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PRELIMINARY REPORT ON IRRIGATION PRICING AND MAN...ENT

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Ms. Joan Atherton
Social Science Analyst
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Dear Joan:

Devres is pleased to submit the enclosed three copies of the Preliminary Report on Irrigation Pricing and Management. As discussed at the meetings in December, we have defined six issues specified as questions in lieu of hypotheses. The issues are focused on recovery of recurrent costs and on increased farmer participation to improve irrigation management. The current literature on each issue is discussed and the procedures for analyzing it are specified. Data sources are also noted.

The six case study sites that have been selected for field work are India, Indonesia, Morocco, Peru, the Dominican Republic and the Philippines. In response to your concerns we substituted the Dominican Republic for Mexico and added the Philippines. The work plan required by the RFP is provided in Annex 1 of the Report. Annex 2 is a partially Annotated Bibliography. As we agreed over the phone a couple of weeks ago a complete version of the Bibliography will be included in the Final Report.

We look forward to receiving your comments on the Preliminary Report. If you have any questions or comments, please call me. Thank you for your assistance and cooperation.

Warm regards,

Sincerely,

Rekha Mehra

Rekha Mehra
Associate

Enclosure: Preliminary Report on
Irrigation Pricing and Management

RM/rtn

LIST OF ACRONYMS AND ABBREVIATIONS

DGAS	Direccion General de Aguas y Suelos
INAF	Instituto Nacional de Ampliacion de la Frontera
INDHRI	Instituto de Recursos Hidrolicos
INIPA	National Agricultural Research Institute (Peru)
kharif	In India, the crop planted in the spring and harvested in the fall
NIA	National Irrigation Administration
O and M	Operations and Maintenance
ONERN	Oficina Nacional de Energia y Recursos Naturales
PET	Potential Evapotranspiration
RFP	Request for Proposal
subak	In Indonesia, term for irrigation society

PRELIMINARY REPORT ON IRRIGATION PRICING AND MANAGEMENT

TABLE OF CONTENTS

Page

Page

LIST OF TABLES

EXECUTIVE SUMMARY

A. Purpose and Procedures

The purpose and procedures of this study on irrigation pricing and management which are set forth in Chapter I are as follows:

1. Purpose

The purpose of this study is to investigate ways to improve the effectiveness of functioning irrigation systems by examining the role of:

- Direct charges in meeting recurrent costs: This is based on the premise that successful mobilization of local resources from users will promote irrigation efficiency directly through improved water utilization, and indirectly, through better Operations and Maintenance (O and M); and

- Increased farmer participation in system management: There is a growing belief that the mobilization of human resources in this way will impact favorably on both O and M and cost recovery.

Six issues related to these objectives on the pricing and management of irrigation water are specified in Chapter IV.

2. Procedures

The procedure for carrying out the research is as follows: First, secondary source literature will be drawn upon as background to the study. This will be followed by six case studies based on field visits conducted by two multidisciplinary teams. They will go to irrigation project sites in Indonesia, Morocco, India, the Philippines, Dominican Republic and Peru.

Team 1 which is scheduled to visit Indonesia, India and Morocco from March 20-April 17, 1985, consists of:

- Dr. Ian Carruthers (Economist and Principal Investigator);

- Dr. Dean Peterson (Engineer); and

- Dr. Rekha Mehra (Agricultural Economist and Social/Institutional Specialist).

Team 2 is scheduled to visit Peru, the Dominican Republic and the Philippines from March 20-April 22, 1985. Its members are:

- o Dr. N.S. Peabody (Social/Institutional Specialist);
- o Dr. A. Bishop (Engineer);
- o Dr. J. Seagraves (Economist) who will go to Peru; and
- o Dr. A. LeBaron (Economist) who will go to the Dominican Republic.

Dr. Peabody is the only team member who will go to the Philippines where he will work with a Philippine-based economist. Detailed itineraries for in-country travel are provided in Chapter V, and Annex 1 is a work plan for completing the final report and case studies.

The exercise is primarily one of synthesizing the extensive literature in the area and of identifying points where there are gaps that should be filled. Particular attention will be given in the process of the literature review to obtain information about the countries and project sites for which field visits are planned. Based on this information and the data obtained during the field visits, an attempt will be made to develop generalizations about workable cost recovery and O and M programs that can become inputs into the policy making process. Theory will be used to guide the research but the emphasis will be on the empirical and practical.

B. Statement of the Problem

The importance of irrigation in the developing countries, the huge investments made by governments and donors in developing irrigation capacity and its failure to achieve potential gains are pointed out in Chapter II. Irrigation availability was largely responsible for the "Green Revolution" that developed food production in many Asian countries. The hope that irrigation will continue to improve agricultural production remains strong as evidenced by the fact that estimates of irrigation and other water-related investments for the 1980s range between $50 billion and $100 billion.

However, there is also considerable evidence that the potential gains from irrigation are not being fully realized. It is estimated that irrigation performs at 50 percent of efficiency and systems around the world are plagued with financial and managerial problems. The result is poorly maintained and deteriorating systems that require costly rehabilitation and do not deliver the water to crops in a timely and efficient manner, thus hampering productivity.

There are numerous causes for the failure of irrigation to achieve its goals: poor design, inadequate on-farm water management; insufficient resources for O and M, inadequate maintenance of structure, etc. These problems are complex and interrelated and require a holistic approach for their solution. It is intended that this study make a contribution to solving some of these irrigation system problems.

C. Theoretical and Practical Considerations

Chapter III briefly reviews the theory of marginal cost pricing as a basis for setting irrigation water charges. In principle, if the price of irrigation water equals the cost of supplying it resource allocation will be optimal. However, the simple application of this theory to the pricing of irrigation water is problematic and likely to yield a revenue below the total cost of water delivery.

Other factors that complicate the setting of "appropriate" water rates are the characteristic of irrigation water as a public good and the fact that prices in other sectors are distorted because of regulation in developing country economics. Finally, political and equity issues also arise. It is therefore necessary to adopt a more pragmatic approach to the setting of water rate policy.

Chapter III concludes with a discussion of what is involved in irrigation system management. The objective of management is the delivery of water at the proper time and in the appropriate amounts to each crop. The variety of tasks related to operations and maintenance (O and M) are defined as are the management problems that frequently arise. They include shortages of funds, inadequate O and M planning, corruption among officials, etc. The recent attention given to increased farmer participation in management as a means of solving these problems is cited. A distinction is made between passive and active participation. The institutionalization of active participation in water user associations and cooperatives is also described.

D. Issues and Analysis

Chapter IV defines six issues related to pricing and management that will be the basis for investigation. Current opinions on each issue are discussed and data requirements needed to help resolve each issue are defined.

The issues are as follows:

1. To what extent is cost recovery through direct monetary charges a feasible goal in irrigation systems?

Cost recovery has generally been low in most countries due to difficulties in determining the proper measures of assessment and levels of charges. Factors such as the unreliability of water supply, farmer ability to pay and variations in ability to pay resulting from variations in crop returns are also important.

2. Do increased farmer participation and control contribute to improved cost recovery?

High cost recovery is often associated with high levels of formal farmer participation as in the Korean and Taiwanese water user associations. However, other factors also may be involved. The exact relation between cost recovery and local participation is not yet clear because of a lack of attention to other relevant variables.

3. To what degree does improved cost recovery depend upon reliability of water supply?

Lack of reliability of water delivery is a major operational problem with irrigation. Unreliable irrigation causes direct crop losses and indirectly reduces production by increasing farmer risk awareness. Reduced production reduces farmer ability to pay water charges. Corruption also increases unreliability and uncertainty.

4. Does increase in the cost of water lead to more efficient use?

Economic theory suggests that as water prices increase so does efficiency of water use. Such a clear relationship is difficult to establish in use of irrigation water especially where it is abundant. Scarcity improves water use efficiency.

5. Are increased water charges a necessary and sufficient condition for improved O and M?

Although lack of funds is a prime case of O and M neglect in many countries, other factors are also involved: lack of planning for O and M, poor construction and design, adherence to traditional rotational practices, etc. Thus, even when adequate funds are available O and M inefficiencies may occur.

6. Do institutional arrangements whereby farmers participate in and control irrigation systems improve O and M?

It is commonly believed that if farmers are made responsible for management of irrigation, the systems would run effectively. Reliability and accountability would improve, as would efficiency. However, the record is uneven: efficiency of water use varies greatly even where farmers are organized and informal farmer participation is sometimes more effective than highly organized forms of participation.

E. Data Sources

In addition to published sources of information, data will be obtained from government and irrigation department records, interviews with administrative officials and farmers and from personal observation at irrigation sites.

F. Outputs

The outputs of the research following this preliminary report are:

- A final report including six annexes which describe the field case studies; and

- A seminar at AID in which Dr. Ian Carruthers, the Principal Investigator, will discuss the findings and recommendations of the study.

A draft of the final report will be delivered to AID by June 30, 1985 and will be revised by a mutually agreed-upon time.

I. PURPOSE AND PROCEDURES

A. Purpose

The general objective of this study is to investigate ways to improve the effectiveness of functioning irrigation systems by examining the role of:

- Direct charges in meeting recurrent costs. This is based on the premise that successful mobilization of local resources from users will promote irrigation efficiency directly through improved water utilization, and indirectly, through better Operations and Maintenance (O and M); and

- Increased farmer participation in system management. There is a growing belief that the mobilization of human resources in this way will impact favorably on both O and M and cost recovery.

The specific issues related to these objectives are stated in greater detail in Chapter IV. The basis in economic theory for the institution of water-user charges will be reviewed in the next chapter, and the shortcomings in its application to irrigation pricing will be highlighted. The emphasis will be on investigating practical experience, including the feasibility of cost recovery and the most successful means for collecting fees. Similarly, the farmer participation question will be studied from a practical point of view.

B. Procedures

The investigation will be based on the accumulated experience in the areas of irrigation cost recovery and farmer participation in management. While theory will be used whenever necessary to guide observations, the emphasis will be on the empirical. This approach has been adopted as being the most appropriate to develop generalizations about workable cost recovery and O and M programs that can be used to guide policy making.

Since there is already a considerable amount of evidence in the available literature, the first step will be to review and synthesize this. The process will help identify the areas in which there are gaps and where more information will be needed while uncovering the data that already exists and is applicable to our study. This will be followed by six field studies that will serve essentially a verification function.

The six countries to be visited are the Dominican Republic, Peru, the Philippines, India, Morocco, and Indonesia. They represent a wide range of irrigation technology, financial institutional and management systems and statuses. Two multidisciplinary teams, each consisting of an irrigation engineer, an irrigation economist and a social/institutional specialist will do the research. Team 1 will go to Indonesia, Morocco and India and Team 2 will go to Peru and the Dominican Republic. The Philippine visit will be made by one of the Team 1 members who will be joined by a Philippine-based irrigation economist.

