# IRRIGATION PRICING AND MANAGEMENT

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# IRRIGATION PRICING AND MANAGEMENT

Submitted to: Ms. Joan Atherton
Social Science Analyst
U.S. Agency for International Development
Office of Policy Development and Program Review
Bureau of Program and Policy Coordination

Submitted by: Ian D. Carruthers
N.S. Peabody, III
A.A. Bishop
A.D. LeBaron
Rekha Mehra
Ramchand Oad
Dean Peterson
Dennis H. Wood

DEVRES, INC.
2426 Ontario Road, N.W.
Washington, D.C. 20009
(202) 797-9610
Cable: DEVRES
Telex: 440184

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## FOREWORD

Irrigation systems are not monolithic. Despite diversity this study has produced some valid general conclusions. Public sector financial pressures are severely affecting irrigation departments as all other public services. Governments are turning again to the old intractable area of user fees and water tariffs. "Get the prices right" is the current slogan in agricultural policy and it is now dawning that this means get the input prices right as well as the product prices. There is not much enthusiasm in irrigation departments for economic pricing policies, partly because economists and financial analysts can not agree on precisely what this means. Another major problem is that any revenue raised by irrigation systems or districts is generally not retained by the local entity that raised it or even by the national irrigation department.

Several aid donors have recently or are currently sponsoring studies to find new approaches to securing finance for O and M, with farmers contributing more than hitherto. Whether or not this is successful, there is little doubt that irrigation departments will soon have to reassess the scope and purpose of their workload and possibly hand over some of their responsibilities to farmers.

As efforts to make irrigation more effective and to find new financial resources for irrigation activities have proceeded, inevitable policy conflicts have arisen. For example, research reveals how beneficial a water extension service can be, and aid agencies are promoting below outlet public sector investment. However, other groups in the same donor agencies, through policy dialogue, are urging withdrawal of public services to match the declining public sector financial resources available to irrigation. This study is intended to be a timely contribution to this and other current debates.

Ian D. Carruthers
Washington, DC
July 1985



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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AID | Agency for International Development |
| APBN | Central government sectoral budget for irrigation (Indonesia) |
| ASCE | American Society of Civil Engineers |
| B/C | benefit/cost |
| DGWRD | Directorate General of Water Resources Development (Indonesia) |
| DR | Dominican Republic |
| FAO | Food and Agriculture Organization of the United Nations |
| HYV | High yield variety |
| IBRD | International Bank for Reconstruction and Development |
| INAF | Instituto Nacional de Ampliación de la Frontera Agricola (Peru) |
| INDRHI | Instituto Nacional de Recursos Hidráulicos |
| IPEDA | Land tax (Indonesia) |
| IRRI | International Rice Research Institute |
| l/s | liters per second |
| M | million(s) |
| MERIS | Mejoramiento de Reigo en la Sierra (Peru) |
| NCAER | National Council of Applied Economics Research |
| NIA | National Irrigation Administration (Philippines) |
| O and M | Operation(s) and Maintenance |
| OECD | Organization for Economic Cooperation and Development |
| OM | Operations Manager (Philippines) |
| ORMVA | Office de Mise en Valeur (Morocco) |
| ORMVAD | Office de Mise en Valeur du Doukkala - Regional Office for the Development of the Doukkala (Morocco) |
| PEPM | Proyecto Especial Pequennas y Medeanas Irrigaciones (Peru) |
| PET | Potential evapotranspiration |
| PRYN | Proyecto de Riego Yaque del Norte (Dominican Republic) |
| UPRC | Upper Pampanga River Project |
| UPRIIS | Upper Pampanga Integrated Irrigation Project (Philippines) |
| US | United States |
| USAID | United States Agency for International Development |
| WUA | Water User Association(s) |



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## CURRENCY EQUIVALENTS

US$ 1.00 = RD$ (Dominican Republic pesos) 1.00

US$ 1.00 = Rp. (Indonesian Rupiah) 11,000

US$ 1.00 = DH (Morrocan Dirhams) 9.84

US$ 1.00 = S/ (Peruvian soles) 8,250 (22 March 1985)

US$ 1.00 = ₱ (Philippine pesos) 17.60

## WEIGHTS AND MEASURES

| | | |
|---|---|---|
| 1 hectare (ha) | = | 10,000 $m^2$ |
| | = | 2.471 acres |
| 100 hectares (ha) | = | 1 $km^2$ |
| 1 kilogram (kg) | = | 2.204 pounds |
| 1 metric ton (MT or t) | = | 1,000 kg |
| | = | 2,204 pounds |
| 1 kilometer (km) | = | 0.621 miles |
| 1 square kilometer ($km^2$) | = | 100 ha |
| 1 millimeter (mm) | = | 0.04 inch |
| 1 cubic meter ($m^3$) | = | 0.061 cubic inch |
| 1 liter | = | 1.066 quarts |

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# EXECUTIVE SUMMARY

## A. Purpose

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

- Direct and indirect 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.

Five issues dealing with the pricing and management of irrigation water were examined in-depth. They are specified in detail in Chapter IV and briefly stated in part C of this Executive Summary.

## B. Procedure

To achieve the above objectives several interrelated activities were carried out.

- Relevant irrigation literature was obtained, reviewed and abstracted (see Annex 6), thereby expanding upon each of the issues to be dealt with during the assignment;

- A preliminary report was prepared (see Annex 7), setting out in detail the issues to be examined and specific countries and irrigation schemes where they might be reviewed best;

- Detailed case study and final report outlines were prepared to ensure comparability between different field studies and the comprehensiveness of the entire effort;

- Field work was carried out by two teams, one carrying out case studies in Morocco, the Philippines and Indonesia, the other carrying out case studies in Peru and the Dominican Republic. (See Annexes 1, 2, 3, 4 and 5 respectively.) The tables in Annex 8 summarize the characteristics of the irrigation projects visited in each of the five countries; and



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- The field study teams were composed of three persons each--an irrigation economist, an irrigation engineer, and a social/institutional specialist to ensure a broad based interdisciplinary review of each case study and issue.

The case studies in the five countries were carried out by the two teams during a five-week period in March/April 1985. Preparation of the case studies and final report was completed by the teams and Devres' home office staff during May/June 1985.

## C. Conclusions and Recommendations

In developing countries there is an immense diversity of irrigation farming. Therefore, all generalizations about irrigation are likely to be untrue (except this one). However, there is little doubt that the general severity and extended duration of the economic and financial problems faced by all developing countries has placed unprecedented difficulties upon public sector budgets and upon irrigation departments in particular. As a result, the increasingly important irrigation service is seriously below potential. Within this context, ways to realize fully the potential of irrigation must be identified and implemented.

The main conclusion of this study is that the resources for maintaining irrigation inputs must come from the direct beneficiaries. However, appropriate decisions on the level and form of service fees can only be taken whilst simultaneously reviewing the general policy regime applicable to each country and irrigation project. Thus, while the conclusions and recommendations that follow provide overall guidance for achieving more of the potential available from existing and future irrigation systems, they need to be applied by senior administrators and policy makers in their specific technical, economic and political situations. For this reason, it is important to communicate the outcome of this and similar studies to politicians, administrators and others who can adapt, apply, and refine the recommendations in specific situations.

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

#### a. Conclusions

- It is essential to devise politically-supported policies that will raise revenue at least to the level of full O and M costs;

- Cost recovery through direct charges to farmers is feasible, especially to meet O and M requirements;

- It is not essential for fees to be monetized. In fact, there may be advantages to fees collected in-kind, particularly in the largely subsistence agricultural sector of many developing economies. In addition, there is an element of automatic indexation inherent in in-kind payments;

- The feasibility of increased cost recovery through direct charges in each specific case is dependent upon decision makers recognizing the true nature of the complex financial problems they face and acting firmly on the basis of these insights with appropriate policies. One example of devising an appropriate policy is to make provision for gradually phasing in a full fee over a period of years, particularly on a new scheme which may take several years to achieve full operational capacity;

- Indirect charges also can be used to pay for irrigation costs and they may ultimately work as well as direct charges in achieving cost recovery objectives. However, they are a second best alternative because they do not inform farmers about the real costs of their irrigation system nor involve them sufficiently in taking responsibility for or participating in aspects of the system; and

- Highly subsidized water supplies are an inequitable and inefficient form of farm income support. Irrigation farmers, though often poor, are seldom ultra-poor and often they have a relatively satisfactory and secure income.

b. Recommendations

- Increased direct charges to farmers must be an accepted policy goal. However, any charging scheme must be sensitive to the numerous factors which influence particular farmers' benefits from the irrigation system--variations in production from year to year, especially poor farmers, inequitable water distribution patterns in the system, etc.;

- If direct charges do not match minimum financial needs sufficient amounts must be provided from indirect charges to the irrigation system to guarantee proper O and M services. Sufficient revenues raised from indirect charges must be transferred to the irrigation scheme to enable it to maintain proper service.

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

a. Conclusions

- Increased farmer participation and control do seem to contribute to improved cost recovery; and

- Increased farmer participation and control can improve cost recovery directly by their accepting more responsibility and paying higher user charges or indirectly by their becoming responsible for more of the O and M work required by the system, thereby reducing public costs.

b. Recommendations

- Additional action research should be undertaken on means to transfer responsibilities to farmers for support services thus reducing public costs. Programs implementing the findings of such research should receive sympathetic donor consideration for financial under-writing. For such transference policies to work, there will have to be increased farmer benefits;

- The action research undertaken should be consistent with the realities faced by the public sector in terms of financial, personnel and policy limitations. It should identify and analyze specific successful interfaces that join necessary governmental and farmer contributions so as to optimize system benefits and the sharing of system responsibilities; and

3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?

a. Conclusions

- Unless a water supply is reliable, it is unlikely that improved cost recovery can be achieved and sustained. Seldom is financial performance satisfactory when the main system supply is unreliable. It is difficult, however, to prove that improved cost recovery depends upon a reliable supply of water. Thus, although a reliable water supply may be a necessary condition for improved cost recovery, it is not sufficient. On the other hand, use of mechanisms such as charging in advance may make it possible to improve cost recovery even where water delivery is unreliable;

- The adequacy of water supply does not appear to be directly linked to improved cost recovery. Farmers rarely consider their supplies to be adequate and water supplies are always inadequate at some times and in some areas within every system; and

- Since successful cost recovery is possible even without water measurement at the tertiary level, it follows that sophisticated water measurement technology is not necessary for improved cost recovery. Water measurement technology is important only if rates are levied on an actual volumetric basis which is relatively rare in gravity irrigation systems.

b. Recommendations

- Reliability and adequacy of water supplies should be an important part of any effort to improve cost recovery. Even though they cannot be shown to be essential to the achievement of cost recovery objectives, their improvement will provide long-run insurance that cost recovery successes can be maintained. Direct charges should be used when possible because they are the most appropriate means for involving farmers for the reasons indicated earlier; and

- Pending improvements in water measurement technology at the tertiary level, it may be possible to experiment with wholesaling larger quantities of water as these can be more easily and effectively measured at the primary and secondary levels. The water could be wholesaled to groups of farmers (rather than the individual farmer) and this could be made a basis for improved interaction between irrigation authorities and farmers based on mutual accountability. Such an experiment has potential for improving cost recovery and is deserving of donor assistance.

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water?

a. Conclusions

- Increased water charges appear to be necessary to achieve improved O and M. However, they will not be sufficient;

- Efforts to increase water charges are likely to be more successful if they are combined with visible system improvements which result in making the system more reliable and system rehabilitation can be made conditional upon guarantees of price policy reform; and

- The cost of water and application efficiency do not appear to be directly linked, however, the value of water and application efficiency are linked. This is clearly shown in farmer-controlled tubewell systems and on gravity schemes at crucial times of the year.



