quaternary systems is often left as a local responsibility" (p. 23).

Steinberg, Clapp-Wincek and Turner (1983, p. 76) concur by noting:

> "It is also evident that farmer involvement through associations in the planning stage has resulted in avoiding costly errors in design of canals. There is every evidence that discussions with farmers by project design staff, either of implementing agencies or donors or preferably both, at the earliest stage would yield practical improvements in the systems and probably cut operation and maintenance costs."

Chambers (cited in Howe and Dixon, n.d., p. 24) speculates on the failure of the government and other agencies to mobilize local resources:

> "Chambers calls attention to the wealth of accumulated experience and knowledge of local inhabitants ... But government servants and researchers are not inclined to spend much time listening and learning. They either think they know already, or somehow fear to ask, or do not know how to, or are insulated from contact with the local inhabitants by their habit of rushing out and back from their offices ... The cost is great".

However, it must also be recognized that WUOs are not without limitations. Size is an important issue. WUO should be small in size to be given a chance to work effectively. Large WUO are likely to prove too inflexible and difficult to administer in an equitable manner. Bottrail (1981) notes that size is an important factor:

> "It is generally agreed by scholars who have studied both large and small irrigation systems in developing countries that in each context there is a certain point along the spectrum of size above which the level of performance can be expected to decline if executive responsibility for operating and maintaining the system is left exclusively in the hands of the farmers themselves. Above this dividing line, better results can be achieved if executive responsibility for the O&M of the main distribution system is given to an independent specialized agency (usually in the public sector), with small groups of farmers retaining

responsibility for O&M below each watercourse outlet" (p. 200).

Precisely where this threshold or upper limit comes on smaller systems depends on a number of factors, of which the most important appear to be the simplicity or complexity of the technology concerned, the abundance or scarcity of the water supply and the social cohesion of the community or communities concerned. The last factor is likely to be heavily influenced by the nature of the system's origins: whether it is an 'indigenous' system which was constructed exclusively by the farmers themselves and has subsequently been operated and maintained by them with little or no external support; or whether it was constructed by government. In the former the motivation to act cooperatively is likely to be much more strongly developed. Where unusually complex multi-community systems are found to be operating successfully under farmers' management alone, they appear invariably to be indigenous systems with a long tradition of cooperative action" (p. 201).

Another difficulty lies with efforts regarding irrigation reform. Conversion of an existing institutional structure to one based on WUO can prove to be extremely difficult. Ali (1981) provides an appraisal of efforts at implementing irrigation reform in the state of Andhra Pradesh, India:

"In spite of laudable and progressive policy decisions taken both by the Central and State Governments, the implementing agencies in the existing department's of government continued to cling to their existing structure and refused to part with any items of work or any portion of their powers. They had ignored the objectives and functions for which the new organizations were set up" (p. 21).

A part of the problem in forming and maintaining active WUO arises from the fact that local users could not depend on the main irrigation systems for a reliable source of water. Hence, as Jayaraman (1981) notes dependable water supplies are a must.

> "Pious expressions of farmers' voluntarily coming together and setting up an association to maintain the infrastructure below the outlet and to distribute the supplies among themselves tend to remain only on paper until credibility in the irrigation management is established. Unless the designed discharge is let out at the outlet at appropriate intervals as desired by the irrigators to suit the crop-water requirements, irrigators will not have any trust in the project management and an atmosphere of conflict can never pave the way for voluntary maintenance of the infrastructure (p. 263).

In view of these limitations, WUO have been more a slogan than a practice. Singh (1983) warns that it takes more than just establishing WUO to solve water management problems:

> "The establishment of Farmers' Association or Water Users' Associations is not an easy solution to irrigation management problems. It requires intensive government effort, appropriate training institutions, staff who stay in a district long enough to become familiar with its social structure and to gain experience in the techniques of building up farmer participation, and a consistent policy over the term of years necessary for new social institutions to acquire their own norms and legitimacy" (p. 11).

Finally, Hunt (1985) argues that community or communal irrigation organizations are not good analogs of water user associations (WUA) in bureaucratic canal irrigation systems because these WUA do not obtain rights or sufficient rewards from performing O&M tasks.

> "It is clear that conceptually WUA are an analog of Irrigation Communities, and it is clear that this is a weak analogy at best. Irrigation communities have rights and duties, and WUA have only a disaggregated bundle of duties. Irrigation communities are based on rewards as well as rights and duties, WUA on duties alone. Irrigation communities are systems of rights, duties and roles with substantial local control, WUA are duties alone, with no rights, and no local control, and no system among these things. Irrigation communities are vertically integrated to

the headgate, so that the rights to water are protected and institutionalized, and in WUA there are no group rights to water, and no arenas to legitimately discuss problems with water delivery" (Hunt, 1985, p. 30).