II. STATEMENT OF THE PROBLEM

A. Irrigation Plays a Central Role in Agricultural Development

Over the past few decades national governments and international donor agencies have made huge irrigation investments in developing countries, thereby reflecting their faith in its potential to improve agricultural productivity and promote rural development. OECD data show that total official commitments to irrigation by bilateral and multilateral donors amounted to $2.2 billion in 1980. In fact, between 1976 and 1980 nearly 20 percent of all the industrialized world's aid to food and agriculture went to irrigation investment. Moreover, the investment projected for irrigation and other water-related development in the next ten years ranges between $50 billion and $100 billion.[1]

Irrigation availability has been particularly important for developing countries over the past twenty years. In particular, it was required for the success of the package of agronomic and technical advances that made possible the "Green Revolution" and doubled food production in many Asian countries. Although irrigation serves only 20 percent of the developing world's arable land, irrigated land receives 60 percent of all fertilizers and produces 40 percent of all crops.[2] In general, satisfactory economic returns are obtained from irrigation. For example, Hotes reports that of 40 World Bank projects, 32 had economic rates of return of 10 percent or more and over half were above 15 percent.[3]

1. The potential benefits from irrigation are not being realized

There is, however, considerable evidence that the potential gains from irrigation are not being fully realized. The performance efficiency of irrigation systems in most developing countries is estimated at less than 50 percent. For example, inadequate water management is held to be the largest single factor in explaining the gap between actual and potential rice yields. It is estimated that more than half the total water supply is wasted before reaching the crops. Fell's analysis of irrigation in the Sahel shows that

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[1]G. Levine and H.C. Hart, Mobilizing Local Resources for Irrigation, Report No. 22 (NY: Agricultural Development Council, 1981).

[2]Ian Carruthers, ed., Aid for the Development of Irrigation (Paris: OECD, 1983), p. 38.

[3]F.L. Hotes, "The Experience of the World Bank," in Ian Carruthers, ed., Aid for the Development of Irrigation (Paris: OECD, 1983).

substandard performance is the norm because of technical, management, agricultural policy and financing problems.[1]

2. Numerous interrelated reasons account for the failure of irrigation investments to produce their intended benefits

No single reason can be put forward to explain failure of irrigation investments to realize their potential. Problems cited in various analyses include:

- Inadequate preparation of projects (e.g., poor assessment of water availability, soil analysis, etc.);
- Lack of drainage, insufficient control structures; in essence under-investment in infrastructure;
- Poor canal management and organization (e.g., faulty personnel policies);
- Insufficient resources for operation and maintenance;
- Poor crop production techniques and agricultural services (e.g., seeds);
- Neglect of public health aspects of irrigation design and operation;
- Poor land levelling and on-farm water management; and
- Exogenous problems such as unrealistic crop pricing policy; unreliable delivery of inputs such as fertilizer or electricity.

These problems are interlinked. One problem can initiate another which can cause a third and so forth. Poor canal design can lead to shortage of water. In turn, this leads to farmers stealing extra supplies which, in arid areas, will cause water-logging at the head of canals and drought and soil salinity in the irrigated lands at the tails. Low returns to farmers in these circumstances may, in time, lead to farmer refusal to pay irrigation charges. Financial delinquency by farmers may starve the operating agency of financial resources which may affect lack of operations and maintenance, although this link is by no means clear or inevitable. Still, irrigation is part of an interdependent system, and therefore, reform of one component requires a holistic approach that recognizes the complexity of interrelationships between all the components of the system.

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[1] A.M. Fell, "An Overview of Irrigation Strategy and Results in the Sahel," in Ian Carruthers, ed., Aid for the Development of Irrigation (Paris: OECD, 1983).

B. The Special Emphasis is Now Being Placed on Better Utilization of Existing Irrigation Systems

In recent years, the problems effecting irrigation systems have shifted attention away from irrigation development and towards better utilization of existing resources. Additional factors influencing this drift include the fact that in many countries the area suitable for new irrigation is now insignificant and in others the per acre costs are steeply rising.

The availability of the new, profitable agricultural technology is also encouraging a switch from increasing cropped area to increasing yield per hectare on the existing 200 million hectares of irrigated land. More than this, in many countries water is now the scarce resource and not land, so the rational new irrigation strategy is to maximize returns per cubic meter of water and not crop yield per hectare. This will require investment to be redirected toward improvement in physical infrastructure and operating mechanisms.

1. Upgrading existing irrigation infrastructure is a promising means for achieving better utilization

Upgrading existing irrigation infrastructure may be the most promising investment option. However, it is not inexpensive. There is an immense scale of investment necessary to complete projects built to minimum standards (e.g., increase numbers of canal control structures, level fields, implement drainage), and to rehabilitate projects that have deteriorated through age or neglect (e.g., replace barrage gates, rebuild masonry, realign watercourses). Therefore, consideration of irrigation pricing and management as means to deal with such issues is timely and likely to assume greater importance in the near future as the emphasis shifts toward improving efficiency of existing irrigation schemes to maximize their potential benefits.

2. An increased financial flow is needed to improve benefits from existing systems

Most irrigation reforms and improvements will require, as a necessary condition, an increase in the flow of finance to complete construction, to rehabilitate infrastructure, and to provide staff training facilities and financial inducements. This finance can come from one or more of the following sources: from the farmers who are direct beneficiaries of irrigation facilities, from consumers of the products of irrigated agriculture, from financial transfers from the general exchequer raised by taxes or borrowings, or from overseas aid donors. This study will examine the potential for covering recurrent costs directly through charges imposed on irrigation users and the appropriate mix of policies and mechanisms that might be suitable in the various circumstances of developing countries.

3. Economic, financial and social objectives must be balanced when improving existing irrigation systems

Irrigation water is an increasingly valuable scarce resource which must be economically used. The opportunity cost of waste is rising. Efficient delivery of irrigation water is unlikely unless the irrigation entity is financially sound. If financial strength and economic efficiency could be achieved by a socially just mechanism, then an ideal policy environment would be created. Therefore, in this study we explore the practical feasibility of balancing economic, financial and social objectives while also mobilizing the resources necessary to enable irrigation agriculture to reach its proven potential.

4. Local farmer participation may increase irrigation benefits

Both from social and economic perspectives, local farmer participation is often recommended as a means to improve the financial condition of operating irrigation systems and for equity and efficiency reasons as well. Greater farmer participation could facilitate operating system efficiency by tapping farmers' knowledge of local conditions. This could be an important input for rehabilitation and operation of minor and technical systems. Individual and collective farmer experience in managing water deliveries below the controlled turn-out level would supplement centrally controlled management where this does not extend to individual holdings.[1] Farmer participation is even more important in small-scale systems where lower production levels do not permit extensive support of external personnel to manage the system. Generating farmer support for management of governmentally planned systems has generally met with limited success but some communal systems have been credited with relatively better O and M as a result of farmer participation.[2]

The potential for improved management through greater farmer participation will be explored in this study. The problems are first, to determine the factors that restrict farmer participation with a view to overcoming them, and secondly, to identify the incentives for increased local involvement. The theoretical arguments which provide the conceptual framework for the analysis will be tested against field conditions in six countries. The strategies and tactics used in particular situations to develop appropriate financial and management resources for irrigation will be examined during the field work to see if tentative guidelines can be developed in this important area.

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[1] Levine and Hart, Mobilizing Local Resources.

[2] R.P. de Los Reyes, "Stereotypes and Facts in Irrigation Management: Preliminary Findings from a Case Study of a Philippine Communal Grant System," in Irrigation Policy and Management in Southeast Asia (Los Banos, Philippines: IRRI, 1978): pp. 193-198.

III. THEORETICAL AND PRACTICAL CONSIDERATIONS

A. The Needs of the Various Groups Involved in Irrigation are Different

1. The principal goal of irrigation systems are the same

The overriding goal of irrigation as of other development activities in general is to promote human well-being. However, the one specific purpose or goal which is uniquely served by an irrigation system is to increase agricultural production by adequate and timely delivery of water supplies for crops. In the context of these broad goals, the specific needs of different groups involved in an irrigation system vary. Thus, the farmer is most concerned with low cost and predictable water supplies to his fields while the irrigation engineer may be more concerned with the efficient delivery of water from headworks to outlet, the agricultural economist with higher farm production and the sociologist with the extent of farmer participation in management.

2. There are many criteria for assessing irrigation system performance

At the risk of oversimplification it can be said that the two most important criteria by which the effectiveness of an irrigation system in achieving the goals above can be judged are high productivity and efficiency of water supply. Productivity generally means output divided by input. In the case of irrigation this would mean production per unit of water, though in actual practice it could vary from system to system and be measured by water delivered, irrigated area, yield, income, etc. The measure of productivity would be the gross value of production divided by the water available at the storage point or diversion, less the gross value of production in a like case where no water is available.

Several other criteria can be used for judging irrigation performance also, one of which is equity of water distribution.[1] In canal irrigation, equity is a distant goal primarily because of the disadvantages suffered by tailenders and the disproportionate benefits of being located at the head. A more equitable distribution could be based on the doctrine of proportionate equality which suggests water allocation proportionate to size and landholding. This principle is far from equitable, however, in the sense that it reinforces the inequality inherent in landholding patterns so that the landless get no water at all. A more equitable distribution might be based on

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[1]R. Chambers, Irrigation Management: Ends, Means and Opportunities (Lucknow, India: Giri Institute of Development Studies, 1982.)

equal water rights for each household regardless of the size of landholding.

Performance could be measured as well by the criterion of stability which refers to the minimization of adverse physical effects such as water-logging, leaching, salinity, erosion, etc. Promotion of people's well-being is another dimension which would depend on what people themselves want, but may include provision of amenities, improvement in nutritional status, a greater sense of participation and so on. Whatever is accepted as a measure of performance, the potential for improvement of existing and planned irrigation systems may be enhanced through improved cost recovery and by greater farmer participation in management. However, before examining specific aspects of these propositions, the next section reviews: the theory of marginal cost pricing and the difficulties inherent in its application to irrigation water; management of irrigation; and, the role of farmer participation.

B. There are Practical Difficulties in Applying Marginal Cost Pricing to the Case of Irrigation Water

1. The market for irrigation water is complicated

In this section, we consider the basis in economic theory of marginal cost pricing and demonstrate the practical difficulties involved in applying this to irrigation because of the peculiar nature of the market for water which is more complicated than that for other commodities. Characteristics such as time, quality, location and security of supply generate various ill-specified markets for water. Thus, water characteristics in June are different than those in July and storage is generally impossible. Saline water has a different value to a farmer than fresh water. Water at the head of one system is of no use to farmers at the tail and the technical possibilities for cross-system transfers or even transfers within a system are quite limited. Security of delivery obviously affects the value of water. Farmers often link all their irrigations, siuceingthe value of a secure early season supply is offset if there is anticipated insecurity in later season deliveries.