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b. Recommendations

- Water charges should be used as an integral part of efforts to improve cost recovery and O and M. They are only a part of the overall solution, however, and must be integrated with other aspects necessary to achieve O and M improvement such as farmer participation, more "earmarking" or utilization of funds collected directly for O and M activities, equity of distribution within the system, etc.;

- Water charges should vary more between and within developing countries. The two guiding principles for developing such charges should be (1) separate budgets for each irrigation scheme and (2) retained revenues for each scheme. Retaining revenue effectively shifts irrigation departments from being only public service entities to being public utilities. Scheme charging, perhaps more controversial, is advised on efficiency grounds to indicate the real costs of new, ambitious and technically difficult schemes and the high costs of necessary improvements such as pumped drainages; and

- Attempts to bring the cost of water to farmers closer to the value of water to the individual farmer should be made for specific irrigation projects. This could help provide financial resources needed to improve O and M and may increase application efficiency if the cost can be made to accurately effect the value of water to the individual farmer.

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

a. Conclusions

- Institutionalized farmer participation in the operation and maintenance of irrigation systems appears to result in improved O and M, especially in the case of tubewell systems. However, the degree to which it is true of canal systems is unclear; and

- There are few canal or tubewell systems in which irrigation officials have transferred much O and M responsibilities to farmers. The Philippines experience is the most extensive in this regard and a few examples of improved O and M are available where such transfers have been made. However, since the transfer of O and M responsibility is not yet widespread, any positive results must be regarded as promising but not yet generalizeable.



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b. Recommendations

- Increased farmer participation in O and M activities is desirable and, in the long term, necessary particularly in bearing a larger share of the the cost of running the irrigation system. Therefore, moves in this direction should be an important part of irrigation policy. This can be expected to contribute to several aspects of irrigation system improvement--one of which may be better O and M;

- Efforts should be made to ensure women's participation in irrigation groups to an extent at least equal to their contribution to farm production; and

- Specific institutional arrangements adapted to each socio/cultural environment and irrigation system should be identified and experimented with to provide additional bases to increase farmer participation in irrigation projects. AID donors should support these experiments financially.

# I. INTRODUCTION

## A. Purpose and Procedures

The general objective of this study was to investigate ways to mobilize human and financial resources for improving the functioning of irrigation systems, the underlying purpose being to maximize the unrealized potential from irrigated lands for improved agricultural production and increased farmer incomes. In particular, the study focuses on the role of:

- Direct and indirect charges in meeting recurrent cost needs. This is based on the premise that successful cost recovery from users can assist financially deficient irrigation administrations to keep systems functioning with improved maintenance and operational levels; and

- Increased farmer participation in irrigation management. This is based on the assumption that mobilization of human resources at the local level is likely to have a favorable impact on both cost recovery and on improved operations and maintenance (O and M).

Following a review of the literature to investigate questions related to cost recovery and farmer participation, five issues were formulated. They are as follows:

- To what extent is cost recovery through direct and indirect charges a feasible goal in irrigation systems?;

- Do increased farmer participation and control contribute to improved cost recovery?;

- To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?;

- Are increased water charges a necessary and sufficient condition of improved O and M? To what extent does efficiency of water use vary with the cost of water?; and

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



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The investigation of issues was based on the accumulated experience in the areas of irrigation cost recovery and farmer participation in management. Theory was used whenever applicable to guide observations, but an emphasis was placed on empirical evidence and field interviews in five countries. This approach was 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.

There is already a considerable amount of evidence in the available literature, and the first step was to review and synthesize this. Summaries of the more important sources are provided in the Annotated Bibliography (Annex 6). The process helped identify the areas in which there were gaps and where most information was needed. The literature study was followed by field visits to Morocco, the Philippines, Indonesia, Peru and the Dominican Republic. As shown in Table 1, these countries offer a wide range of irrigation technologies, financial, institutional and management systems and statuses.

Two multidisciplinary teams, each consisting of an irrigation engineer, an irrigation economist and a social institutional specialist conducted the research. Team 1, which visited Morocco, the Philippines and Indonesia between March 20-April 20, 1985 consisted of:

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

They were joined by:

- Dr. Ramchand Oad (Engineer) in Indonesia.

Team 2 visited Peru and the Dominican Republic from March 20-April 19, 1985. Its members were:

- Dr. N.S. Peabody, III (Social/Institutional Specialist); and
- Dr. A. Bishop (Engineer).

They were joined by:

- Dr. J. Seagraves (Economist) in Peru; and
- Dr. A. LeBaron (Economist) in the Dominican Republic;

and assisted by:

- Dr. Carlos Sarria in Peru.

Table 1: Growth in Irrigated Area, by Continent, 1950-82

| Region | Total Irrigated Area, 1982 (million ha) | Growth in Irrigated Area 1950-60 | 1960-70 (percent) | 1970-80[a] |
|---|---|---|---|---|
| Africa | 12 | 25 | 80 | 33 |
| Asia[b] | 177 | 52 | 32 | 34 |
| Europe[c] | 28 | 50 | 67 | 40 |
| North America | 34 | 42 | 71 | 17 |
| South America | 8 | 67 | 20 | 33 |
| Oceania | 2 | 0 | 100 | 0 |
| World | 261 | 49 | 41 | 32 |

[a]Percentage increase between 1970 and 1982 prorated to 1970-80 to maintain comparison by decade.
[b]Includes the Asian portion of the Soviet Union.
[c]Includes the European portion of the Soviet Union.

Source: W.R. Rangeley, "Irrigation--Current Trends and a Future Perspective," World Bank Seminar, Washington, DC, February 1983. Cited by L.R. Brown, et al. State of the World (N.Y.: Norton, 1985).



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The basis in economic theory for the institution of water charges is reviewed in Chapter II, which also points out the inherent difficulties in applying marginal cost pricing to the case of irrigation water. Issues related to water management and what is meant by O and M are also raised in Chapter II as is the role of farmer participation. Chapter III describes briefly each of the project sites visited during the course of the field studies, and summarizes the main observations concerning them. The field studies are described in more detail in Annexes 1-5. Each of the five issues is discussed at length in Chapter IV including insights gathered in the field. Finally, Chapter V presents the general conclusions and recommendations.

## B. Statement of the Problem

### 1. Macroeconomic influences

The severity of the present economic and financial crisis facing most countries, and the prolonged international recession, is generating unprecedented difficulties for Governments in general, and, in our context, for irrigation authorities in particular. The current macroeconomic context has inevitably created new problems and priorities for the irrigation sector. Typically, national debt service obligations are causing extreme obstacles: many public sector institutions have liquidity crises and some agencies are practically insolvent. A precondition for any effective irrigation sector policy analysis in the mid 1980s is a consideration and understanding of the macroeconomic framework. This is particularly true of any analysis of financial elements of irrigation policy. Unless and until the ramifications of the macroeconomy are recognized, there can be no guarantee that any irrigation policy change will be an effective, let alone an efficient, improvement. In an unstable economy, a policy change that would be helpful in other circumstances, could even cause damage.

Despite substantial economic progress in developing countries during the 1970s, the varied external and internal economic shocks of the 1980s have revealed crucial structural weaknesses in their economies. It is now apparent that growth in the 1970s was being obtained at high investment cost. In many areas such as manufacturing, (and in some sections of agriculture), high levels of protection and public sector subsidy using inappropriate trade, industrial, financial and exchange rate policies led to sheltered investments in activities where many developing countries lacked a clear comparative advantage.

More specifically, in agriculture, there was typically public sector market regulation and input and output price controls, together with archaic institutional frameworks, that inhibited the capacity of the sector to benefit fully from the general economic growth of the 1970s. Despite belated but widespread recognition of the negative impact upon the economy of effectively taxing agriculture to fund urban



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sector needs, there will be a temptation in some countries to do so given the scale of agriculture, the severity of the adjustment problem, and the few alternative policy instruments available to governments.

If agriculture did well in some developing countries in the 1970s (such as where irrigated wheat and, latterly, rice were the main crops) it often did so in spite of, rather than because of, public sector policy. It seems likely that agricultural planners in the late 1980s, will have to rely upon agricultural growth yet again to stimulate their economies but without moving the internal terms of trade too much in favor of agriculture. The expenditure patterns of many governments between 1979 to 1985 have produced a medium-term shortage of financial resources that makes internal generation of finance from farmers by one means or another inevitable. It must be accepted that the scope for direct or indirect financial subsidies for irrigation is for the most part extremely limited. The two central problems of irrigation policy are thus the complicated one of how to obtain relatively small amounts of finance from large numbers of very poor farmers and then, this being achieved, how to ensure the finance is used to provide an effective and efficient irrigation service.

In the mid-1980s many irrigation agencies and projects are facing unrelenting financial problems. We need to explore how this could have arisen when irrigation at least appeared to be a relatively successful technology during the 1970s. It is certain that the unfavorable macroeconomic situation played a key part. The macroeconomic picture which emerged in the early 1980s was confused. However, recognition of government use of massive external borrowing and imports to bolster the gains of the 1970s, and sustain investment programs in the face of unfavorable world economic conditions, sharpens the image. It is clear that despite public sector initiatives economic growth failed to resume previous levels, high interest rates and global inflation prevailed, and for many countries there was a stagnation in terms of trade. The growth of external deficits was exacerbated in most developing countries by a fall in government revenues.

Many governments underestimated the severity and duration of recession and borrowed heavily for both investment and consumption purposes. The perception that structural adjustment to a new economic order was a necessity was only slowly realized in 1979-83. Furthermore, once recognized, achieving stabilization and adjustment has proved to be a harsh and costly process. In addition to unfavorable external factors there are often domestic political imperatives such as the need to reduce the impact of urban unemployment, to protect infant industries not able to 'grow up' to competitive independence at this time. Responding to these features will inevitably restrict or slow the adjustment process.

In this process, irrigation institutions have probably suffered less than manufacturing industry but the expansion of area irrigated has generally slowed and farmers dependent upon technology such as pumped schemes and groundwater have often faced rapidly increased costs

(or added to the government financial burden). There are clear limits to the ability and willingness of many governments to finance irrigation infrastructure adequately from general revenue. To allow irrigation facilities to deteriorate at a time when complementary inputs have combined to create unprecedented productivity would be irrational. Hence, most governments in developing countries are being forced to reconsider their policies toward irrigation subsidies, farmer payments of service fees and direct and other indirect charges, and greater farmer participation in the process of operation and maintenance.

The study team was repeatedly informed by government officials that financial stringency in public expenditure threatens to reduce further the generally unsatisfactory standards of irrigation performance. Thus, the irrigation sector illustrates in exaggerated form the recurrent cost problem: expansion of the investment portfolio; reluctance to service the investments; and, more recently, growing inability to finance the investments fully. The expanding economic opportunities for the existing irrigation networks will be realized only if there are policy shifts, and resources for operations are mobilized much more reliably and widely than hitherto. This report examines the scope of mobilizing resources with particular focus upon the role of farmers in this process.

While the production potential of a modern well-functioning irrigation system is enormous, success can also create problems for cost recovery. For example, increases in production may be on a sufficient scale to depress prices of crops and thus the profitability of agriculture. This is well illustrated in the case of Indonesia, where successful adoption of modern rice varieties and high levels of fertilizer application, together with massive investments in rehabilitating and extending irrigation (since 1968 the World Bank alone has provided more than one billion dollars for irrigation), have combined to produce a rice surplus at the favorable price environment presently enjoyed by farmers. However, Government is struggling to maintain high real producer prices because prospects for exports are very limited, the financial cost of crop purchase for Government storage is extremely high, and the physical limits to suitable grain stores are nearly reached. If such circumstances combine to reduce farm prices and farm incomes the scope for simultaneous significant increases in fees or charges for irrigation are much reduced. This illustrates the broad context within which water pricing policies have to be considered.