The Centralized Approach

At the opposite end of the spectrum from the WUO "bottom-up" approach is the model of a "top-down," centralized administration of an irrigation system.

Pakistan provides an excellent example of centralized administration with their Provincial Irrigation Departments (PIDs).[6] A number of references pertain to Pakistan's centralized administration (Johnson, Early and Lowdermilk, 1977; Reuss, Skogerboe and Merrey, 1979; and Skogerboe, Kemper and Reuss, 1980). Reuss, Skogerboe and Merrey sketch out the advantages of a centralized system:

> "Superficially, the advantage of this model appears to be that rapid physical progress is possible. Theoretically, the government could simply improve watercourses by itself, or through contractors, or even order the farmers to do it. Strict regulations could be promulgated to ensure the maintenance of watercourses. The long and difficult process of motivation, education, extension and organization of farmers believed necessary by many to get farmers to cooperate on voluntary programs could then be minimized or even eliminated. Some states in India appear to have adopted a variant of this type of strategy" (1979, p. 416).

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[6]Development Alternatives, Inc. was recently employed by AID to assess PIDs in Pakistan. See their report, "Funding Requirements for Adequate Irrigation System Operation and Maintenance: Pakistan," 1984.

However, a number of authors note that past, as well as current, performance of centralized types of organizations has been less than adequate:

> "There are many drawbacks in the centralized strategy. In the first place, this approach to future water management projects would require a huge bureaucracy if the program is done at the large scale envisioned: a veritable army of administrators, engineers, accountants, inspectors, typists, clerks, drivers, peons, rodmen, and the like. Such a large bureaucracy would not only create very high overhead costs but, based on past experience, would be extremely ineffective: abuses of powers would be impossible to control, recruitment of competent personnel problematic and quality control difficult.
>
> Another objection to this approach derives from social anthropological evidence and theory based on studies of the history of other centralized irrigation systems. Studies of "irrigation civilizations" in the past and present in Mesopotamia (modern Irao) and in Mexico suggest that for various complex reasons such centralized systems have an inevitable tendency to break down (Fernea and Effendi, 1970; Flannery, 1972; Lees, 1974). Some of the reasons are that such systems are very vulnerable to political instability at the top; the tendency to overcontrol and coopt authority by higher levels of the organization leads to insensitivity to local problems (Pakistan Times, 1979). This tendency is observable in all complex organizations in all countries" (Reuss, Skogerboe and Merrey, 1979, p. 416).

As a result of these shortcomings, a number of authors have called for or otherwise advocated a decentralized mode of organization for water management as an approach to improving irrigation systems.[7] This leads back to water user organizations and the need for farmer participation particularly at the local level.

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[7]See for example Reuss, Skogerboe and Merrey, 1979, p. 417.

In the absence of either a decentralized or centralized type of administration, alternative organizational and institutional arrangements need to be developed. This would include mechanisms to collect fees based on an irrigation code which has adequate incentives, penalties and means of enforcement to be effective. Unfortunately, there is virtually no mention of this type of institutional planning in the literature except in the context of the decentralized and centralized models already outlined.[8] Attention needs to be focused on these types of institutional and organizational arrangements to provide new alternatives.

LESSONS LEARNED

Donor agencies can help in plugging the gaps, but the prerequisite for successful irrigation projects and programs is a national commitment to the irrigation sector. In addition, the potential beneficiaries must be motivated by appropriate incentives and be prepared to contribute to O&M so that the facilities will continue to function after they have been installed or rehabilitated.

In summary, the goals and objectives of an efficient and equitable irrigation system can be achieved but will require the following:

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[8]See for example Dissanayake in Levine and Hart, 1981, p. 9-11.

-- clearly established management objectives.

-- an adequate organizational structure with adequate resources (agency).

-- a basic framework of management procedures within the irrigation agency.

-- an information system which accurately reports who receives water and what crops are grown.

-- an approach to determine the level of water charges to be assessed.

-- mechanisms for provision of a sufficient level of O&M (water user organizations, etc.).

-- an effective and dependable delivery system.

-- enforcement procedures and incentives to obtain the appropriate farmer response.

-- effective use of farmer water fees to maintain and improve their irrigation systems.

-- mechanisms for involving farmers in irrigation planning and management decisions.

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