2. Economic and financial prices for irrigation water often diverge

Understanding the market for irrigation water necessitates making the distinction between economic and market prices. Economic prices represent real or opportunity costs whereas prevailing market prices are often distorted, mainly by government interference in pursuit of other objectives. The effects of this distinction upon irrigation can be illustrated with a typical situation relating to canal maintenance. Government may increase the cost of unskilled labor for perfectly legitimate reasons by enacting minimum wage legislation and thus increasing the financial or money cost of, say, desilting canals. The real or opportunity cost to the economy of tempting laborers away from their farms to desilt the canals is the economic value lost by their absence. The financial cost is the official minimum wages paid. The economic opportunity cost is generally much lower than the government regulated wage rates.

If, simultaneously, the government has an overvalued exchange rate, the cost of imported machinery and the fuel to run them will appear to be much lower than the economic opportunity cost. In a heavily distorted economy, with a plentiful supply of cheap labor and a shortage of foreign exchange, such distortions can result in employing expensive machines to clear canals while laborers are left underemployed on their farms. If a foreign exchange crisis occurs there may be insufficient cash for machine spares or oil. At the same time, there is often a shortage of domestic tax revenue to pay laborers the difference between their economic or `shadow' wages and the legally enforced minimum wage. The net result is that canal maintenance may be neglected, while an economically unsuitable technology may be used.

Another way in which the difference between economic prices and financial prices affects the market for irrigation water is when economists determine that the appropriate price signal to the consumer of an input should be based on the marginal, rather than the average, cost of supply. According to economic theory, if the farmer-consumer pays less than the marginal cost he/she will consider the resource cheap and will try to consume more than a rational supplier would be willing to provide. Similarly, if the cost is above marginal cost the consumer is likely to ask for less than the optimum amount of water. The following paragraphs set out the theoretical basis for attempting to adopt marginal cost pricing policy and elaborate the practical difficulties of applying this economic rule to irrigation. The discussion is useful from the practical perspective of what should be the basis for establishing water charges, if marginal cost pricing is inappropriate.

3. Marginal cost pricing involves conceptual and measurement problems

In principle, the price of irrigation water should equal the marginal cost of supplying it and this will lead to efficient resource allocation. This rule is derived directly from standard price theory. (See, for example, Samuelson.[1]) Like all apparently simple and powerful general rules, its application to real world problems is not straightforward. There are both conceptual problems and practical measurement difficulties in its application to irrigation water supply. Implementers of the rule have to decide if the rule should be applied to short-run marginal costs or long run

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[1] Paul Samuelson, Economics, 11th Edition (New York: McGraw-Hill, 1980), Chapter 23.

marginal costs and also to what extent the calculation should be disaggregated by location. For example, should the marginal cost for each canal command be calculated separately, with each group of farmers paying their particular marginal cost? Should those at the head of a system pay more than tail-enders? Should those farmers who generate peak demands pay the installation of the (expensive) capacity that enables the peak demand to be met? In practice, most governments that decide to change anything, adopt a system of national charges with each farmer paying equally, irrespective of the marginal cost of supplying him. This charging system is sometimes known as the `postage stamp´ system because the post office levies an equal charge irrespective of the actual cost of delivery of a particular letter.

This is an oversimplification – there is no difference between water and other commodities.

Temporal problems are generally more difficult to resolve than locational problems. In the case of irrigation, there is a particular problem relating to canal irrigation´s unusual cost structure. First, irrigation has high fixed costs for investments in source works and distribution facilities. Thus, long-run marginal costs (which include fixed costs) tend to be much higher than short-run marginal costs. Second, over a large range of feasible scheme capacity there tend to be increasing returns to size. The cost/m^3 is lower in large schemes. Furthermore, for any given size of scheme the cost/m^3 of water delivered falls over a wide range as the installed capacity increases. There will be various limits to the amount of installed capacity, including the water available, the desirability of downstream developments, and the anticipated take-up period for the available supplies. This latter point has important financial implications where farmers, for whatever reason, will not use the full capacity for several years. Idle capacity ties up scarce investment resource. Where there are economies of scale that are not fully exploited, average costs are decreasing and marginal cost is lower than average cost. In these circumstances, a marginal cost pricing policy will yield a revenue below the total cost of production and the agency will incur a deficit.

So what else is new?

A third unusual element to the cost structure is relatively low variable or recurrent costs but with a high component that does not vary with the amount of water delivered. The annual recurrent cost of gravity irrigation schemes is typically less than 5 percent of the investment cost (`r´ coefficient = 0.05), while Heller suggests that for general agriculture the `r´ coefficient is typically 0.10, for livestock it is 0.14, for veterinary services 0.07, and for rural development it ranges widely from 0.08 to 0.43.[1] The component of recurrent cost that is invariable over a given range of output is known as indivisible cost (fixed cost is invariable over a given range of time). For example, costs of canal operating staff and maintenance staff are independent of the level of use. The comparatively low recurrent costs and relatively high proportion of indivisible costs

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[1] P. Heller, "The Underfinancing of Recurrent Development Costs," Finance and Development, XVI (1979), p. 38-41.

of irrigation (unless pumping is involved) has considerable influence on pricing policy because it means that true short run marginal costs are practically zero. As a rule, marginal cost pricing means short-run marginal costs.

The textbook case indicates that the price of irrigation water should equal marginal cost. But in practice, if short-run marginal costs are used then this implies a free supply. If short-run marginal costs are positive but small, the marginal cost curve will not rise steeply enough to cut the average cost curve prior to full utilization of the capacity. Therefore, no theoretically optimum price can be charged. Clearly if short-run marginal costs are used as the basis for water pricing the revenue will be minimal and economic efficiency will lead to financial crises. Countries such as Thailand and Sri Lanka which, until 1984, provided free irrigation water are using short-run marginal cost pricing either by accident or choice.

Critics of short-run marginal cost pricing would argue that the signal to farmers that water is cheap will eventually lead to full-capacity use and demand for additional high-cost capacity. Furthermore, it would not be possible to plan optimum investment because the future demand schedule is unknown. In addition, the losses incurred by the irrigation authority must be made up from taxation which prevents taxpayers from exercising their preferences and this will lead to other inefficiencies.

Another area of difficulty concerns the public or collective nature of the benefits from irrigation. There may be gains to others in society from irrigation development, and it can therefore be considered unreasonable for the direct beneficiary to bear the full costs. For example, the enormous benefits obtained in India by grain consumers (often low-income people) as a consequence of large increases in grain production from irrigation farming and the fall in real grain prices are an undoubted external benefit from irrigation.

Finally, the general theory of the "second best" explains why simple efficiency rules such as setting prices equal to marginal cost can fail. To be valid it requires that all other firms (and government) within the economy are setting their prices equal to marginal cost. In the highly distorted and regulated economies of developing countries most economic agencies either cannot or do not set prices equal to marginal cost and to attempt to do so for irrigation has no theoretical validity.

In summary, advocates of market solutions to the problems of irrigation efficiency are confronted with several shortcomings:

- Market imperfections--markets function improperly;
- Markets give wrong signals by ignoring externalities;

- o Markets don't work to provide public goods (those to which public access cannot be denied and where public consumption does not deplete the benefits);

- o Markets yield undesirable results in terms of alternative objectives; and

- o There are lags in adjustments.

Clearly, the peculiarities of the market for irrigation water makes the setting of "appropriate" water rates a particularly difficult task since conventional theory only has limited applicability. This makes it even harder to establish workable connections between water charges, cost recovery for improved O and M and irrigation performance. The problems are compounded by the fact that other social and political considerations also enter into the pricing of irrigation water.

4. <u>The many social/political dimensions associated with irrigation water often make specific pricing policies difficult to apply</u>

Charging for water is a highly political matter because of its characteristics as a public good. In fact, in some countries water charges are illegal. At the least, as Hotes suggests, irrigation charges are controversial--more so than other government charges such as electric power and municipal water supplies.[1] In democratic countries the problem is one of implementing a particular policy given the spectrum of interest groups.

On the social side, the question of equity arises especially with respect to the justice of charging low income farmers. Even though there may be definite benefits to farmers as a result of irrigation, their total incomes are often very low. For example, Taylor found it difficult to recommend higher charges in the irrigated areas of the Pekalen Sampean Project in East Java given that annual agricultural incomes were about $20.[2] The question then becomes one of the reasonableness of charging a subsistence farmer. The issue also involves the justice of making all farmers, rich and poor alike, pay the same rates. Additionally, various other sectors and groups such as the food-consuming public, the government, and agriculture-related industries may also benefit indirectly from irrigation so that it may not be just for farmers to shoulder the entire burden of paying for

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[1]Hotes, <u>The Experience of the World Bank</u>.

[2]D.C. Taylor, "Financing Irrigation Services in the Pekalen Sampean Irrigation Project, East Java, Indonesia," in <u>Irrigation Policy and Management in Southeast Asia</u> (Los Banos, Philippines: IRRI, 1978), pp. 111-122.

irrigation. These issues will be taken into consideration during our study.

C. Irrigation Water Management Needs to be Improved

1. The principal goal of irrigation water management is to optimize crop production via efficient water delivery

The fundamental goal of an irrigation water management system is the appropriate and timely delivery of water in the proper quantities to farmer fields in order to maximize profitable crop production.

2. Irrigation water management encompasses all O and M activities

Water management encompasses all the activities associated with O and M. Operation involves the allocation and delivery of water supplies, management of storage facilities and handling of drainage runoff. Reduction of water losses and prevention of waterlogging and salinity problems are also important aspects of operation. Maintenance involves upkeep and repair of irrigation and drainage structures--embankments, dams, outlets, etc.

The varieties of specific management tasks associated with surface water irrigation include upstream watershed management for erosion control and sedimentation reduction, dam and reservoir management, instream transport management and maintenance of the physical structure of the irrigation network for minimal water loss and increased water-use efficiency. Upstream headwater management is a highly technical task, frequently the responsibility of the state through an irrigation or agriculture department. At the local level, however, it is possible to find some degree of farmer participation in the management process. The organizational structure at the local level may vary from direct state management to joint state and water user association management or state coordination of traditional village organizations.

As was discussed in Chapter II, inadequate O and M is a serious and growing problem that directly effects the productivity of agriculture, raises the cost of irrigation and has indirect effects on the rest of the economy. Uncertainty and inadequacy of water supplies stemming from poor O and M impacts negatively upon agriculture by causing reduction in crop area, lower yields, shift to lower valued crops and lower investment in inputs. Irrigation costs are raised in the long run if O and M neglect results in the need for major investment in rehabilitation or causes canal or dam failure. The effects upon the rest of the economy include the losses from lowered agricultural productivity and the possibly high cost of rehabilitation.

The causes of deficiencies in irrigation O and M arise from a variety of factors including, at the project level, design, construction and planning, and problems of financing and personnel at the operational stage.[1] Other macro level problems include donor preference for capital transfer and the neglect of recurrent cost by both national governments and donor agencies. These factors are significant but are not the direct concern of this research. The focus here is upon the financial and managerial problems of project operation.