Indonesia is a country that has been relatively favorably treated by AID donors and it has the benefit of substantial oil revenues. The symptoms of over-extended capital investment and shortage of finance for O and M are clear in this case.[1] Such symptoms are likely to be all the more obvious in poorer countries.

2. Sector distortions

Mobilizing financial resources for irrigation is but one aspect of irrigation policy. Farmers are simply one possible source of finance. Finance is only one resource farmers can offer; their labor may be of greater value. However, making judgments about the appropriate level and mechanisms for farmer contributions involves complex economic, financial, equity, political, administrative and legal considerations. Each of these considerations will require criteria or tests by which to judge policy options. These criteria will seldom if ever have equal weight nor always be consistent.

Public policy affects the availability and price of virtually all inputs and outputs in the irrigation sector. In applying tests to a policy change, for instance, to increase water fees to signal the real costs of the service to farmers, the overall context has to be simultaneously considered or infeasible or inappropriate policies may be advocated. This is perhaps best illustrated by a fairly typical but hypothetical example. If rice is the major crop in an irrigation system and the price of rice is held at two-thirds the free market or equilibrium price, then there is a transfer of income from producers (rural) to consumers (mainly urban). The rural areas will in effect be subsidizing urban wage earners, but it is difficult to determine by how much. To impose high irrigation charges in such circumstances in order to generate public savings, or even to cover the costs of installation or just operation and maintenance, may be impractical as well as unjust. However, if agriculturalists at the same time are subject to a set of subsidies and taxes for credit, fertilizer and other inputs, export taxes, export quotas and so forth, the policy environment becomes exponentially more complex. Irrigation authorities in many countries operate within just such a distorted policy framework. We conclude that rational decisions about changes, in irrigation fees or other methods of resource mobilization, cannot be made without simultaneously reviewing general policy regime.

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[1]It is, however, necessary to clarify that although capital investment in irrigation may be considered high relative to the availability of O and M funds, the investments may not be excessive when looked at from the point of view of Indonesia's food import bill. Between 1976-83, Indonesia's rice and wheat imports avaeraged 2.6 million tons and cost about $500 million annually. We are indebted to Raymond W. Hooker for this insight.

3. The importance of irrigation 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 irrigation's potential to improve agricultural productivity and promote rural development. The bulk of investment has been made by developing country governments and private farmers. Irrigation is also a favorite sector for aid donors. 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.[2] Table 1 shows the rapid increase in area over the last 30 years.

This growth in irrigation availability has been extremely important for food production in developing countries. In particular, it was required to ensure 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, according to one estimate, 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.[3] Another estimate is that a third of today's harvest comes from the 17 percent of the world's cropland that is irrigated.[4] Irrigation clearly is vital if the developing world is to meet the challenge of feeding an ever-growing population. In general, irrigation investment is worthwhile, and 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.[5]

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

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

[4]L.R. Brown, et al., State of the World (N.Y.: Norton, 1985).

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



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a. The failure to realize maximum potential in irrigation

There is, however, considerable evidence that the potential gains from irrigation are far from being fully realized. 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 half the water supply wasted before reaching the crops could, with sound infrastructure and good management, be beneficially used, increasing water availability for crop growth by up to 25 percent. Fell's analysis of irrigation in the Sahel shows that substandard performance is the norm because of technical, management, agricultural policy and financing problems.[6]

Numerous interrelated reasons account for the failure of irrigation investments to produce their intended benefits. No single reason, not even financial problems, can be put forward to explain failure of irrigation investments to realize their maximum potential. Problems cited in various analyses include:

- Inadequate preparation of projects (e.g., poor assessment of water availability, soil analysis, etc.); faulty design (especially at the farm end of systems);
- Lack of drainage, insufficient control structures; in essence under-investment in infrastructure;
- Poor canal management and organization (e.g., faulty personnel policies);
- Insufficient financial resources and priority for operation and maintenance;
- Poor crop production techniques and agricultural services (e.g., use of low quality seeds, no extension services);
- Neglect of public health aspects of irrigation design and operation;
- Poor land levelling and water management at the farm level; and
- Exogenous problems such as unrealistic crop pricing policy; unreliable delivery of inputs such as fertilizer or electricity.

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[6] 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).



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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 waterlogging 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 operation and maintenance, but this link is by no means clear or inevitable. In most countries, water user charges revert to the general treasury and O and M levels are decided politically or administratively rather than by the level of collections. Still, irrigation is part of an interdependent socioeconomic system, and therefore as with macroeconomic influences discussed above, reform of one component requires a holistic approach that recognizes the complexity of interrelationships between all the components of the system.

b. Recent emphasis on better utilization of existing irrigation systems

In recent years, the problems affecting irrigation systems have shifted attention away from further 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 greatly reduced and in others the per acre costs are steeply rising.

The availability of new, profitable agricultural technology is also encouraging a switch from increasing cropped area to increasing yield per hectare and the number of crops per year on the existing 260 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 tends more toward maximizing returns per unit of water rather than yield per hectare. This will require investment to be redirected toward improvement in physical infrastructure and operating mechanisms, and institutional efforts to be directed from planning land development toward improved water operations management.

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

Upgrading existing irrigation infrastructure may be the most promising investment option as a high proportion of total costs will be sunk costs. However, it is not inexpensive and may be unwarranted unless the conditions that led to deterioration are overcome. 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 part of the rehabilitation package is timely and likely to assume greater importance in the near future as the emphasis shifts toward improving the effectiveness 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 who are indirect beneficiaries; from financial transfers from the general exchequer raised by taxes or internal borrowings; or from overseas aid donors. This study examines the potential for covering recurrent costs directly through charges imposed on irrigation users and will explore 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 water is rising. Efficient delivery of irrigation water is unlikely to be achieved unless the irrigation entity is financially sound. If financial strength and economic efficiency could be achieved by an agreed 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, among other things, tapping farmers' knowledge of local conditions. This always has been an important input for traditional systems and could be for rehabilitation and operation of small-scale systems as well as that of the watercourse or field level of major 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.[7]

Farmer participation is even more important in small-scale systems where lower production levels do not permit extensive support of external personnel to manage these systems. 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.[8] However, it is important to point out that the experiment in the Philippines and elsewhere to hand over more responsibilities to farmers on the bigger public schemes has received more impetus from the adverse financial status of the National Irrigation Authority than from the successful experiments on communal systems. This may be true in other areas as well.

The potential for improved management through greater farmer participation is 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, and thirdly to identify the desirable roles for participants to play. The theoretical arguments are tested against field conditions in the five countries visited. The strategies and tactics used in particular situations to mobilize local financial and management resources for irrigation were examined during the field work to see if tentative policy guidelines could be developed.

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[7]Levine and Hart, Mobilizing Local Resources.

[8]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.



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## II. THEORETICAL AND PRACTICAL CONSIDERATIONS

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 sustain and 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 timely and adequate water supplies to his fields while the irrigation engineer may be more concerned with the efficient delivery of water from head works to outlet, the agricultural economist with higher farm production and the sociologist with operation and management of the system as a whole.

Until recently, there was insufficient understanding of different interests and perspectives, but in many countries this is rapidly changing. Sometimes the main impetus for interdisciplinary collaboration is academic,[9] sometimes it stems from new institutions such as the recently formed International Institute for Irrigation Management in Sri Lanka. Our (interdisciplinary) team found real and growing collaboration between natural and social scientists and engineers in most places visited, but notably so in the Philippines and at the International Rice Research Institute (IRRI). If progress is to be made with increasing irrigated agricultural productivity, then it is essential to maintain the recent progress in combining insights from different disciplines. This is particularly true when the objective is to mobilize farmers to accept higher degrees of financial and management responsibility.

### A. Criteria for Assessing Irrigation System Performance

At the risk of oversimplification one can say that the three most important criteria by which the effectiveness of an irrigation system is assessed are high productivity, efficiency of water use and equity. 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, water used in a crucial time period, or some other more remote 'proxy' measure such as irrigated area, yield, farm income, etc. A measure of productivity might be the gross value of production

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[9]See, for example, A.F. Bottrall, Comparative Study of the Management and Organization of Irrigation Projects, Staff Working Paper No. 458 (Washington, DC: The World Bank, 1981); E.W. Coward, Irrigation and Agricultural Development in Asia (Ithaca: Cornell University Press, 1980) and R. Chambers, In Search of a Water Revolution: Questions for Managing Canal Irrigation in the 1980s (Brighton: Institute of Development Studies, University of Sussex, 1980).



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divided by water available, less the gross value of production with a similar resource base but without irrigation. A measure of equity is the degree to which all farmers in the system receive equally dependable and adequate water supplies.

1. Technical efficiency

Technical efficiency of water supply and irrigation use are even more elusive concepts.[10] In many systems, only a small proportion of the water diverted from a river or dam (often less than 35 percent for a total season) will be beneficially used in crop evapotranspiration on that same system. This is not necessarily a cause for concern as water leaving the system sometimes may be reused downstream. Moreover, water-use efficiency varies throughout a season. During critical times when plant water requirements are high and water supplies are low, efficiencies are much higher than for the entire season. During periods of low demand and high flow, farmers may bypass the water because they do not need it. Given such variation, technical measures to increase water-use efficiency should be carefully scrutinized to make sure they pass economic and financial tests. Engineers and others concerned with technical efficiency must not saddle either governments or farmers with financial or management burdens which cannot be justified by net productivity arguments. The concept of efficiency is discussed in more detail in Section B, below.

2. Equity

Several other criteria should also be used for judging irrigation performance, one of which is equity of water distribution.[11] In most canal irrigation, equity is an elusive goal primarily because of the disadvantages suffered by tailenders and the disproportionate benefits enjoyed by farmers who are located at the head. In principle, an equitable distribution pattern might be based on the doctrine of proportionate equality which suggests water delivery proportionate to the size of a landholding. On the other hand, this principle is far from equitable in the sense that it reinforces any inequality inherent in landholding patterns so that the landless get no water at all. A more equitable idealized distribution might be based on equal water rights for each household regardless of the size of landholding. The level of equity in a particular irrigation system, which must be determined empirically, has important implications for any discussion of cost recovery and participation.

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[10] M.C. Bos and J. Nugteren On Irrigation Efficiencies (Wageningen, The Netherlands: Int. Instit. for Land Reclamation and Improvements, 1974).

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



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## B. Complexities in Defining, Measuring and Attributing Water Use Efficiency

The notion of water use efficiency underlies virtually all discussions of irrigation management, including the present one. However, the term is rarely defined precisely, which has led to the perpetuation of a number of questionable conclusions about ways to increase water use efficiency. This section discusses the concept of water use efficiency in some detail in order to clarify that variance in irrigation efficiencies derive from a variety of different factors and the cost of water is seldom, if ever, a causal factor.

### 1. Defining efficiency

Efficiency terms typically relate the output of a given system to the input. Irrigation efficiency may be measured in physical terms or in economic terms. The point of highest physical efficiency is not necessarily, in fact seldom is, point of highest economic efficiency because the farmer may find it more profitable to invest some of his limited labor and capital in other inputs such as fertilizer and pesticides or weeding than to use them to save water. This discussion will cover only physical efficiency. A high physical efficiency implies little loss, whereas low efficiencies indicate high losses. When applied to irrigation, if a high proportion of the water diverted is utilized to grow crops, the efficiency is said to be high and water losses low. Since irrigation entails a number of water management events (diversion, conveyance and distribution, application on the farm and evapotranspiration), each event may be subject to an efficiency evaluation.