The financial problems include the fact that water rate policy is often designed to satisfy economic, financial and social criteria which may be incompatible. Even when policy is directly focused on economic or financial considerations additional problems exist. For example, rate collection is often difficult to enforce and falls below target. Inflation is an additional factor that reduces spending on non-salary elements of O and M. In some countries, corruption is an important element that affects irrigation directly by lowering the profitability of farming, thereby reducing farmer ability and willingness to pay charges.

In general, O and M problems due to personnel shortcomings arise because of inadequate training, faulty information systems, lack of or improper incentives for efficient operation and overload. Each management system, however, is likely to have some problems that are unique. Corruption among officials may be a system problem too, in that it creates incentives for manipulating and mismanaging water delivery operations in order to make protection of the designed supply of source of illegal income.[2]

Since this study will pay particular attention to the effects of farmer participation on improved cost recovery and O and M, a brief discussion of what is meant by farmer participation follows.

D. More Effective Farmer Participation May Improve Cost Recovery and O and M

1. Farmer participation can be passive or active

The concern for participation in irrigation reflects a strong value commitment that is not generally made explicit. Participation is assumed to be good because it exemplifies democracy in action or

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[1] Ian Carruthers, "Neglect of O and M in Irrigation: The Need for New Sources and Forms of Support," in Irrigation Development: Implications of Recent Experience for Aid Policy. Annex II (Paris: OECD, 1982).

[2] R. Wade, "The System of Administrative and Political Corruption: Canal Irrigation in South India," Journal of Development Studies, XVIII (3) (1982): pp. 288-327.

because it is a vehicle that can be harnessed to reduce costs. Alternatively, it may be bad because it brings too many fingers into a pie. Analytically, it is more useful to distinguish between passive and active participation. The literature is generally biased in the activist direction but passive participation may be just as valuable.

Passive participation involves at least the three elements of information, consent and compliance. Thus, farmers can be described as participants if they know what is going on in the irrigation system, if they consent to its operation without obstructing it and if they comply with regulations imposed on them. This level of participation is rarely taken seriously yet it is critical to the proper functioning of irrigation systems. An empirical question that arises is to examine the ways in which passive participation is either fostered or discouraged.

Active participation, on the other hand, is more complex. Indeed, it is more of a catch-all phrase than an operational concept, as such. Nonetheless, it is a useful reference point around which to focus data collection and analysis. At least five aspects of the notion could be identified and observed in the field: the locus of participation; quality of participation; types of participants; methods of changing established patterns; and the broader context of participation. The locus of participation refers primarily to the task at hand: participation for what? In irrigation, a number of activities can be seen as potentially subject to participation: design; construction; system scheduling (water delivery, shut-downs, and so on); water distribution (including rotation and farmer-to-farmer distribution); maintenance; management (setting regulations, coordinating activities, and so on); problem solving; system upgrading; and so on.

2. Active farmer participation often is institutionalized

In many countries, active farmer participation is institutionalized and takes the form of water-user associations or cooperatives or some other organization. In some countries, such as Indonesia, the associations are traditionally based and highly organized and formalized whereas, in others, local responsibility is through much more informal mechanisms. One informal (though effective) institutional structure was described by Wade for South Indian canal agriculture.[1] Where newer systems operate there may be no existing traditional institutions which can function as a base for local participation in water management.

Yet the formation of formal water user associations is often recommended as a means for improving management especially where problems have arisen due to the separation between water user and

[1] R. Wade, "The Social Response to Irrigation: An Indian Case Study," Journal of Development Studies, XVI (1) (1979): pp. 3-26.

water authority.[1] Both groups are necessary to efficient water management from the perspective that farmers have a particularly good understanding of irrigated farming needs and are not as qualified on the technical requirements of the infrastructure upon which they depend. Water authorities, on the other hand, are more familiar with the latter. The importance of good articulation between the two groups is therefore essential for effective management. The organization of groups of water users into formal associations is viewed as a means for enhancing farmer agency linkage. The issues set forth in Chapter IV are intended to shed some light on the effectiveness of various forms of farmer participation on improved cost recovery and management.

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[1]E.W. Coward, Jr. ed., Irrigation and Agricultural Development in Asia (Ithaca: Cornell University Press, 1980), p. 221-222.

IV. ISSUES AND ANALYSIS

There are a multitude of issues related to the pricing and management of irrigation water that deserve examination and would yield useful information. However, given the constraints of time and resource availability the team has selected for study six issues that are likely to be the most effective in accomplishing the objectives set forth in Chapter I. These issues are focused on the themes of cost recovery and local farmer participation.

Emphasis is placed on recovery of recurrent rather than fixed costs. While planners would like to recover fixed costs as well, this is generally regarded as unlikely in the near future. In economic terms, fixed costs are sunk costs anyway and from the point of view of improved management of existing projects, recovery of recurrent costs is more relevant. Similarly, reform of the management of irrigation projects could be at any level of the irrigation bureaucracy and a complete analysis would necessitate examination of a wide range of possibilities. This is precluded by the time and resource constraints of this study. Thus, farmer participation will be the focus of attention. This emphasis is not misplaced, however, given the current interest in involving farmers and local communities to improve irrigation O and M.

The six issues being examined in this study are:

1. <u>To what extent is cost recovery through direct monetary charges a feasible goal in irrigation schemes?</u>

2. <u>Do increased farmer participation and control contribute to improved cost recovery?</u>

3. <u>To what degree does improved cost recovery depend upon reliability of water supply?</u>

4. <u>Do increases in the cost of water lead to more efficient water use?</u>

5. <u>Are increased water charges a necessary and sufficient condition for improved O and M?</u> and

6. <u>Do institutional arrangements whereby farmers participate in and control irrigation systems improve O and M?</u>

In the next sections the above issues are divided into two groups, one pertaining primarily to pricing and the other to management. Each issue is then discussed at greater length. This is followed by a discussion of the types of evidence that will be required to help resolve each issue and the procedures to be followed in obtaining such information.

A. Pricing Issues

1. To what extent is cost recovery through direct monetary charges a feasible goal in irrigation schemes?

a. Discussion

A variety of direct and indirect means exist for recovering the costs of irrigation. Direct recovery of costs may be through annual or seasonal water charges for irrigation services. They may be based on measured volume of water, charges per share of the stream or canal flow, per each irrigation and per acre irrigated. Such charges are usually made only for reimbursement of recurrent costs, although sometimes capital cost recovery is also an objective. Another direct charge sometimes used is the betterment levy, a tax on the capital increase in the land value resulting from irrigation. Betterment levies are generally applied to capital recovery. Indirect cost recovery methods also may be used. The most common is a sales tax on crop outputs marketed or on inputs purchased such as fertilizers.

Which of the available cost recovery methods is used will depend on the value of water, dependability of supply, ability to control the flow, traditional land ownership patterns, cropping patterns, types of O and M problems, government pricing policies for agriculture, etc. In this study, direct charges as a means for meeting recurrent cost needs will be emphasized.

The accumulated evidence on the efficacy of cost recovery through direct monetary charges is not uniformly reassuring. Irrigation authorities encounter difficulties in determining the proper bases and amounts of the charges given farmer capacity to pay and recurrent cost requirements. They also encounter problems with collection. Although there is considerable variation in collection rates they generally tend to be low in most countries. Certainly the World Bank's experience with cost recovery has followed the general pattern. Since 1971, the Bank's policy has been to recover completely at least operational and maintenance costs from its agricultural projects (which include irrigation).[1] A 1984 review of Bank-financed projects showed that in at least two-thirds of the cases where there were convenants requiring O and M costs to be recovered from beneficiaries the goal was not achieved.

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[1]World Bank, Operational Policy Memorandum No. 261 (Washington, D.C.: World Bank, 1971).

In a 1981 report Bottrall suggests that low rates and low collection are symptomatic of the general problems with irrigation management systems.[1] Further, he cites four examples which suggest that the lower the charge the higher the rate of default, as shown in Table 1. On the other hand, there are projects such as Area 4 in the Table (a thinly disguised Taiwan case) which have a recovery rate approaching 100 percent. Some of the success in this case may be due to the decentralized farmer-controlled irrigation associations that have the responsibility for collection--an issue that will be discussed separately as Issue 2 below.

A large number of factors combine to make it difficult to achieve cost recovery goals through direct charges. In addition to the difficulties involved in determining the proper measures of assessment and levels of charges are factors such as the unreliability of water supply, farmer ability to pay and variations in the ability to pay resulting from variations in crop returns. Although it is generally believed that irrigation stabilizes yields, there is some evidence for irrigated rice that absolute variance in yield increases with irrigation. Relative variability may also increase if more intensive agriculture and fewer varieties result in increased crop losses due to pest and disease attack. If crop prices do not rise to compensate for the loss in yield, farmer incomes and their capacity to pay irrigation charges are seriously affected. Reliability of water supply also effects farmer ability to pay through its impact upon the aggregate volume of crop production. The question of reliability and cost recovery is important enough to merit separate consideration and is discussed at greater length as Issue 4.

b. <u>Evidence sought</u>

In examining this issue examples of irrigation sites exhibiting high and low cost recovery patterns will be identified and analyzed. Alternatively, a site that demonstrated changes in cost recovery patterns over time would serve the same purpose. If both types of examples are available they may be used together.

The general data required for background purposes for all sites selected is the following:

- Types and bases of water charges;
- Levels of water charges;
- Cost recovery history (i.e. the proportion of recurrent cost recovered over time);

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[1]A. Bottrall, Comparative Study of the Management and Organization of Irrigation Projects, World Bank Staff Working Paper #458 (Washington, D.C: World Bank, 1981).

Table 1: Water Rate Levels and Recovery Charges for Four Areas

	Average Water Charge/ha $	Recovery %
Area 1	7.50	60–70
Area 2	4	48
Area 3	14.50[a]	NA[b]
Area 4	87	97.8

[a]This represents a land tax rather than a water charge.
[b]NA = Not available.

Source: A. Bottrall. Comparative Study of the Management and Organization of Irrigation Projects, World Bank Staff Working Paper 458.

- o Level of farmer incomes; and
- o Size of farmer landholdings.

In making the comparison between high and low cost recovery sites/periods to determine the facilitating/constraining factors, the following and similar questions will be asked:

- o Is there a relation between local agricultural production patterns and cost recovery? A related question is the trend/levels of farmer incomes over the relevant period/sites.
- o What are the rate collection mechanisms? How is rate collection enforced?
- o What are the penalties involved in nonpayment of rates? What are the benefits to farmers of making payments?
- o What is the eventual disposition of the rates collected? Where do the funds go (i.e. to the irrigation agency or into general revenues)?
- o Are the funds managed well?
- o What proportion of the funds are applied to O and M?
- o Are there mechanisms to prevent erosion of financial resources (e.g., indexing, payment in kind, etc.)?
- o Why are farmers willing/unwilling to pay water charges--as stated by themselves?
- o Are there social/institutional barriers to water charges (e.g., customs, religion, political factors, etc.)? Are there social/institutional factors that promote rate collection (e.g., political coercion, clearly established water rights, etc.)?
- o Are there unique factors that account for the particular success/failure in cost recovery at the particular site/period?