Israelsen[12] was the first to public efficiency definitions related to the various events in irrigation. Conveyance efficiency (Ec) was defined as the ratio of the water delivered to the farm (Wf) to the water diverted from the river (Wr). Then by definition $Ec = 100(Wf/Wr)$. In a similar way, application efficiency (Ea) at the farm was defined as the ratio of the volume of water that is stored by the irrigation in the soil and ultimately consumed by the crop (Ws) to the water delivered to the farm, $Ea = 100(Ws/Wf)$. Both conveyance efficiency and application efficiency are important aspects of irrigation water use efficiency, as are other efficiency elements such as reservoir storage efficiency, distribution efficiency, transpiration efficiency, and uniformity efficiency.

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[12]Israelsen, D.W., "Irrigation Principles and Practices", John Wiley and Sons, Inc., 1st ed., New York, NY, 1932.



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2. Measuring efficiency

Since the farmers' involvement is primarily with application efficiency, the discussions will focus mainly on the application issue at the tertiary level. The concept of application efficiency is a simple and a very valuable indicator when applied to single irrigation events confined to the tertiary level. However, when averages are drawn and the results extrapolated to a seasonal or basin concept, the results can be extremely misleading. Based on a study of hundreds of soil moisture samples and measurements of water applied on nearly 150 separate efficiency measurements, Israelsen reported that water application efficiency for the 150 events varied from a low of 6 percent to a high of 92 percent, with an average efficiency of 35 percent. [13] One farmer on the same field at different times in the same season had a low efficiency of 27 percent and a high of 92 percent. The low efficiency (27 percent) was recorded in springtime when the snow-fed streams were at flood stage, the crop was in the early growth period and evapotranspiration demands low, while the 92 percent was recorded later in the season when flow was low, crop demands were at their peak.

Similar high efficiencies with surface irrigation when water was scarce were noted by Willardson[14] and by Utah State University researchers in Cape Verde (unpublished) where water application efficiencies of over 90 percent were common. Their studies and observations indicate that when water is abundant the farmers tend to substitute water for labor, and low efficiencies result. On the other hand, when drought conditions prevail farmers expend the necessary labor to get water to all of the cropped area with high water efficiencies being achieved. In all of the above instances the price of water was not involved. Scarcity of water and the prospect for economic returns provided the impetus for intensive care of the water resulting in high efficiency.

Because the overall seasonal application efficiency is only about 35 to 50 percent, there is a general misconception that surface irrigation or traditional practices cannot result in high efficiencies and that high technology (sprinkler irrigation or trickle irrigation) must be employed to achieve high efficiencies. This myth should be dispelled. Given reasonable land preparation, the efficiency of use by a farmer depends to a large extent upon the supply delivered to him, its timing, amount and relationship to the crop requirement and soil

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[13] Israelsen, O.W., W.D. Criddle and D.K. Fuhriman, "Water Application Efficiencies Studies", Utah Agricultural Experiment Station Bulletin 311, 1944.

[14] Willardson, L.S., "Attainable Irrigation Efficiencies", Journal of the Irrigation and Drainage Division, ASCE, Vol. 98, No. IR2, June 1972.



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moisture storage capacity.[15] If the delivery system provides the farmer with a given quantity of water according to a schedule, it may or may not result in high efficiencies at the farm level. The farmer usually will apply all of the water delivered. If it is more than the crop and soil requirement, his vigilance to cover the cropped area can be relaxed and low efficiency will result. If, on the other hand, the water delivered is only equal to the amount required, the farmer will exercise the necessary care and increase his labor input to see that all land is irrigated. The result will be a near 100 percent efficiency. On run-of-the-river or partially regulated systems with either continuous flow or rotation delivery, the quantity of water provided to the farm is beyond the control of the farmer. He uses what he gets, but is considered to be at fault if the resulting efficiency is low. However, the fault usually lies with the system providing the excess, and not with the farmer.

3. Other

Performance could be measured as well by the criterion of short- and long-term stability which refers to the minimization of year-to-year variation in productivity and long-term deterioration through insidious adverse physical effects such as waterlogging, excessive leaching, salinity, erosion, etc. Promotion of people's well-being is another evaluation criterion. This assessment ultimately depends on an assessment of what people themselves want, but it may include the provision of amenities, an assessment of improvements in nutritional status, protection or insurance from famine conditions, a greater sense of participation and so on.

Whatever is accepted as a measure of performance, it is widely believed that the potential for improving existing and planned irrigation systems may be enhanced through improved cost recovery and by greater farmer participation in management. Before examining specific aspects of these propositions, the next section reviews the possible application of marginal cost pricing to irrigation water within the context of the economically efficient use of water. This theory of marginal cost pricing is the standard tool available to the economist to determine the "appropriate" price for a commodity--in this case water. Economists contend that the application of marginal cost pricing to an economic problem results in an optional solution in terms of economic efficiency and social welfare gains. However, as the next section clarifies, there are serious difficulties in applying marginal cost pricing to irrigation water.

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[15]Willardson, L.S., "Attainable Irrigation Efficiencies", Journal of the Irrigation and Drainage Division, ASCE, Vol. 98, No. IR2, June 1972.



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## C. Allocation and Pricing of Irrigation Water

Efficiency in the economic sense refers to the optimal use of resources (in this case, water) from the standpoint of society. Optimal use is defined as the state in which society's welfare cannot be improved by reallocating water to other uses. Given a fixed quantity of water, the marginal social benefits of additional water allocated to each use should be equal. Then the value of water, or its opportunity cost, corresponds to the marginal social benefits in its best usage. If additional water can be obtained it will be at a marginal social cost in terms of other resources. The marginal value of water is represented by this cost. Maximum social welfare is achieved when the marginal social cost of acquiring additional water for each use equals its marginal social benefits in each use.[16]

Among alternate ways to achieve the optimal state, the standard recommendation made by economists would be to set prices based on marginal net social costs which include, at the least, the costs of producing and delivering water. Charges would be set at the marginal cost of production per unit volume ($m^3$) and would be sold volumetrically. A rational farmer would then use water until his marginal private benefit equals the price (his marginal cost). Thus, the individual farmer's private decision would result in the socially optimal (economically efficient) use of water across all users. The problem is that charges for irrigation water, wherever they exist, are generally well below costs. For a variety of reasons, including the problems associated with water measurement, there are difficulties in the application of marginal cost pricing to irrigation water and, hence, water markets and not well developed. Additionally, rate-setting is seldom a purely economic process and noneconomic factors often impinge upon the decision-making process.

### 1. The market model and the difficulties of establishing water markets

Based on certain assumptions and under idealized competitive conditions, the market system through the interaction of producers and consumers acting in their own self-interest, can be shown to produce the optimal allocation of resources. Price is the regulating mechanism that influences market forces in the desired directions. When actual market conditions do not meet the idealized construct, regulatory processes or public production is required to allocate resources. This has happened frequently in the case of irrigation water which has the characteristics of a public or collective good (i.e., one which is non-competitive in use). It may also happen if externalities are present, as for example, if there are uncompensated side effects such

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[16] H.M. Neghassi and J.A. Seagraves, "Efficiency in the Use of Water for Irrigation: The Role of Prices and Regulations." Natural Resources Forum 3(1978), p. 57.



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as pollution or if there are economies of scale that set the preconditions for monopoly. These factors, along with others, such as the relative plentitude of water (until recently), its physical characteristics and the social values attached to it, explain the lack of well-developed water markets.[17]

Among the physical attributes of water that prevent the full development of water markets is its mobility and its property of changing from solid to liquid to gas over the seasons. This makes it difficult to specify units of water, creates measurement problems and becomes an obstacle to the establishment of water (property) rights which are necessary for the exchange process in a market allocation system. Another constraint to measurement and the definition of rights is the fact that irrigation water is seldom fully "used" by farmers. As noted in Section B above, most water users only consume a part of the available supply and the rest becomes accessible to downstream users. Measuring specific portions in this case is even more difficult.[18]

The primary economic reason inhibiting the full development of water markets is the relative abundance of water relative to demand. Since water generally has not been scarce, except in certain places at specific times, formal institutions for managing scarcity (for example, markets) have not been created. There is another reason why most societies have chosen non-market administrative means to allocate water. The demand for non-consumptive water use (such as recreational use) often represents collective demand which is likely to result in under supply when governed by market relations.[19] However, it is important to remember that water is a widely different commodity in different places and at different times.[20] For example, the value of water varies sharply depending on the seasons and upon crop needs. As the demand for irrigation water grows and it becomes relatively more scarce, formal institutional arrangements for managing water will become increasingly important.

Finally, there is a strong tradition of social values in many places that works against the adoption of market institutions for water allocation. Values that assign sacredness or ritual symbolic importance to water undermine tendencies toward market allocation by

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[17]R.A. Young, Notes on the Allocation, Pricing and Valuation of Irrigation Water. Paper prepared for a Seminar on "Economics of Water Uses for Irrigation in Egypt" (Cairo, Egypt: Department of Hydraulic Engineering, Cairo University and Water Research Center, Ministry of Irrigation, December 6, 1983), p. 4.

[18]Ibid., p. 5.

[19]Ibid., p. 5.

[20]Neghassi and Seagraves, "Efficiency in the Use of Water," p. 57.



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having a negative impact upon the individual's willingness to pay for water. Such values may be institutionalized in religious teachings which explicitly or implicitly prohibit market allocations for water. The overall impact of some or all these factors is the general absence of developed water markets and the establishment of government rules and regulations for water use which do not always result in economically efficient resource allocation.[21]

2. Marginal cost pricing: theory and practice

Prior to examining the alternate ways in which water rates may be set, this section briefly presents the theory of marginal cost pricing and the difficulties of its application in the case of irrigation water. The principle underlying marginal cost pricing is that a price set at the point where marginal cost (or the incremental cost of water supply) equals marginal benefit, will result in the supply (and consumption) of an optimal quantity of water. This means that at that point the consumer's willingness to pay for the marginal unit of water exactly equals the opportunity cost or willingness to pay for opportunities foregone. If price policies encourage greater than the optimal consumption, the marginal worth of each additional unit consumed will be less than the incremental cost of supply. Alternately, if consumption is restricted below the optimal level, the value of additional units is greater than the cost of supplying them.

Like all apparently simple and powerful general rules, the application of marginal cost pricing to real world problems is not straightforward. There are both conceptual problems and practical measurement difficulties in its application to irrigation water supply. Implementors of the rule have to decide if it should be applied to short-run marginal costs, principally O and M costs, or long-run marginal costs, which include capital repayment, 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 tailenders? Should those farmers who generate peak demands pay the extra cost of the additional (expensive) capacity that enables the peak demand to be met? In practice, most governments that decide to charge 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 it follows the post office practice to levy an equal charge across the country irrespective to the actual cost of delivery of a particular letter.

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[21]Young, Allocation, Pricing and Valuation of Irrigation Water, p. 6.



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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 very 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 per cubic meter is lower in large schemes. Furthermore, for any given size of scheme the cost per cubic meter of water delivered decreases 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 resources. Where there are no 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 resulting in a deficit.

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 '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.[22] 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. In fact, for most canal systems (unless pumping is involved) the supply for any season is essentially fixed by the weather and the system characteristics and in any season is not subject to management manipulation. The comparatively low recurrent costs and relatively high proportion of indivisible costs 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 virtually 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

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



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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, which has a free water supply, are using short-run marginal cost pricing either by accident or choice.

Critics of short-run marginal cost pricing argue that the signal to farmers that water is cheap will eventually lead to demand for additional high-cost capacity. For canal systems, this could be costly. Furthermore, they argue that it would not be possible to plan optimum investment because the future demand schedule is unknown. In addition, the financial 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. On the other hand, some irrigation authorities would argue that these problems are more apparent than real and no different in kind from problems in other sectors. Certainly, it is possible to predict shifts in demand, the merits of rehabilitation and new projects and the likely level of farmer response given cropping pattern projections, climate records and operations simulation and in this way the sensitivity of farm response to changes in revenue might be explored. However, underlying the main thrust of this paragraph is the premise that if low short-run marginal cost pricing is adopted the signal farmers receive will result in extravagant use of water.

Another area of difficulty concerns the public or collective nature of the benefits from irrigation. There are 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. Where grain prices have been held below market values by Government price regulation there is a transfer of benefit from farmers to consumers. Where irrigation includes regional drainage or flood protection services it is impossible to stop one farmer benefitting from the service even if he does not pay. Indeed, "free riders" exist in most irrigation systems because of the practical as well as political difficulty of excluding people from access to irrigation water. Irrigation has a public good element and therefore some public subsidy is in order. Unfortunately, defining the appropriate subsidy on these grounds is apparently an intractable empirical problem. However, difficulty in measurement should not be an excuse for inaction. Research to establish the direct, approximate order of magnitude and the bounds is worthwhile. Once this is achieved it might be possible to devise methods to 'capture' some of these indirect benefits. For example, this has been achieved in the western US by an ad valorem tax on all property within the service area of a conveyancy District in

addition to repayments by direct beneficiaries e.g., central Utah, northern Colorado. This principal has been willingly accepted by tax payers by referendum.

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. Thus, if marginal cost pricing were adopted there would be no guarantee of an overall improvement in resource allocation and economic efficiency.

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

- Market imperfections--markets function improperly;
- Technical characteristics of canal irrigation systems tend to result in low or zero marginal costs per unit volume of water;
- Markets give wrong signals by ignoring externalities;
- Markets do not work to provide the optimum level of public goods (those to which public access cannot be denied and where public consumption does not deplete the benefits);
- Markets may yield undesirable results in terms of alternative objectives; and
- There are lags in adjustments and any manipulated adjustment may not be an improvement if various distortions exist in the economy.

3. Rate-setting principles for irrigation water

It is important to clarify at the outset that in actual practice the setting of water rates is a public policy decision and sometimes even a purely political decision. Further, allocative efficiency which is the goal of marginal cost pricing policy is often superseded by other factors such as equity or revenue considerations, each with its own rule for converting the social goal into a formula for setting rates. One way of meeting multiple objectives is through a multi-part pricing system where marginal price is set equal to marginal





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cost and an additional charge is levied to reflect fixed costs. Such multi-part pricing structures, while not uniformly satisfactory, have been applied in irrigation systems.[23]

There are also a variety of other rate-setting principles that have been proposed or utilized.[24] These include, for example, the following:

- The "ability to pay" principle has been used for setting rates in US federal irrigation projects where the original goal of full cost recovery from farmers was modified to 10-20 percent of total costs. It has also been applied to village water supplies in developing countries. Since the concept is basically subjective, its usefulness is constrained to situations where achieving equity is the primary consideration;

- The "net benefit" principle is based on the idea of capturing all the economic surplus accruing to the user through charges. Rate collection would be governed by user net productivity but fixed and opportunity costs would be ignored; and

- The average cost principle requires that charges be based on the average cost of delivering each unit of water. It has the advantage that beneficiaries pay only those resource costs that are incurred in their behalf.

In summary, where scarcity exists and water has a high value, the proper signals are delivered and water is used efficiently. The success of efficiency pricing depends upon the ability to measure water. In the absence of scarcity, water has a low value and it is generally not economical to measure it or to levy charges. Metered sale of canal irrigation water, for example, is costly to implement and is rarely practiced in developing countries.[25] More accurate measurements and pricing systems could emerge as water becomes more scarce and its value increases. Meanwhile, Young suggests that where water is not yet scarce enough to justify, the costs of establishing formal pricing systems, "flat rates will satisfactorily ration use and satisfy repayment requirements."[26]

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[23]Young, Allocation, Pricing and Valuation of Irrigation Water, p. 10.

[24]Ibid., pp. 11-13.

[25]Neghassi and Seagraves, "Efficiency in the Use of Water," p. 61.

[26]Young, Allocation, Pricing and Valuation of Irrigation Water, p. 12.



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## D. Irrigation Water Management Issues

The fundamental goal of an irrigation water management system is the timely delivery of water, in the proper quantities, to farmer fields, in a reliable and equitable fashion, in order to enable farmers to obtain maximum crop production. The underlying objectives may include increased farmer earnings and improved equity of income distribution.

### 1. Operations and Maintenance (O and M)

Water management encompasses all of 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 system water losses and prevention of waterlogging and salinity problems are also important aspects of operation. System water losses include seepage through the beds and banks of canals, leakage from gates and turnouts, ruff-off and deep percolation from fields and errors in scheduling which deliver water at times and places where it can't be used, e.g., following a major rain or a delivery schedule which delivers water to a field due to be harvested. These latter are called operational losses. System losses, it should be noted, are sometimes the input or gain to another system. This is particularly true of many rice systems and in the groundwater field. Maintenance involves weed and silt control, upkeep and repair of irrigation and drainage structures: embankments, dams, outlets, pumps, etc. O and M transitional responsibilities may include elements of project completion, modernization or development.

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, in-stream transport management and maintenance of the physical structure of the irrigation network for minimal water loss and increased water-use efficiency consistent with economic tests. 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, there is frequently a shift to a 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. The financial crisis straining state budgets for staff is proving to be a strong incentive to develop more farmer participation even though some engineering authorities are unconvinced that it has merits.

The costs of O and M can vary considerably with the standard of execution. The inclusion of repair of damaged or deteriorating facilities can increase O and M costs. Similarly, costs will be higher if O and M includes elements of completion, preventative maintenance, improvement, replacement, extension of service or rehabilitation. The O and M needs vary for different projects in a country and for

different years on a particular project. Yet normally irrigation charges are the same throughout the country and each year. Designers and farmers alike know that capital can substitute for O and M. For example, high specification construction (e.g., concrete rather than wood) is costly to build and cheap to maintain. Certain designs (e.g., gravity distribution) are sometimes more expensive than alternatives (pump schemes) but cheaper to operate. A rational aid recipient who has a problem raising local revenue will prefer a flow operating cost scheme. This preference is reinforced because aid donors are generally generous with capital cost support but extremely reluctant to aid current O and M costs. Farmers likewise, who know at first hand about frequent government failures with O and M prefer the capital intensive alternative. Unfortunately, as there are high opportunity costs for aid funds, high discount rates are used in project appraisal, and the low capital high recurrent cost option appears relatively favorable at this stage.

Inadequate O and M is a serious and growing problem that directly affects the productivity of irrigated agriculture. In the long run, poor O and M raises the cost of irrigation and thus 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, shifts 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.

Irrigation managers often have insufficient appreciation of agriculture's needs and the ways in which these needs change with new agronomic technology. For example, changing of age-old canal rotation periods or the timing of closure for annual maintenance can be necessitated by new crop varieties. There is evidence from Egypt to support this view, and in Pakistan gains would result to the wheat crop if the traditional late December-early January closure was deferred until late February-early March. Clearly a rounded picture of the costs of O and M would include more knowledge of the opportunity costs to agriculture of deficiencies in O and M execution.[27]

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 or may not be enforced at all. Inflation is an additional factor that tends to reduce spending on non-salary elements of O and M. In some

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[27] I. Carruthers (Ed.). Aid for the Development of Irrigation (Paris: OECD, 1983). See especially Chapter VII for a more comprehensive review of O and M difficulties.



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countries, corruption is an important element that affects irrigation directly by lowering the profitability of farming and the quality of the service, thereby reducing farmer ability and willingness to pay charges, as well as the impetus of officials to collect official 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. Each management system, however, is likely to have some problems that are unique. Corruption often creates incentives for manipulating and mismanaging water delivery options in order to make protection of the designed supply or short changing of non-contributing farmers a source of illegal income, and overload of the system to produce unaccounted for water that usually finds a ready market.

The causes of deficiencies in irrigation O and M arise from a variety of factors including, at the project level, lack of economic, social and soil and water resources information, planning, design, and construction errors, and at the operational stage, the problems of financing, personnel and management.[28] Other macro-level problems include donor preference for capital transfer and the neglect of recurrent costs by both national governments and donor agencies. These factors are significant and are constraining as described in Section B.1., but are not the direct concern of this study. The focus here is upon the financial and managerial problems of project operation.

2. Farmer participation in cost recovery and O and M

Since this study has paid particular attention to the effects of participation on improved cost recovery and O and M, a brief discussion of what is meant by farmer participation is in order.

Participation is a complex concept which means many different things in different contexts. For our purposes, participation refers to the active involvement of persons, individually and in groups, in various tasks related to establishing and running an irrigation system.[29] Although a proper analysis of a system focuses on the activities of irrigation authorities as well as that of farmers, many discussions of participation take officials for granted and concentrate almost exclusively on aspects of farmer participation.

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[28]Ian Carruthers, "Neglect of O and M in Irrigation: The Need for New Sources and Forms of Support," in Ian Carruthers, ed., Aid for the Development of Irrigation (Paris: OECD, 1983).

[29]N. Uphoff, "Farmer Participation and Orgnaization for Irrigation Water Management: A Discussion Paper", mimeo, draft 1/1/84, p. 2.

The concern for farmer participation in irrigation is inspired by both ideological and practical considerations which are mutually reinforcing. On one hand, farmer participation is viewed as a manifestation of democracy in action, or the embodiment of the "self-help" principle. On the other hand, farmer participation is seen as a vehicle for reducing the growing cost of establishing and running irrigation systems. Discussions of participation include a wide range of issues which extend from how decisions are made, to ways to create, motivate or revitalize farmer organizations, to how to divide O and M responsibilities between irrigation authorities and farmers.

Increasingly, farmer participation is assumed to be good, if not necessary, for effective water management, and many countries have adopted policies which require the formation of water user associations. Consequently, while recognizing that many farmers currently manage irrigation systems to a greater or lesser degree, discussions of participation focus on practical considerations, attempting to answer one of two questions: first, how can a cost effective, mutually beneficial partnership be established between officials and farmers in an irrigation system?; and second, to what extent can farmers be expected to assume responsibility and control for their irrigation systems, and how should the participation be institutionalized? For the most part, attention is directed to O and M activities,[30] but there is a growing conviction that system design and construction can be improved if farmers participate in the process.

Active farmer participation in O and M is invariably institutionalized through formal or informal water user associations, which may be separate entities or adjuncts of village or cooperative organizations. In some areas, the associations are traditionally based and highly organized and formalized; in others, they are less structured, informal groups. The Subaks in Bali, perhaps the most famous traditional irrigation associations, are highly structured elements of wider community-based religious and social institutions. Wade has described an effective, informal user group structure on a canal system in South India.[31]

In some systems, farmers are organized into a formal hierarchy of primary and representative associations; in others, informal turnout groups may develop within a structure of larger, formal institutions, or totally outside of the official structure. In the Doukkala I Project in Morocco, the team found that people in service blocks

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[30] N. Uphoff categorizes many elements of the issues in ibid., and "Analyzing Farmer Participation in Irrigation Water Management", (mimeo) prepared for the FAO/USAID Expert Consultation on Irrigation Water Management: Experience in Involving Farmers to Improve Irrigation System Performance, Jogyakarta, Indonesia, July 1984.

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



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appoint a representative to deal with the irrigation authority. In La Vega in the Dominican Republic, it found a land reform credit group which manages water distribution within a turnout block but has no official irrigation status beyond the turnout.