2. <u>Do increased farmer participation and control contribute to improved cost recovery?</u>

a. Discussion

While it is generally believed that increased farmer participation is highly correlated with additional mobilization of local economic and non-economic resources for irrigation, the exact relation between cost recovery and local participation is not clear.

In Korea, the rate of collection of water charges is as high as 95 percent. Responsibility for rate collection is in the hands of farmer associations to whom O and M functions are transferred after the completion of the irrigation system. Initially, water charges are low but at full development they are intended to cover O and M and capital repayment. However, it is not clear that farmer involvement is either the sole or the most important element in this success. It is important to point out that other economic and sociocultural factors may also play a part. Among them are the high profitability of farming in Korea and the fact that the society is very disciplined. And there may well be other reasons.

The high fee performance efficiency of Taiwanese irrigation is also well-known. In the literature, much of the credit for this has been given to the system of decentralized farmer-controlled irrigation associations. However, what is less well known is that the government assumed direct control over the irrigation associations in 1975 because of poor management, their serious and deteriorating financial position, the high levels of membership fees and, in some areas, declining rates of fee collection. Some observers suggest that government action was partially due to domination and exploitation of the associations by local political coalitions against the general interest. Further, the injection of government capital in the associations has improved irigation service which is an important element in the current high fee performance rate which stands at 88 percent.[1]

b. <u>Evidence sought</u>

Two alternative bases of comparison could be used to examine this issue. First, an appropriate comparison would be one in which sites are selected where there was little or no farmer participation previously and it was introduced later. Assuming a length of time has elapsed during which changes in cost recovery patterns could have been accomplished the results of these changes could be observed. The other choice would be to make comparisons between sites that have high and low farmer participation using the high participation site as a proxy for increased levels of participation. A "control" situation in which there was virtually no farmer participation could be paired with either of the above cases. Finally, if sufficient examples are available, all of these examples could be used.

The general data on cost recovery required for Issue 1 of this section would also be needed here, namely: types and bases for charges, fee levels, collection methods, cost recovery history, level of farmer income and size of holdings. In addition, information would be needed on the nature and extent of farmer participation. The following questions will be asked:

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[1]Mike Moore, personal communication.

- Is farmer participation formal or nonformal? Is participation active or passive? (Active participation would be the more interesting case.)

- What is the rate of farmer participation in (i) decision-making and/or (ii) active involvement in irrigation O and M as evidenced by personal contributions of time, labor and funds?

- What kind of organizational structure (if any) exists to facilitate farmer participation?

- What is the nature of the leadership?

- What is the extent of farmer control in relation to the irrigation bureaucracy?

Finally, it would be important to raise questions pertaining directly to the relation between farmer participation and cost recovery. The following questions will be asked:

- If cost recovery is improved with increased farmer participation, which aspects contributed to the result?

- If farmer participation was increased and cost recovery did not improve, what are the reasons for this?

- Does increased farmer participation in decision-making result in more "realistic" charges (e.g., in terms of capacity to pay and in taking account of "bad" year contingencies)? Do better price policies result?

- Is farmer willingness to pay affected in any way by increased participation and control (i.e., is there an attitudinal change)?

- Does participation improve reliability of water supply and does this have a positive affect on farmer willingness to pay water charges?

3. <u>To what degree does improved cost recovery depend upon reliability of water supply?</u>

a. <u>Discussion</u>

A major contention of this study is that cost recovery from irrigation will remain an intractable problem as long as authorities fail to provide a reliable water supply. Reliability can be defined from the viewpoint of an irrigation farmer as the degree to which he/she can depend upon a system to deliver the design amount of irrigation water to the field in predictable quantities at the expected times. Late or non-delivery of the design quantity of water as happens typically at the tail ends of some canal systems because of illegal withdrawals at the head disrupt supply reliability. Irrigation also can be considered unreliable if poor maintenance of canal structures means that delivery is unpredictable, or if following rain the supply is not curtailed.

Unreliable irrigation causes damage not only to the farmer's standing crops but additional losses from increased farmer risk. If unreliable irrigation increases farmer risk they typically react in conservative ways by reducing crop intensity, not using complementary inputs such as fertilizer and crop protection in the optimal manner, not weeding crops fully and so on. The result is reduced productivity which in the long run undermines farmer ability and willingness to pay water charges. More important, farmers are also likely to resist any reform of water rates in line with shifts in policy or even adjustments for inflation.

Underpricing of water may also cause uncertainty with regard to water supply and result in underutilization. While on the surface this may seem contradictory to expectations, the problem arises when underpricing leads to overuse of water at the heads of canals. If this occurs during times of scarcity water supply is depleted before reaching tail end users who come to expect shortages. Their response to the uncertainty is to react as risk minimizers even in times of abundant water supply.[1]

Corruption is another factor that increases unreliability and uncertainty of water supply in many countries. In some places this may be very important but it has until now received scant attention. Wade has provided the most recent and comprehensive account of the effects of corruption on irrigation efficiency based on field work in South India.[2] He documents how public servant corruption diverts canal management from its main tasks of serving the needs of crop production. It also encourages management inefficiency because this makes "protection" of the designed supply a source of income. For example, running canals above design and robbing water from those at the tail end increases water availability in other parts of the system which can be illegally sold to the highest bidders. In order to maximize bribes, engineers have been known to make ad hoc and unannounced cut-offs part of their system of operation and to tamper with water rotations. All these factors heighten uncertainty. Any look at the issue of reliability should also consider the parallel illegal market in water to get a complete picture.

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[1]W.K. Easter and D. Ellingson, A Review and Bibliography of Studies Regarding Irrigation Institutions, Management and Investment in Asia (St. Paul, Minnesota: Department of Agricultural and Applied Economics, University of Minnesota, 1982).

[2]R. Wade, "The Social Response to Irrigation."

Clearly, a major aim of any reform of water charges should be based on measures that will improve the reliability of water supply and reduce farmer uncertainty. Further, rehabilitation investment also should be directed towards improving reliability, and other objectives such as capacity augmentation, completion, modernization, etc., should be regarded as secondary. The payoffs of improved and reliable water delivery as Wickham points out are increased production and presumably higher farmer incomes which are generally acknowledged as sound bases for enhancing farmer ability to pay water charges.[1] Chaudhary recommends that planned increases in water rates should be related to reliability of water supply if they are to be successfully instituted.[2] The high charges paid by farmers in India, Pakistan and Nepal for groundwater show that farmers are willing to pay substantial amounts if the supply is reliable.

b. Evidence sought

For comparative purposes, site selection will be based on either identification of projects (i) where there have been observable changes in the reliability of water supply over the period of observation, or (ii) sites that have reliable water supply and those that do not. A useful first step would be to obtain (if possible) data showing the correlation between cost recovery and the reliability/unreliability of water supply. However, this would not be sufficient. Since the literature suggests that reliability impacts on cost recovery through improvements in production and income levels, to establish causation it would be necessary to ask the following types of questions:

- o What were the trends in agricultural production and/or productivity during the observation period?
- o What is farmer risk responsiveness (as evidenced by adoption of available new technologies, intensified production, etc.) with more reliable irrigation?
- o What were the trends in farmer incomes in the relevant time?
- o Were there any parallel changes in levels of farmer participation?

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[1] T.H. Wickham, Water Management in the Humid Tropics: A Farm Level Analysis. Ph.D. Thesis (Ithaca, New York: Cornell University, 1971).

[2] M.A. Chaudhary, "Determination of cost of tubewell water and estimation of economic rent in canal irrigation," Pakistan Development Review, XVII (2), pp. 139-168.

- o Were there are other identifiable factors unrelated to improved reliability that may have effected cost recovery? If so, what is the importance of these factors relative to reliability in promoting cost recovery?

It may be possible also to approach this issue from the perspective of low cost recovery/low reliability systems and examine the factors involved. Some insight could thereby be obtained on the problems that require solution if systems are to be made more reliable and cost effective. The pertinent questions are the following:

- o Does corruption exist? If it does, what forms does it take and how does this impact upon available revenue for O and M, management of the system, design allocation of water, delivery of water to the user, etc.?

- o What is the role of underpricing water in increasing uncertainty and making farmers reluctant to invest in (i) agricultural improvements and (ii) irrigation system O and M (as evidenced by reluctance to pay water charges, volunteer labor, etc.)?

- o Is the irrigation institutional structure so removed from the user that inappropriate water allocation and management policies have been instituted?

B. Management Issues

1. Do increases in the cost of water lead to more efficient water use?

a. Discussion

It is plausible to expect that as water prices increase it becomes more rational to increase physical efficiency by selecting and adopting improved methods of controlling, measuring and applying water. It follows that it should be possible to design systems of pricing and regulations that will promote efficient use. However, as Neghassi and Seagraves suggest, since the value of water is often low there is little economic incentive to improve physical efficiency.[1] Hence, a clear relationship between the price of water and efficiency of its use cannot be easily established. Other factors such as dependability of supplies, systems of delivery and flow regulations effect efficiency and obscure pure price incentives.

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[1] H.B. Neghassi and J.A. Seagraves, "Efficiency in the Use of Water for Irrigation: The Role of Prices and Regulations," in Natural Resources Forum. Vol. 3. (Boston: D. Reidel, 1978), pp. 53-72.

In general, increasing the cost of an unreliable water supply is unlikely to increase efficiency of use. Farmers know how to use water efficiently when it has high value to them. Even on unreliable or poorly managed schemes there are times of the year, sometimes as brief as a week, when there is high value to water. At peak demand times there is no inefficient water use. Each drop is watched. Inefficient distribution of water on farms is generally an indication of low value to farmers due to circumstances beyond their control.

b. Evidence sought

The essential first step in examining this issue is to establish a workable definition of what constitutes efficient water use. Efficiency in water use can be approximated by either the gross or net design water requirement used as the basis for the capacity of the system. Systems are generally designed to deliver to the farmer or user the amount of water required to supplement probable local rainfall or soil water reserves up to the level of potential evapotranspiration (PET). When PET is satisfied, plant growth is at or near the maximum. Delivery of water at the farm level exceeds the net requirement in order to account for losses in delivery. The gross design water requirement accounts for the losses in distribution and storage. Irrigation water requirement is expressed as hectare/centimeters or cubic meters of PET. It is proposed here that delivery and use of the net or gross design water requirement be taken as the standard of efficiency.

To examine this issue, areas to be reviewed can be: (i) sites where relevant increases were instituted in water charges during the period of observation and/or (ii) sites with water charges compared with sites where there are none. The most important data would be that which establishes a correlation (or indicates an absence of correlation) between charges and efficiency, namely, data on:

- Levels of efficiency over time or at points in time; and

- Levels of water charges (if any) over time or at points in time.