When new systems are established there may be no existing traditional institution which can function as a base for active local participation in water management. The boundaries of an irrigation system may not match those of traditional villages or civil administrative units, thus the system itself may generate conflicts which it has no mechanism to resolve. Similarly, when traditional systems are rehabilitated by external authorities, traditional associations may be destroyed by changes in the system which either break up existing groups or force them to expand to include outsiders, or they may be rendered useless by having their responsibilities usurped by the new authorities.[32]

The formation of formal water user associations is often recommended for improving management, especially where problems have arisen due to the separation between water user and water authority.[33] Theoretically, the idea has merit because farmers and officials need each other. Experienced irrigation farmers generally have a good understanding of irrigated farming needs, but they are not as qualified as water authorities to handle the technical requirements of the infrastructure upon which they depend. Established rainfed farmers on new irrigation systems generally are knowledgeable about the limits and potential of their soil resources but they need to learn rapidly to deal with new aspects of production resulting from irrigation. In each case, officials need to tap farmers' knowledge in order to operate systems effectively. Good articulation between the two groups--farmers and officials--is thus essential for effective system management, and formal water user associations with by-laws and legal authority are seen as means to enhance the farmer/agency linkage. However, this strategy has been easier to recommend than to implement effectively.

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[32]N.S. Peabody, III, Labdu-Dhikure-Sera Irrigation Project, (Kathmandu, Nepal: Rasuwa/Nuwakot Rural Development Project, 1983), pp. 18-22.

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



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The process of establishing viable water user associations, or otherwise sponsoring farmer participation, has been complicated by many factors which may or may not pertain to a specific location.[34]

- The roles and expected objectives of the associations are inconsistent with each other or unfocused;
- Role expectations are unrealistic, given the resources and authority of the associations;
- The responsibilities of the association are too trivial or undesirable to generate farmer commitment;
- Farmers and officials have inconsistent or conflicting definitions of their respective roles;
- Groups are too heterogeneous or too large to function;
- Farmers do not have enough technical knowledge to enable them to make reasonable decisions;
- Officials are unwilling to share information or authority; and
- Farmer leadership is weak, inexperienced or faction-ridden.

Above all, many efforts to establish water user associations have taken place in a kind of institutional vacuum, without reference to existing participatory mechanisms, other organizational efforts which may be underway, and without taking advantage of accumulated experience. Governmental institutions rarely are called upon to organize client groups, thus there is little overall experience available from which to draw, and few personnel available who have group organizing skills. This is especially true in technical agencies like irrigation authorities. Consequently, the problems indicated above are generally exacerbated by the fact that irrigation agencies, and irrigation personnel, are simply unprepared to carry out such a mandate. Moreover, until recently there was little research literature available anywhere which might have been used to help agencies fulfill their new participatory mandate.

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[34]See K.W. Easter and D.E. Welsch Socioeconomic Issues in Irrigation Development and Distribution, University of Minnesota, Department of Agricultural and Applied Economics, Economic Report ER83-5, pp. 21-30.

In the last few years, the literature on operational and organizational aspects of irrigation systems has proliferated, especially descriptive literature. Meanwhile, some attempts to organize farmers have been documented, particularly in the Philippines and Sri Lanka.[35]

The Philippines was the first country to embark on a large-scale attempt to devolve responsibility to user groups which utilized a cadre of people with group organizing functions as part of the program. Based on the Philippine model, the Gal Oya Project in Sri Lanka attempts to establish water user groups in conjunction with a major rehabilitation program of a large resettlement scheme. The project has demonstrated the value of the approach using "catalysts" to organize farmers, and plans are underway to apply some aspects of the model to new settings. However, questions remain about the overall manpower requirements and cost of the approach, as well as the plight of the cadres of "Irrigation Organizers," once the program ends.

Overall, the experiences in the Philippines and Sri Lanka both highlight the need to re-orient and re-educate officials, as well as farmers, if participation is to be encouraged, and both depend for their success on the labors of a cadre of low-level technicians, the very types of positions which are most sensitive to budgetary entrenchment. Moreover, results of the experiences seem to indicate a positive impact of participation on cost recovery and O and M, but final conclusions are still premature.

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[35]C.J. Cruz and R.Y. Siy, Jr., "Issues in Irrigation Water Management in the Philippines," (mimeo) prepared for Agricultural Policy Working Group Mini-Workshop in Rice Policy, January, 1985, University of the Philippines at Los Banos; E.C. DeJesus, "Bureaucratic Reorientation at the National Irrigation Administration: A Philippine case Study," (mimeo) Asian Institute of Management, September, 1982; D.C. Korten, "Community Organizations and Rural Development: A Learning Process Approach," Public Administration Review, 40 (5), pp. 480-511; and F.F. Korten, Building National Capacity to Develop Water Users' Associations: Experience from the Philippines, (Washington, DC: The World Bank, 1981); Norman Uphoff, "Contrasting Approaches to Water Management Development in Sri Lanka," paper submitted to International Center for Law and Development, 1984; "Experience with People's Participation in Water Management: Gal Oya, Sri Lanka," in Jean Claude Garciaa-Zamor, ed., Participation in Development Planning and Management: Cases from Africa and Asia, (West Hartford, Connecticut: Kumarin Press, 1984); and "Analyzing Farmer Participation in Irrigation Water Management," paper prepared for the FAO/USAID Expert Consultation on Irrigation Water Management: Experience in Involving Farmers to Improve Irrigation System Performance, Yogyakarta, 1984.



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The team visited countries in which farmer participation is being encouraged or organized in various ways, often for different reasons. Although it is clear that some agencies or governments have indeed established water user associations, it is still too early to say whether the efforts have achieved the desired objectives, and whether the associations will survive over time. To the extent possible, Chapter IV discusses the relationship between farmer participation and cost recovery and management.

## E. Irrigation Department Problems and Adjustments to Economic Recession

In most developing countries, irrigation departments are experiencing financial difficulties that are compounded by the effects of recession. Some of the problems confronting irrigation departments include:

- Increasing costs of new projects (e.g., Philippines) and a switch of funds from O and M to maintain "new" project investment;

- More focus on neglected rainfed project areas where most poor people live and where in some countries (e.g., Morocco) higher rates of return to capital are anticipated;

- Greater attention to other sectors, particularly those serving the organized and energetic urban voters (e.g., in Philippines energy, urban job creation, industry);

- A failure to find assured profitable export markets for high value crops (e.g., Morocco, horticulture products) or surplus cereals (e.g., Indonesia, rice) coming from early successful irrigation;

- The record of past slow construction with cost escalation (e.g., India 1983 Public Accounts Committee noted that not a single irrigation project had ever been completed on time since planning started);

- The increasingly obvious need for modernization and rehabilitation of the existing network deflects resources from new investment. In Egypt, India and Pakistan much of the infrastructure such as barrages, regulators and so forth is over 50 years old, sometimes over 100 years old;

- Governmental perception of irrigation may change from a public service to a public utility, or even a source of public savings, an option not available in other sectors. In the Philippines in the last five years, Government has shifted from a "soft service" view of irrigation and it is



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reported to be now contemplating full capital and recurrent cost recovery by the NIA. But such drastic reforms are easier to contemplate than to execute.

Government financial stringency can force radical experiments with repayment and irrigation management. In the Philippines, for example, an extremely imaginative scheme for devolving management responsibility to farmers includes:

- Water fee collection;
- Water management at the tertiary level; and
- Canal maintenance.

The team studied the early application of this procedure in the Upper Pampanga River Project (see Annex 4). This is in essence a scheme for "privatization" of minor canal, watercourse and field irrigation. Philippine experience is particularly interesting as withdrawal of public irrigation services subsidies--albeit as a response to public sector financial problems, is counter to the trend in India, Pakistan, the Dominican Republic and elsewhere. In these countries the Governments, with aid agency financial support and encouragement, have been moving down below the canal outlet or turnout and are implementing with public funds, watercourse, realignment and rehabilitation, watercourse lining and precision field levelling. It is to be hoped that the shortage of Government finance, which has forced the Philippines to look for ways of reducing government expenditure, do not in turn force retrenchment in command area development and water management programs at the tertiary level. However, our judgement of the financial situation suggests that Governments should be looking for ways to remove civil servants from low-level posts in irrigation systems and train farmers to assume responsibility, rather than developing additional cadres of lower-level technicians.

A similar contradiction exists in the Philippines in that by this year more than 600 water management technicians will have received one year training with a World Bank training assistance grant. Survey of field performance of technicians shows marked increases in local water use efficiency and crop yields.[36] However, these new personnel add a burden to an already over-extended recurrent budget liability and doubts must exist about the agencies' ability to absorb them once their aid-assisted contracts expire. Thus, there is a danger that the agricultural engineers, specifically trained for operation, maintenance and management will be dispersed with but the longer serving construction trained engineers will be retained.

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[36] M.C. Cruz and R. Siy. "Issues in Irrigation Water Management in the Philippines." Agricultural Policy Working Group Mini-Workshop on Rice Policy, Los Banos, University of the Philippines, January 3-4, 1985.



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Earlier experiences in the Philippines to improve collection of fees were not encouraging.[37] However, if recent progress is sustained, then a forced withdrawal of public support for certain, or close to all farm irrigation services, many produce management and financial benefits to all. Short-term indications at Upper Pampanga are that Farmer Irrigation Groups (FIG) and their local clustering into Farmer Irrigation Associations (FIA) can successfully execute canal maintenance contracts, water diversion, and, for commission, collect water fees more successfully than government officials.

Progress to date with nearly one third of the area in FIG is encouraging. However, the gains are extremely fragile. It is possible that the relatively easy-to-organize groups were early innovators; or that a bad typhoon, pest or disease attack in the transition period could seriously disrupt progress; or that there may be insuperable legal and financial problems in reducing government staff to produce cost savings and to allow farmers to assume responsibility; that if Government, for any reason, makes a large increase in the real level of water charges farmer goodwill will be dispersed prematurely.

The Team was impressed by this pioneering effort in institution building. The NIA needs time because institution building is a slow, complex, collective and coalescing process and not amenable to a quick fix. Institutions provide a working framework of rules, norms, values, rights, obligations and authority relationships. Institutions must be shaped by participants and institutions in turn will shape the behavior of participants. In short, institutions like traditions evolve and cannot be created. This being the case, the Government must refrain from giving NIA unrealistic financial or timing deadlines.

There are two additional features to the Philippines system that will help sustain the changes in irrigation finance and management. The first is that water fees are specified in kind at 125 and 175 kg/ha of rough rice--about three percent of gross production in the wet and dry season respectively. They are paid in cash by converting at the Government minimum price, thus virtually indexing the fees--an important feature in an economy with a 40 percent plus inflation rate. Second, the irrigation agency can retain fees for operating expenditure, thus giving the agencies maximum incentive for collection. Agency staff interviewed were, however, unanimous that willingness to pay fees was very elastic and that even modest fee increases would increase delinquency and reduce total revenue.

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[37] R.N. Tagarino and R.D. Torres. "The Pricing of Irrigation Water: A Case Study of the Philippines Upper Pampanga River Project." Irrigation Policy and the Management of Irrigation Systems in South East Asia. Edited by D.C. Taylor and T.M. Wickham, Bangkok: A.D.C, 1979.





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## III. DISCUSSION OF CASE STUDIES

### A. Peru

Peru has a rich, complex range of irrigation experiences and conditions. Almost 1.3 million ha are under irrigation. Sixty percent of the area is located in 53 arid coastal valleys, where the irrigation water is essential for agriculture. Irrigation is supplemental in the Sierras, yet accounts for almost 40 percent of the irrigated land.

Over the last few decades, the Government of Peru has made substantial investments in irrigation, primarily in the coastal systems. Recently, two trends have become increasingly apparent. First, much of current and programmed investment in irrigation is directed to rehabilitating and expanding existing projects on the coast (50 percent of total investment). About one-half of the total coastal investment is to be directed to a single project, Majes-Siguas. Second, the growing economic crisis has made it impossible for the Government to undertake the O and M tasks it previously assumed, thus it is shifting the financial burden to the water users.

In 1969, the country abolished private rights over water resources and declared national ownership, with the understanding that the government would establish rational norms for water resource use and exploitation. As part of the process, a hierarchical structure of water user associations was established in each irrigation district and given the authority to set water charges, among other responsibilities. This network of consumer groups has become a central feature in the current government's effort to divest itself of recurrent O and M costs. Water users have been assessed water charges for a long time, but collection was not enforced seriously, and payment levels have been low. At the moment, however, collection of water charges is receiving much attention as the means for obtaining the O and M funds needed to offset the loss of funds from the center, thus collection efforts are being stepped up. At the same time, the water user groups are being asked to assume management responsibilities and everyday administrative costs, which were previously outside of their purview.

The team visited three irrigation situations in Peru: a highly regulated, bureaucratically complex system on the north coast (Tinajones); a smaller system in the south with remnants of traditional management (Tacna); and a project which aims to develop a series of small systems in the Sierras with external donor funding, much external influence, and rather inconsistent aspirations (Plan MERIS-II).



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1. Tinajones Project

a. General discussion

The Tinajones Project covers the Valle de Chancay-Lambayeque, an arid coastal plain in northern Peru with about 100,000 ha of irrigable land. Parts of the valley were irrigated during the Inca period, and the irrigated area has been expanded ever since, first for sugar cane cultivation, and more recently for rice. The latest expansion effort, the Tinajones Project, was started in 1968, funded by German bilateral aid. The objective of the multi-phase project is to divert and store water in order to regulate and increase the water supply in the valley, ultimately expanding the irrigated area from 68,000 ha to about 100,000 ha. Phase I, the Tinajones Reservoir and associated conveyance structures, was completed in 1976, by which time the present estimated 90,000 ha were already under cultivation. Some major storage and diversion structures in the highlands must still be completed before the water supply in the valley will be adequate for rice, the preferred crop. Tinajones is known as one of the most "regulated" systems in Peru, in a technical sense.

Tinajones is a large and complex system, containing a variety of cropping management patterns and mixture of farmers with differing experiences and economic conditions. It is managed by a Technical Administrator, a staff member of the Regional Agricultural Office, with the active collaboration of the official hierarchy of water user groups.

Tinajones is at the forefront of the Government of Peru's attempt to unburden itself of the financial responsibility for irrigation O and M. The water users groups (the Junta and Comisiones) play a critical role in the process. The Junta sets water charge rates, pays part of the cost of operating the Technical Administrator's office, and recently established a non-profit corporation to take care of maintenance. Water charge collection has been poor in Tinajones, but has started to improve as the Government of Peru has reduced O and M funds.

b. Discussion of field visit

The team discussed the system with various levels of officials; inspected water courses from the diversion for the reservoir at the top to the major drains at the bottom; and then observed the implementation at the field level of a new rotation system. Overall, the system seems to have a smoothly functioning organizational structure, but the organization cannot compensate for a shortage of water. The Technical Administration attempts to reconcile cropping preferences with chronically limited water supplies by using a Plan de Cultivo y Riego, which is supposed to limit cultivation. Although, that particular effort seems increasingly futile, the team obtained the impression that farmers' representatives and administrators are collaborating actively to operate and improve the system.

2. Tacna

a. General discussion

Tacna is the southernmost coastal valley of Peru, a desert plain nestled among dry hills and huge sand dunes. The land around Tacna is irrigated by water from the Rio Caplina, at the top of the valley, and the Uchusuma Canal, which originates over 150 km away in the interior, passing through a corner of Chile on its course. The Uchusuma Canal was completed over a century ago, and its supply has been augmented by tubewells and by tapping additional surface sources. However, the total supply of the Uchusuma and Caplina Canals is adequate for only about 2,500 ha, 60 percent of the cultivated land. Thus much land lies fallow at any one time. The major crops are fruits, alfalfa, chili peppers, vegetables, maize and wheat. Double cropping is common.

Ostensibly, Tacna is managed by a Technical Administrator who applies standard rules and regulations. In practice, however, most aspects of traditional (non-bureaucratic) irrigation administration apply in Tacna. Farmers are allocated water on the basis of time shares; water distribution is overseen by salaried ditch tenders during the day and by farmers themselves at night; and farmers unceremoniously assist official maintenance staff, as needed, without seeking compensation. Water charge rates are very low and payment rates are also low, but both rates and collections are expected to increase due to the combined efforts of officials and comision leaders.

The city of Tacna obtains drinking water from the irrigation canals. As the population has grown rapidly over the last decade, so has urban water demand, which means that irrigation supplies have been reduced to meet the urban demand. The problem is growing.

b. Discussion of field visit

The team visited the system from the wier on the Rio Caplina to a high point on the Uchusuma Canal to the major irrigated areas. Uchusuma Canal supplies are augmented by tubewells upstream but these were not visited. In addition, the team visited LaYarada, an area in the valley which is irrigated by tubewells. Both systems appeared to be in good condition physically, as well as institutionally. Farmers seem to manage water well.

The farmers in Tacna are in a real bind. On one hand, they are increasingly threatened by diminishing water supplies, due to growing urban use. On the other hand, they are financially pressed by high operating costs of the tubewells on the Uchusuma Canal and the growing need to assume additonal O and M costs. Meanwhile, they experience severe marketing limitations: they are too far from the major urban markets to be able to demand top prices for their primary produce, or to increase production precipitously.



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3. Plan MERIS-II

a. General Discussion

Unlike the other two systems, Plan MERIS-II is a composite project implemented by PEPMI, Proyecto Especial Pequeñas y Medianas Irrigaciones, a section of INAF, the Instituto Nacional de Ampliación de La Frontera Agrícola, an autonomous agency within the Ministry of Agriculture. Funded by German bilateral aid the project aims to improve, expand and upgrade at least ten traditional irrigation systems in the Vilcanota Valley, southeast of Cuzco, in the highlands. These systems provide supplemental irrigation, about twice a season, and may serve a small part of the command area for a second crop.

Six systems have been completed to date, one of which farmers virtually refuse to use, two are under construction, and two or three are in the planning or design stages. After they are completed, the systems will provide enough water to double-crop throughout the command area. The projects range from 125 ha to 1,200 ha, benefitting from 130 to 900 families each. Plan MERIS-II intends to maintain a presence in the systems for at least three years after completion of the civil works in order to overcome shakedown problems and to establish the agricultural development program firmly.

Plan MERIS-II is an indecisive cross between two types of projects: simple irrigation design and construction, and integrated rural development. Its objective is agricultural development, but the agriculture program has been secondary to the irrigation work; it has used minor infrastructural and social program investments in an ad hoc fashion to overcome local resistance to the irrigation investment. Lately, the Plan has begun to revise its approach to the villages, encouraging local participation in various aspects of the program, rather than avoiding it. Whether this new approach will be successful remains to be seen.

Plan MERIS-II encourages water user groups to organize work days and collect a minimal quota to cover minor maintenance costs for which they are responsible. Project advisors are now raising questions about the economic viability of farmsteads in these systems under any conditions, irrigated or not, thus only a modest cost recovery strategy seems reasonable. However, that does not resolve the long term question of who will pay for O and M if the government cannot do so. This question is even more critical in the Sierra than the coast, yet it is being bypassed for the moment because of the availability of investment funds.

b. Discussion of field visit

The team visited one project, Salcca, which has been under construction for three years, and talked to leaders of the water user organizations at Cusipata, which was completed in late 1983.

Salcca is one of the largest projects undertaken by the Plan, covering approximately 1,200 ha. The system includes seven diversion structures, and over 30 km of main canals. Approximately 800 families will benefit from the system. The system meanders along either side of a stream which joins the Vilcanota at Salcca, and an area alongside the Vilcanota, as well. The terrain is rough, but parts are terraced.

The Salcca project will unite ten small communities, some of which were already irrigated. Initially, farmers opposed the system: many of them already had irrigation of some sort; those who already had irrigation canals did not want to relinquish land for new canals that served others; and because they feared they would be required to pay for water once the system was complete. According to Plan staff, such opposition has decreased over time. Even though existing irrigation channels have not been interrupted by construction, the agricultural development program is slowly being introduced late in the construction phase, so Plan staff will be present for some time in the future.

Development of the Cusipata System followed the steps outlined above. Four water user Comites and a system-wide Comision have been formed. The users groups are responsible for minor maintenance, but very little else. Most questions regarding distribution, conflicts, and the like, are referred to the Plan staff for resolution. Ultimately, however, the groups will be expected to assume full responsibility for operating and maintaining the system, including conflict resolution.

Water user leaders identified some of the problems they have encountered in establishing and maintaining the Cusipata System. Most of the obvious problems seem to stem from the poor communication patterns established between the Plan and the villages. This also exacerbates the ongoing need to develop a mechanism for villages and Comites to cooperate with each other in O and M. The Plan essentially united previously discrete social units, without adequate preparation, and appropriate collective administrative arrangements have yet to emerge.

Otherwise, the leaders expressed very positive attitudes toward the system, saying that initial oppositon had been overcome, particularly that relating to technical questions. Apparently many people in Cusipata originally opposed the system because they had doubts about the wisdom and viability of diverting water from so far upstream. Now they understand how it can be done, but they still do not know how to organize themselves to maintain the long canals once the Plan administration disappears.

A small fee per area irrigated has been levied and collected once in Cusipata, apparently without great difficulty. However, farmers rejected the recommendation of the Comision to increase the fee for the current year. This may be an indication that material benefits of the system have yet to appear. On the other hand, it may also indicate that the farmers have yet to understand that the system is "theirs," rather than the "Plan's." The answer is probably a combination of both.

B. Dominican Republic

Much of the arable land in the Dominican Republic is suitable only for rainfed agriculture, and most of the remainder (approximately 710,000 ha) is irrigated or suitable for irrigation. There are no precise data regarding the total area under irrigation, but estimates vary from 189,000 ha (INDRHI) to 206,518 ha (FAO).

Since 1965, water resource development in the Dominican Republic has been the responsibility of the Instituto Nacional de Recursos Hidraulicos (INDRHI), an autonomous public agency. Until recently, INDRHI has concentrated on the planning and construction of major water projects, paying less attention to management. By 1984, storage capacity of about 2,600 $mm^3$ has been completed in six major reservoirs, and about 100,000 to 125,000 ha have been brought into more systematic irrigation networks backed by water storage structures and better regulated canals. Six irrigation projects are currently underway, expected to cost about US$ 150 million by the end of 1985. They will serve about 51,050 ha. Others are in various phases of study and planning.

INDRHI is a highly centralized institution. Contracting, planning and supply purchases are all managed from headquarters in Santo Domingo. However, in the wake of the economic slowdown of the last few years, INDRHI has started to delegate some responsiblities to field offices, which it plans to make financially self-sufficient. For administrative purposes, the country is divided into seven irrigation districts, seventeen zones and four sub-zones. Over the next five years, INDRHI plans to raise water tariffs high enough to cover the cost of operation and maintenance in each zone and sub-zone. Allied to this is a plan to establish water user associations throughout the irrigated areas. Both programs are in their first year of implementation.

Beginning this year, all irrigation district staffs are expected to achieve good compliance in water fee collections, which are set to recover 50 percent of the expected 1985 O and M budget. INDRHI appears to have a good chance to achieve this goal. Relative to many other countries, the state irrigation systems are under good control and the new water fee program should allow the systems to operate very well.