Once again, correlation does not establish causation. Therefore, the questions to be posed must attempt to establish the linkage. They are:

- What is the relative scarcity of water?

- Do the prevalent social norms regard water as a public good?

- Does the farmer's definition of efficiency differ from the definition adopted here (i.e., how does the farmer determine the opportunity cost of nonuse of irrigation water)?

- o Can farmer use of irrigation water be manipulated by water charges (i.e., to what extent do prices act as incentives)?

- o How reliable is the irrigation system?

- o Do higher charges provide greater incentives for farmer concern with repair and maintenance? Is this concern acted upon?

2. Are increased water charges a necessary and sufficient condition for improved O and M?

a. Discussion

Undoubtedly, lack of financial resources is an important element that causes neglect of O and M in many countries. A US Government Accounting Office study of AID-financed irrigation projects in four Asian countries found that each country deferred maintenance until systems had deteriorated to the point of requiring major rehabilitation.[1] The study concluded that the primary reason for the failure was inadequate funding of O and M on a regular basis. Following diagnoses similar to this it is widely believed that "poor cost recovery discipline" has predictable results: "poor O and M, poor project performance and continuing deterioration of the system."[2] All this is plausible but unproven. Indeed this deterministic thesis is misleading because it implies that there is an automatic process of improvement once farmers pay for water, and presumably the more they pay the more rapid and complete the improved performance. This ignores the other ways in which the money might be spent and all the other causes of inefficiency that might remain after removal of the O and M funding problems.

Part of the explanation for the gap between planners' predictions of irrigation performance and the field reality is that the details of O and M are not well specified beforehand. During the planning stages not enough detailed work is undertaken to outline the needs, resources necessary and the procedures to be followed. Furthermore, the variety of causes for neglect and disrepair in irrigation are not well-known nor is there a clear picture of the relative contribution of each. Neither is it always the case that if farmers pay, the funds will be made available for O and M. For example, Taylor found that in the Pekalen Sampean Project in East Java, farmers were paying much more

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[1] Irrigation Assistance to Developing Countries Should Require Stronger Commitments to Operation and Maintenance (Washington, DC: U.S. General Accounting Office, 1983).

[2] Hotes, The Experience of the World Bank.

than was being used for O and M.[1] Even if adequate funds are available from water charges there is no guarantee that they will be well managed or judiciously used for improved O and M. In fact, there is little reliable data on the accounting aspects of irrigation management.

Physical or technical problems due to inappropriate design or poor construction standards may be significant as well. There is evidence too that irrigation managers have insufficient appreciation of changing agricultural needs as new agronomic technologies develop. For example, managers may be reluctant to change age-old canal rotation patterns or the timing of closure for annual maintenance even though this would be beneficial for improved crop production. This discussion suggests a variety of questions that may be usefully raised by the team.

b. Evidence sought

In order to test this proposition, comparisons will have to made made on either a longitudinal or cross-sectional basis. The first step will be to identify those projects where, (i) water charges were increased within a time period that allows for changes in O and M to have been implemented, or (ii) projects with comparable water charges with differing levels of O and M, (iii) a project where charges were increased and a comparable one where they were not, or (iv) projects with water charges (and/or with water charge increases) and projects with no water charges at all. There will have to be a standard by which to judge "improved" O and M. One measure could be the reliability and timeliness of water supply as judged by the users. An indirect measure of the reliability of supply would be increasing or maintaining levels of production with the assumption that there were no other intervening variables (other than lack or irrigation) that had a negative impact on production. More specifically, direct indications of improvements in O and M would require data on the following:

- Levels of spending on O and M;
- General condition of the physical structure;
- Farmer opinion on system reliability (efficiency of water delivery); and
- Farmer satisfaction with allocation of water.

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[1]D.C. Taylor, "Financing Irrigation Services in the Pekalen Sampean Irrigation Project, East Java, Indonesia," Irrigation Policy and Management in Southeast Asia (Los Banos, Philippines: IRRI, 1978), pp. 111-112.

By the same token, indirect indicators of improved O and M would be factors relating to the achieved benefits of irrigation, namely:

- o Increases in agricultural production and productivity;
- o Increases in farmer incomes; and
- o Increases in farmer adoption of new techniques.

The next step would be to seek data responsive to the following types of questions:

- o What is the level of spending per hectare on O and M within the area covered by the project?
- o What is the estimated spending requirement for good O and M?
- o What proportion of recurrent costs are met by (i) direct user charges and (ii) from other sources?
- o Who is responsible for what aspects of O and M and with what success?
- o What are past/current perceptions of levels of O and M among farmers, irrigation authorities, operators and from the observation of the present field team?
- o If O and M is considered inadequate what are the factors responsible--deficient design, inadequate technical support, inefficient management, lack or mismanagement of funds, etc.? To what extent does each factor contribute to the overall deficiencies?
- o If O and M is considered adequate or good what are the factors responsible?

3. Do institutional arrangements whereby farmers participate in and control irrigation systems improve O and M?

a. Discussion

It is widely believed that if farmers are made responsible for management of irrigation systems they would run them effectively because, as the potential beneficiaries, they would have a direct material interest in doing so. Levine and Hart suggest that longer term mobilization of local resources for improved irrigation O and M "can occur only through the cooperation and voluntary participation of the farmers."[1] They argue, in addition, that appropriate incentives will be required to promote

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[1] Levine and Hart, "Mobilizing Local Resources," p. 5.

participation. Additionally, irrigation department attitudes policies and practices will have to change.

The expected benefits from increased farmer participation include increased capacity to mobilize both economic and noneconomic resources (e.g., voluntary labor) that can be applied to improved O and M, improved ajudication of water rights and conflicts, more satisfactory water allocation and so on. At the very least, farmer participation is necessary to ensure bureaucratic accountability.[1] While it is generally accepted that increased farmer responsibility in local irrgation management has substantial potential for improving O and M, the great variety in levels of performance of farmer organizations suggests that the issue is far from being resolved.

Before considering the record on this issue it is useful to examine the variety of institutional arrangements whereby farmers participate in management of irrigation systems. Forms of paticipation vary from the relatively informal and loose collective organizations in Wade's South Indian case study to the much more complex and formal organizations that exist, for example, in Japan, Taiwan and Indonesia.[2] The Indian irrigation committees studied by Wade have no written constitutions or differentiation of roles within the committee (except for account-keeping) and completely undefined procedures for being accountable to the body of irrigators they serve. This contrasts strikingly with the subaks of Bali each of which has a written constitution and a council that sets policy and elects officials. In Japan and Taiwan the water user associations are similarly highly institutionalized and have a "rational-legal" organizational form.

As might be expected, farmer organizations have met with varying success in improving irrigation efficiency. Levine cites the case of the Tou Liu system in Taiwan where water use efficiency (as measured by delivery of proportion of crop water requirement) is over 90 percent--a higher rate than obtained even in other Taiwanese systems (60 percent).[3] It also contrasts sharply with the efficiency rates of 25 percent in the Phillippines and 40 percent in Malaysia.[4] He attributes this success to the human factor, namely, "A very high

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[1]R.K. Patil, "Farmers' Organisations for Efficient Water Use in Irrigated Agriculture," WAMANA (Quarterly Newsletter on Water Management, Bangalore, India), I (4), (October 1981), p.10.

[2]Wade, "The Social Response to Irrigation."

[3]C. Levine, "The Relationship of Design, Operation, and Management," in E. W. Coward, Jr. ed., Irrigation and Agricultural Development in Asia (Ithaca: Cornell University Press, 1980), pp. 51-62.

[4]Ibid, pp. 53-54.

degree of farmer cooperation, reflected in the joint hiring of common irrigators to whom complete responsibility for water management is delegated...."[1] Other conditions that facilitated the success were political commitment, financial resources and scarcity of water supply but Levine maintains that the relationships among farmers and between farmers and the system are the critical elements.

In an example from a surface irrigation project in the Indian state of Gujarat, Jayaraman describes a case of successful operation managed by village level management commitees.[2] Through seven-member representative committees, farmers at the village level are entirely responsible for field channel maintenance and operation of a rotational system that assures water distribution over 2,000 ha of land. The farmers provide voluntary labor to weed and repair water channels and those who cannot do so are charged a small fee in lieu of their contribution. The system has functioned successfully for the past fifteen years. Critical to farmer success were the scarcity of water and the establishment of rights that ensured water availability during the kharif irrigation season--a process in which the farmers participated through village representatives. Additional factors were organizing on a village basis and the limited functions the committees were expected to perform--channel maintenance and liaison with the irrigation bureaucracy.

In general, one of the most important factors cited in the literature as essential to the success of farmer participation is the reliability of water supply. On the other hand, organization of user associations is suggested by Gustafson and Reidinger as a means of solving the problem of lack of reliability in water supply.[3] Veeman also suggests that the lack of institutions for regulating water rights is frequently responsible for the unreliability of water supply.[4] It is possible that farmer participation and reliability of water supply are mutually reinforcing factors that together contribute to improved O and M. Given the diversity of results obtained by user associations it would be helpful to identify the processes critical to success.

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[1] Levine, pp. 55-56.

[2] T. K. Jayaraman, "Farmers' Organisations in Surface Irrigation Projects: Two Empirical Studies for Gujarat," Economic and Political Weekly, XVI (89) 1981: pp. A89-A98.

[3] E.W. Gustafson and R.B. Reidinger, "Delivery of Canal Water in North India and West Pakistan," Economic and Political Weekly, VI (52) 1971, pp. 157-162.

[4] T.S. Veeman, "Water Policy and Water Institutions in Northern India: The Case of Groundwater Rights," Natural Resources Journal, VIII (3), pp. 569-588.

b. Evidence sought

Here the comparison will have to be based either (i) on sites where changes in levels of farmer participation have occurred and/or (ii) sites that have farmer participation and control and those that do not. In establishing a judgment about "improved" O and M, the same kind of data would be required as was specified in Issue 2 above: O and M spending levels, physical condition of structures, system reliability, and allocation of water. The indirect indicators of improved O and M will also be the same in terms of increased production and productivity, incomes and adoption of new technologies.

In addition, information will be obtained on the institutional arrangements themselves by asking the following questions:

- Is the institutional structure formal/nonformal?
- What is the strength of the institutional structure (as measured by continuity, ability to key fees, regularity of meetings, etc.)?
- What is the level of participation (as measured by number and percent of water users involved)?
- What is the quality of participation (as measured by farmer ability to share in decision-making)?
- What is the quality of the leadership?
- What responsibility does the farmer organization have in irrigation administration?
- What authority does the farmer organization have in administration and what is the extent of the authority relative to the rest of the administration?

In order to examine the causal connections between farmer institutions and improved O and M the important questions are the following:

- What is the relation between the establishment/existence of an institutional structure (user organization) that allows farmer participation and control and:
  - Institutional ability to raise revenues for O and M; and
  - Institutional ability to motivate farmers to volunteer labor for O and M?
- Does the establishment/existence of the user organization promote a greater local consciousness of the need for better O and M and what is the user's role in achieving this?

- Does the establishment/existence of the user organization result in:

  -- Improved water allocation; and

  -- Improved accountability of operators (and other officials) so that irrigation becomes more reliable?

C. Sources of Information

The sources of information for examining all the issues discussed above are similar though it may be necessary from time to time to consult some special sources for a particular issue. This will be determined as the need arises. In part, we will rely heavily on secondary sources such as those listed in Annex 2 of this report. The list will be expanded as additional secondary material is consulted.

In the field visits, we will rely heavily on interviews and discussions with appropriate people. These include government officials such as those in Ministries or Departments of Agriculture and/or Irrigation, and/or water management, etc.; irrigation officials such as engineers, operators, etc.; and finally, but perhaps most important, with farmers who are users of the irrigation.

Since there is not sufficient time to conduct comprehensive surveys, it will be important to identify "key" people, as for example, leaders of water-user associations, or a system chief engineer. As a control, it will also be necessary to speak to others such as a few irrigation users selected at random or the average water association member. Another useful device would be to meet in conference with irrigation researchers (academic and non-academic) and practitioners to discuss the issues. This would be a fast and efficient way of sharing information and ideas. Finally, there will be reliance upon the team members' personal observations of irrigation projects.

V. PROPOSED FIELD VISITS

The overall objective of the field visits is to supplement the secondary source research and provide data for case studies that will be used as evidence evaluating the six irrigation pricing and management issues defined in the previous section. The case studies will be included as Annexes in the Final Report.

Two multidisciplinary teams, each composed of three members, will conduct the field studies. The composition of each team and its proposed schedule are described in Sections A and B.

A. Team 1

1. Composition

Team 1 consists of the following members:

- Dr. Ian Carruthers (Economist and Principal Investigator);
- Dr. Dean Peterson (Engineer); and
- Dr. Rekha Mehra (Agricultural Economist and Social/Institutional Specialist).

The team's schedule is as follows:

- March 18-20, 1985: Washington, DC:
- March 22-29, 1985: Indonesia:
- March 30-April 8, 1985: India:
- April 9-17, 1985: Morocco: and
- April 18, 1985: Washington, DC.

2. Field visit schedules

a. Indonesia

In Indonesia, the Government's Sederhana project provides an excellent opportunity to study the development and operation of small-scale irrigation. The small irrigation projects are technically simple gravity-fed systems constructed throughout the archipelago since 1974. They represent a whole range of construction and management standards and various stages of development of user associations. The team will be able to observe successful systems in Yogyakarta and problematic ones in the South Sulawesi region. The schedule will be as follows:

- March 22-25, Djakarta: Meetings with officials in the Ministry of Agriculture and the Public Works Department and other persons they may identify;

- March 26-27, Yogyakarta: The focus of the visit to this region will be the Randergoway sub-project because of its extraordinary success. It has a well-functioning farmer organization, has established water charges and a continuous maintenance program; and

- March 27-29, South Sulawesi: Some of the sub-projects in this region are experiencing problems due to poor design and construction. These are also O and M problems that should provide a contrast to the Yogyakarta region.

It is expected that all the issues can be examined at these sites.

b. India

India offers a wide variety of irrigation technologies (canals, gravity-fed, groundwater, etc.) as well as a number of different administration and management systems (bureaucratic and participatory). This field visit will offer the opportunity to study sites that may not be available elsewhere because the systems are not as diverse.

The schedule proposed for India is as follows:

- March 30-April 2, New Delhi: Hold preliminary meetings with officials in the Indian Ministries of Agriculture and Finance and with irrigation specialists in USAID's irrigation division. The Ford Foundation has been approached to help us set up a seminar that would draw together irrigation experts from the World Bank and the Water Technology Center in New Delhi, and the Institutes of Management at Ahmedabad and Bangalore. This will provide an excellent opportunity to review the current status of irrigation throughout India;

- April 3-4, Roorkee, U.P.: The objective here will be to draw upon Dr. Peterson's established contacts in the Irrigation section of the Roorkee Engineering Institute. Discussions will be held with the researchers at the Institute and site visits will be made; and

- April 5-8, Bangalore or Ahmedabad: Both locations have Institutes of Management with Irrigation Sections that are currently conducting research. The objective would be to use these resources and to visit neighboring irrigation sites.

The visit to India is contingent upon Government of India clearance for the team. This process has already been initiated with the help of Mr. Robert Nachtrieb of the USAID Mission at New Delhi.

If clearance is not given, we will have to reschedule this portion of the field study either by going to the Philippines or by extending the visit to Indonesia or some other arrangement mutually agreed upon by AID/PPC and Devres.

c. Morocco

Over the past ten years, Morocco has been generally successful in rate collection for O and M and is proposing to begin covering capital costs as well. However, Morocco is an example of efficient rate collection. There is enough of a range in collection rates between irrigation sites to make this an interesting case. It also offers a variety of medium- and small-scale government and private schemes.

The schedule proposed for Morocco is as follows:

- April 9-12, Rabat: The visit here is to meet with officials and to obtain data at the Ministries of Agriculture and the Treasury and the Irrigation Departments;
- April 12-15, Doukkala Project: This is an example of a highly successful canal irrigation system with established water charges. Cost recovery is intended to meet 100 percent of O and M charges and in 1980 the collection rate was 89 percent. Field responsibility for O and M is with farmers and performance is good. Data from this site will provide insight into the high cost recovery/good O and M/farmer participation case; and
- April 16-17: Visits to other project sites to be determined later.

B. Team 2

1. Composition

Team 2 consists of the following members:

- Dr. N. S. Peabody (Social/Institutional Specialist and Team Leader);
- Dr. Alvin Bishop (Engineer);
- Dr. James Seagraves (Economist); and
- Dr. Al LeBaron (Economist).

Dr. Seagraves will be in the team that goes to Peru and Dr. LeBaron will go to the Dominican Republic. Dr. Peabody will be the only team member who is scheduled to visit the Philippines but he will be joined by an economist based in Manila. Devres is in the process of identifying the appropriate person in Manila at one of the following institutions: the Asian Institute of Management, the Institute of Philippine Culture or the National Irrigation Administration (NIA).

The team's schedule is as follows:

- March 18-20, 1985: Washington, DC;
- March 20-April 3, 1985: Peru;
- April 7-17, 1985: Dominican Republic;
- April 11-21, 1985: Philippines (Dr. Peabody); and
- April 18, 1985: Washington, DC (Dr. Peabody arrives April 22).

2. Team Visit Schedules

a. Peru

Peru offers a range of irrigation sites in its many valleys. There are a variety of management systems and diverse problems including different values for water and charging mechanisms that should yield useful information. An extensive body of literature already exists on Peru's irrigation that will be helpful for background material.

The schedule in Peru is as follows:

- March 21-22, Lima: Visit AID, DGASI, INIPA, INAF, Plan Rehatic and maybe ONERN. Prior to the visit, we will try to secure the collaboration of one of these agencies with our study.;
- March 23-25, Cajamarca: Barbara Lynch will meet the team at airport in Cajamarca and take them to Plan MERIS office for conversation with Pepe Hermosa and/or Ing Zapota;
  - March 23: Visit several irrigation schemes near Cajamarca. If there is a reasonable place to stay in San Marcos go there for two nights--otherwise stay in Cajamarca and go early on Sunday to see the Plan MERIS project at San Marcos; and
  - March 25: Visit irrigation schemes at Jequetepeque, Lambayeque and Chiclayo;
- March 26-28, Piura (San Lorenzo): Visit persons who understand the water systems, problems, charges, local commissions and committees;

- March 29-31, Tacna: Visit persons who understand the water systems, problems, charges, local commissions and committees in Tacna, Moquegua and Majes (near Arequipa); and

- April 1-3, Canete and Lima: Visit Canete and return to Lima to secure answers to any questions that remain. Begin write-up.

b. Dominican Republic

In the Dominican Republic there is a long-standing irrigation tradition, a bureaucratic entity the Instituto de Recursos Hidrolicos (INDHRI) with overall responsibility for irrigation and decentralized irrigation districts that the government would like to make self-sufficient. The government also has a cost recovery policy. However, recently problems have arisen with payment rates and wide water management. These factors will offer useful insights for this study.

During the period between April 7-17, some time will be spent at INDHRI followed by site visits to:

- Yaque del Norte: Where there are construction and water management problems;

- Sabareta: Where USAID is about to implement a water management project;

- Yuna-Camir: Which has a good water collection record and a relatively high standard of living; and

- Azna: Which is a new agrarian reform area.

c. Philippines

The Philippines was selected for field study because of the wealth of its experience with farmer participation and user associations. Farmer collective behavior is well-documented here and continuing research is an important part of the work of the National Irrigation Administration.

The procedure in the Philippines will be for Dr. Peabody to work with an economist currently engaged in irrigation research at one of the Institutes in Manila. In Manila, the base of operations will be at the NIA and from there field visits will be made to irrigation sites in the Bicol Basin. Many sites are available within 100 miles of the city.

ANNEX

Proposed Work Impl(

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ANNEX 1

Proposed Work Implementation Plan

I. PRE-FIELD VISIT WASHINGTON MEETING (MARCH 18-20, 1985)

A. Purpose

1. Develop written plan for field work at case study sites

2. Develop written plan to prepare Final Report

3. Devres travel briefing

4. Update and incorporate additional material in annotated bibliography

5. Meet with AID/Washington and review field work and final report plans

B. Procedures

1. Tasks for joint action by Teams 1 (Indonesia, India and Morocco) and 2 (Peru, Dominican Republic and the Philippines)

a. Develop outline for Final Report:

(1) Objectives:

(2) Analysis of case study areas;

(3) Conclusions and recommendations;

(4) Annexes: In-depth report of case studies from: Peru, Dominican Republic, Philippines, Morocca, India and Indonesia: and

(5) Annotated bibliography.

b. Develop schedule for completion of Final Report

(1) Schedule for completion of field studies (by April 17, 1985);

(2) Schedule for completion of case study reports;

(3) Develop agenda for meeting in Washington to discuss results of field trips (April 18-30, 1985): and

(4) Assign writing tasks to Team members including deadlines for completion (due: June 3, 1985 at Devres for input and editing).

2. Tasks for individual action by each of Teams 1 and 2

a. Develop plan for field work;

b. Develop detailed outline for case studies;

c. Assign individual writing tasks and deadlines for field reports;

3. Devres travel briefing--Devres staff

C. Outputs

1. Outline for Final Report

2. Two field work implementation plans

3. Both Teams briefed for travel

II. FIELD VISITS (MARCH 21-APRIL 17, 1985)

A. Purpose

1. Complete case studies through field visits--to six countries specified in Section B above

2. Write report for each case study

B. Procedures

(For Teams 1 and 2:)

1. Visits to sites on itinerary--details provided in Chapter V of this report

2. Interviews, document collection, note-taking and team discussions

3. Begin writing case study reports

C. Output--six sets of detailed field notes and case study draft reports.

III. POST-FIELD VISIT WASHINGTON MEETING (APRIL 18-30, 1985)

A. Purpose

1. Complete case study reports

2. Discuss conclusions and analysis for Final Report

3. Devres travel debriefing

B. Procedures

1. Finish writing case study reports--due: May 13, 1985 at Devres for input and edit

2. Develop outline for conclusions and analysis for Final Report

3. Assign writing tasks and deadlines for completion of Draft Final Report (due: June 3, 1985 at Devres for input and edit)

   a. Executive Summary--Principal Investigator

   b. Objectives--revised from Preliminary Report

   c. Annotated bibliography--revised from Preliminary Report

   d. Analysis--to be written

   e. Conclusions and recommendations--to be written

4. Travel debriefing by Devres staff

C. Outputs

1. Final case study reports draft ready for inclusion as Annexes in Final Report

2. Written task assignments and deadlines for completion of all sections of Final Report (due: June 3, 1985 at Devres for input and edit)

IV. FINAL REPORT PRODUCTION AT DEVRES (JUNE 3-28, 1985)

V. SUBMISSION TO AID ON JUNE 30, 1985 DRAFT OF FINAL REPORT

VI. REVISION OF FINAL REPORT AND AID SEMINAR

A. Receive AID Comments and Revise Draft Within 30 Days in Consultation with Principal Investigator, Dr. Ian Carruthers

B. Submit Final Report to AID

C. Dr. Carruthers, Principal Investigator Prepares and Presents AID Seminar

ANNEX 2

Annotated Bibliogra

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415

ANNEX 2

Annotated Bibliography

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Karuanayake, M.M. "Farmer organizations and irrigation leadership in Sri Lanka: Retrospect and prospect," Marga, VI (1) (1980): pp. 1-17.

The article examines the experience of farmer organizations in Sri Lanka in farm management and raises issues that have practical implications for policy information. Special reference is made to the role of cultivation committees and of irrigation agents. The Mahaweli model of farmer groups is also examined. Special attention is paid to the role of local irrigation management. It is suggested that priority be given to setting up higher level authority to deal with problems of water allocation in major irrigation systems and in the Mahaweli scheme.

Kathpalia, G.N. Improved Irrigation Systems Management. Paper presented at the International Seminar on Field Research Methodologies for Improved Irrigation Systems Management. Coimbatore, India: Tamil Nadu Agricultural University, 1981.

Three types of irrigation system management for water delivery from the main headworks to the farm are contrasted for a selected group of irrigation systems in India. The first type emphasizes the control of water at the head of the minor canal such as those in the Punjab, Harjana, Uttar Pradesh, and parts of Madhya Pradesh. In this sytstem, water drainage is computed from field to field and dependent on type of crop grown. The second type of management is where government controls water distribution up to the outlet (chak) and thus water charges are computed in terms of volume of water received and size of irrigated area. The third type, where the government regulates water flow up to the distributing head of the main or branch canal, assesses water charges on the basis of area irrigated and type of crop grown. A brief review of these approaches is presented and some organizational solutions are discussed.

Keller, Jack; Clyma, Wayne; Drosdoff, Mathew; Lowdermilk, Max K.; and Seckler, David. Irrigation Development Options and Investment Strategies for the 1980's. Water Management Synthesis Project. Logan, Utah: Utah State University, 1980.

Keller, Andrew A. "Unit Command Area Response to Water Delivery by the Main System," Ph.D. Thesis. Logan: Utah State University, May 1984.

Kemper, W.D.: M. Haq; and A. Saeed. Farm Water Management in Upland Areas of Baluchistan. Water Management Technical Report No. 51. Fort Collins: Colorado State University, 1979.

Compared to the Punjabi Canal, water losses are less in Baluchistan due to topographic and physical differences (soil type) and to the policy of charging higher water fees leading to more efficient water use. In spite of these, farmers in Baluchistan have been observed to overirrigate due to lack of farm gate control. For farmers with tubewells, overapplication of water is also high because of inadequate management (extension) and to the fixed monthly charge on electricity rather than on a volumetric method. The authors suggest radical changes in the program and the encouragement of local participation in decision making.

Korten, Frances F. Building National Capacity to Develop Water Users' Associations: Experience from the Philippines. Staff Working Paper No. 528. Washington: The World Bank, 1982.

Levine, Gilbert, "The Relationship of Design, Operation and Management," in E.W. Coward, Jr., ed., Irrigation and Agricultural Development in Asia. Ithaca: Cornell University Press, 1980. Pp. 51-62.

Levine, Gilbert and Hart, Henry C. Mobilizing Local Resources for Irrigation. Report No. 22. New York: Agricultural Development Council, 1981.

Levine, Gilbert and Hart, Henry C. Mobilizing Local Resources for Irrigation. Interpretive Summary of a Seminar by the Agricultural Development Council. Colombo, Sri Lanka: Research and Training Network Program, 1981.

The seminar had three objectives: (1) to provide an opportunity for comparative evaluation of South and Southeast Asian experience in the management of irrigation systems, (2) to identify common problems and their solutions, and (3) to suggest areas for research relevant to government programs. Theme papers and reactions from participants are summarized in this report. The major propositions are divided into the (1) types of resources used in irrigation, mainly labor vs. capital resources, (2) amount of resources needed, (3) approaches used for mobilizing resources, especially communal labor, (4) administration and operation of large-scale irrigation systems, and (5) strategies used in the formation of water user organizations.

Medagama, Jaliya. Some Observations on Farmer Involvement in the Village Irrigation Rehabilitation Project in Sri Lanka. Presented at Workshop on Organization as a Strategic Resource in Irrigation Development. Manila, Philippines: Asian Institute of Management, November 15-19, 1982.

Merrey, Douglas J. Irrigation and Honor: Cultural Impediments to the Improvement of Local Level Water Management in Punjab, Pakistan. Water Management Research Project in Pakistan, Pakistan Report No. 9. Fort Collins, Colorado: Colorado State University, n.d.

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Moore, M.P. "The Management of Irrigation Systems in Sri Lanka: A Study in Practical Sociology." Sri Lanka Journal of Social Sciences.

Neghassi, Habte Mariam and Seagraves, James A. "Efficiency in the Use of Water for Irrigation: The Role of Prices and Regulations." Natural Resources Forum. Vol. 3. Boston: D. Reidel, 1978.

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Nyberg, Albert J. and Prabowo, Dibyo. Status and Performance of Irrigation in Indonesia and the Prospects to 1990 and 2000. Rice Policies in Southeast Asia Project, 1982.

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Pant, Niranjan and Verma, R.K. Farmers' Organization and Irrigation Management. New Delhi: Ashish Publishing House, 1983.

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Quenemoen, M.E. "Price Policy Implications for Small Farms in Kafr El Sheikh Governorate." Water Use and Management Project. Vol. IV: Appendix C: Technical Articles by Egyptian and American Teams. Cairo and Fort Collins, Colorado: Colorado State University, September, 1980.

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Robinson, David M. "Making an Irrigation Association a Vehicle for Development: Preliminary Observations on a Group of Philippine Rice Farmers." Water Management in Philippine Irrigation Systems: Research and Operations. Los Banos, Philippines: The International Rice Research Institute, 1973.

Sallam, Mohamed: Knop, Edward: and Knop, Sheila. "Egyptian Farmer's Perception of Alternative Extension Strategies and Tactics in Irrigated Agricultural Development." Water Use and Management Project. Vol. IV, Appendix C: Technical Articles by Egyptian and American Teams. Cairo and Fort Collins, Colorado: Colorado State University, September, 1980.

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Seagraves, James A. and Easter, K. William. "Pricing Irrigation Water in Developing Countries," Water Resources Bulletin, XIX (4) (August, 1983): pp. 663-672.

Steinberg, David I. Irrigation and AID's Experience: A Consideration Based on Evaluations. Draft. Washington: US Agency for International Development, March, 1983.

Steinberg, David I.; Caton, Douglas; Holloran, Susan; and Hobgood, Thomas. Philippine Small-Scale Irrigation. AID Project Impact Evaluation No. 4. Washington: US Agency for International Development, 1980.

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The irrigation pricing policies of the Philippine government are evaluated in this paper with respect to income distribution, water use efficiency, and economic growth. The major conclusion of the paper is that water charges must be based on both benefits and costs of the project and their implications to farmers' income and government revenue.

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The need for predictable and reliable water supplies to maximize the effectiveness of using the new high yielding varieties (HYVs) has resulted in groundwater problems for northern India. Water supply problems are viewed in this paper as intrinsically related to existing groundwater rights and the lack of institutions for regulating such rights. The "Correlative rights doctrine" is used in analyzing the economic value of having groundwater rights and groundwater regulations.

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Visaya, Benito P. The PRMP and the Zanjeras. Paper Presented at Asian Conference on "Organization as Strategic Resource in Irrigation Development." Manila, Philippines: Asian Institute of Management, November 15-19, 1982.

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The article examines the impact of the Command Area Development (CAD) Programme in terms of improving the efficiency of water use, increasing crop yields, and maintaining land fertility levels on a large scale. The use of such methods as land consolidation and realigning field boundaries and reallocation of lands to farmers is evaluated with respect to their effects on decreasing conflicts in water use and increasing collection of water fees. Wade examines further the effects of the CAD on the institutional design for water sharing at the farm level and suggests that socioeconomic research is needed in evaluating the long-term impact of such projects.

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Wattanavitukul, Somluckrat and Cruz, Ms. Concepcion. Irrigation Water Management at the Village Level in Selected Asian Countries. Draft. Honolulu, Hawaii: East-West Center, 1982.

The majority of case studies of Asian irrigation systems at the village level were done on relatively isolated systems with minimal government inputs. A review of some studies done on village irrigation systems located within large-scale projects is presented in this paper. Four major types of organizational arrangements are identiiified: (1) direct state management where no village organization exists, (2) state coordination with existing local, village administration.

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Wickham, T.H. *Water Management in the Humid Tropics: A Farm Level Analysis.* Ph.D. Thesis. Ithaca: Cornell University, 1971.

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Field experiments conducted in the Philippines show that the mean yield benefit attributable strictly to supplemental irrigation in a season of average rainfall is about 0.87 tons/ha. With controlled water supplies, an additional 0.14 tons/ha can be expected, the combined effect being 15 times larger than the water fee charged in the wet season. Thus a first step in improving water management would be to ensure uniform water supplies along the length of lateral canals, where water distribution is dependent on farmer-to-farmer cooperation.

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World Bank, *Operational Policy Memorandum* No. 261. Washington, D.C.: The World Bank, 1971.

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