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The team visited irrigation systems in three districts: Valle de Azua, a fruit and vegetable-growing area west of Santo Domingo; LaVega, a rice production area north of the capital; and Alto Yaque del Norte, near Santiago, in which a combination of crops is grown, the principal ones being rice, sugar cane and tobacco. The Valle de Azua and Alto Yaque del Norte have recently benefitted from INDRHI construction investments and are to be the loci of the new USAID-funded On-Farm Water Management Project. LaVega is within the district with the highest rates of payment of the water tariff and which typically has received the greatest share of central budget for O and M.

1. Alto Yaque del Norte

a. General discussion

The Yaque del Norte Valley, heading northwest toward the sea from Santiago, has been the site of a number of irrigation development efforts since 1936. The most recent is the Proyecto de Riego Yaque del Norte (PRYN), which will ultimately serve about 45,000 ha improving existing water supplies and bringing some rainfed lands under irrigation. The PRYN started serving about 5,000 ha in late 1984, about 1,000 ha of which are newly irrigated. The principal crops in the district are rice, tobacco and sugar cane. District staff are pressing to obtain high levels of payment of the new water fees.

b. Discussion of field visit

The team visited two zones in the Alto Yaque del Norte Irrigation District: Esperanza, which has started to receive water from the new canal; and Santiago, which is now served by an old canal but will eventually be connected to the new canal. In each zone, officers of the new water user associations were called together to discuss their activities and problems.

In Esperanza, the team followed the system from the headworks to a point where water was being delivered to a rice paddy. The brand new system is fully lined down to the outlets to 40 ha irrigation blocks. It has been in operation only a few months, thus it is still in excellent condition. At the point of delivery, some farmers said they were pleased with the new system, as their water supply had increased; however, others complained that the new system cut off access to a drain which they previously used to supplement their irrigation water. All of the farmers interviewed were dissatisfied with the location of outlets, which seem to have been included in the design without the benefit of field reconnaisance. The farmers in the block clearly have yet to work out a satisfactory and equitable distribution arrangement, and they are not sure that the water supply will actually be sufficient for their needs.





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Farmers at the water user leader meeting came from three sectors, two of which are not yet connected to the new system. In each of the sectors, the main problems are water distribution schedules and maintenance. Water is allocated on a land area basis. The leaders believe that water user groups can address such problems, and illustrated ways in which they have already started to do so. Nonetheless, they do not feel that their leadership roles have been widely accepted by either their constituents or INDRHI. They say that many farmers still question the value of the associations, although the incidence is declining. Ironically, the leaders emphasized their dependence on INDRHI for authority, rather than on their membership. Overall, it appeared to the team that these groups have been established without adequate preparation and are based on population units that are too large to function as intended.

In contrast, the groups on the old canal seem to be off to a good start. Leaders of virtually all sectors on the canal attended the meeting, and uniformly expressed a different attitude toward their members and toward INDRHI. The leaders believe that their associations can become important more because they represent the collective strength of the membership than because they are recognized by INDRHI. At the same time, however, the leaders have a clear concept of the mutual benefit to be derived by forming active partnerships with INDRHI for system O and M. They easily point to examples of system improvements which resulted directly from their own efforts, and indirectly from their approaches to INDRHI.

Both sets of group leaders expect cost recovery to improve as the result of INDRHI's growing seriousness about water charge collection.

2. Valle de Azua

a. General discussion

The Valle de Azua is a dry plain that has been cropped variously since the 1950's. Earlier irrigation was from private tubewells, most of which are not functioning now. In 1978, the current irrigation system was completed; by diverting storage water from Rio Yaque del Sur to the Rio Tábara, which was regulated upstream by the Sabana Yaque dam. The principal crops are melons, tomatoes, and peppers for export. The most outstanding characteristic of the Azua system is the adequacy, or abundance of water, which is not surprising considering the fact that only 64 percent of the Stage I command area of 11,000 ha is currently irrigated.

b. Discussion of field visit

The team visited the project area from the diversion wier on the Rio Tábara to the end of the second lateral, stopping along the way to meet farmers working in their fields, and then met a large landowner who irrigates from private tubewells and drains from the project. Subsequent discussions led the team to understand that

the area we visited represents the best part of the system in terms of maintenance, the condition of structures, the quality of drainage, and terrain (flatness). Nonetheless, even the less pristine sections of the system are known to function satisfactorily.

At each stage along the lateral, farmers said they were pleased with the operation of the system. Water supply is always sufficient, and delivery is dependable and flexible. They indicated that there is a good rapport between farmers and INDRHI staff. There has been no attempt to date to create water user associations, but some credit groups function informally as water distribution groups.

Farmers have virtually no responsibilities for O and M, except to clean field channels and to pay the water tariff. Several examples were cited of farmers who were negligent in cleaning their assigned channels and lost an irrigation turn as a result. However, such incidents apparently do not affect delivery to neighbors, thus there is little social pressure to do minor maintenance.

The water tariff is uniformly regarded by officials and farmers to be insignificant compared to the value of the crops produced. It represents a tiny fraction of the costs of production and covers only a small part of O and M costs. The remainder is borne by INDRHI. The tubewell-operating farmer shared this perception, citing the high cost of operating his electric pumps. Most small farmers in Azua pay the tariff automatically as part of the production credit package they receive from banks or fruit exporting companies. The many large farmers in the valley apparently do not pay the tariff automatically, hence the relatively low collection rate (about 50 percent compliance). As in the case of all irrigation districts in the Dominican Republic, the water fee collections have amounted to only 6-10 percent of O and M costs.

3. LaVega

a. General Discussion

Camú is the largest system in LaVega zone. It covers almost 7,000 ha in a flat valley. Water is diverted from the Rio Camú several kilometers upstream from the valley. This run-of-the-river system is characterized by reasonably high productivity despite chronic water shortages. It was designed to irrigate pastures, but is used almost exclusively for rice production.

b. Discussion of field visit

The team visited the Camú System from the diversion wier on the Rio Camú to the tail end of one lateral which suffers chronic water shortages. In general, the system appears to be maintained adequately: concrete structures are in good shape; unlined canals show the results of normal wear; and no major maintenance problems were noted. Yields are generally good for the main cropping season.

Only a small amount of the land in Camú is occupied by land reform parceleros; many of the holdings are large independent units. However, our principal contacts were parceleros near the head of the system, and with a Farmers' Association at the tail end. Discussions emphasized the inadequacy of water supply for a second rice crop in most years. Farmers apparently always try a second crop, either by seeding or ratoon (retorno), but rarely succeed. Nonetheless, credit is easily available for rice planting, so they keep investing, relying on occasional debt cancellations to rescue them when their crop failures mount up.

INDRHI has not started to organize user groups in Camú. Among land reform parceleros, it may be fairly easy to utilize existing credit groups or Farmers' Associations as starting points. It was not clear if farmers other than parceleros participate in such nascent groups. Large landowners probably do not have to join water user groups in order to deal effectively with INDRHI.

Tariff collection in the Yuna-Camú District is higher than any other irrigation district of the Dominican Republic, and is 100 percent in two of the five zones. Officials attribute this to the farmers' understanding of the value of irrigation water. However, the high compliance rate is probably due to the easy availability of credit for rice production, and the automatic payment of the tariff as part of the credit package, rather than to particular attitudes of LaVega farmers. Whatever the case, collection rates are not expected to drop as the tariff is increased. Participation in WUAs is not likely to affect O and M cost recovery, which is scheduled to reach 50 percent this year and 100 percent by 1989-1990.

## C. Morocco

### 1. Doukkala I

#### a. General discussion

Doukkala I project is located in Morocco's second most important irrigated area, the Oued oum er Rbia basin in West Central Morocco south of Casablanca. The project is part of a broader long-term effort to improve the facilities of the some 250,000 ha under large-scale irrigation in the basin and is under the direction of the Office de Mise en Valeur du Doukkala (ORMVAD) (Regional Office for the Development of the Doukkala). Automatically controlled sprinkle irrigation is provided on demand to 15,840 ha served by an existing canal from the Im-Fout reservoir. Water is delivered by down stream controlled feeder canals to four separate pumps and distributed under pressure to hydrants serving farm fields. Water is applied to fields using portable pipe fitted with sprinkler heads. Maintenance of pressure and supply is fully automatic. Project cost was appraised at US$85 million with U$30 million provided by the World Bank and

US$13 million by AID. The project was completed in 1980 and came under full operation in 1980-81. Yields achieved during 1980-81 essentially reached those expected at full development.

Prior to and during construction, land holdings were consolidated and regularized into rectangular service blocks of approximately 16 ha. Land holdings are laid out parallel to one side with cropping patterns perpendicular across the block so that tillage, etc., can cross farm boundaries. Cropping patterns are set by ORMVAD and include one commercial crop, sugar beets, which all farmers are required to grow. There are 7,754 farm units or an average of 2.05 ha per farm unit but 50 percent of the units are less than 1.0 ha in size. ORMVAD provides all inputs and will provide tillage if required. All costs, including water charges are debited against the land holders' sugar beet account. Besides the standard water charge set nationally at DH .089/$m^3$ the farmers pay a surcharge to cover the cost of power. Under national policy, a betterment tax designed to achieve maximum capital recovery of 40 percent is levied but the first five ha of holdings are exempt. Thus, in Doukkala I capital recovery is estimated at 14 percent. Collection is about 80 percent of assessed charges. While collection is automatic, farmers seem to appreciate the profitably of the modern system do not object to paying the water charges.

Use of sprinklers avoided the costs and hazards of land leveling of fields which were somewhat undulating and should result in good application efficiency. The inclusion of commercial crops tends to insure a cash profit. Using a one-hectare model, net return before taxes was estimated at US$ 2,230/ha at 1981 price and exchange rates. Only a bookkeeping entry is required to collect water charges. All collections are retained by ORMVAD and used locally for operating and maintaining the project.

b. Discussion of field visit

The Team visited the ORMVAD Director at his headquarters in Jadida (March 27). The Director explained that the cropping pattern is in conformity with the national plan but varies locally. It is set by ORMVAD using technical advice and tries to cater to local conditions including farmer preferences. From 90-95 percent of O and M water charges are collected. O and M charges were doubled in 1984 and the betterment levee is being raised from DH 1500/ha to DH 8500/ha. Farmers have accepted these new rates. The Director confirmed that production has held up well since the World Bank audit report of 1982. He is not entirely satisfied with O and M but problems are largely technical ones mostly at pumps. His principal problem is the O and M budget, but with the new rates he expects to develop a surplus beyond routine O and M costs and to initiate a replacement program.

At the Zone office in Zememra the engineers told us that while there had been maintenance problems with the mobile sprinkler equipment, conditions were improving as farmers gained experience. Each 16-ha management block has a representative who interacts with ORMVAD. This is the only farmer organization on the project. Measuring devices are largely out of service, but why this is so is not clear. They were installed during construction one or two years prior to actual allocation of land to farmers so nobody was responsible for them. Water charge assessment is now on a crop area basis and an overall measurement at the pump. Apparently there will be no effort to replace the meters.

The pumping station for the zone was inspected. Six pumps were installed in parallel. The Operator told us he had had no serious maintenance problems over the seven-year period the station had been operated. There was a large leak spouting from the seal around the shaft of one of the pumps. The Operator said this had developed that morning and would be fixed within about one day. Canals, which are in earth, seemed remarkably free from weeds and had only very limited bank caving and erosion. They have had no maintenance nor does much seem to be needed. The zone engineer thought that a fairly high velocity (0.6 m/s) and constant water level may be the reason for no weeds. Not emptying the canal helps avoid bank sloughing.

Several farmers were visited. One farmer shared 0.5 ha with his mother-in-law. All expressed enthusiasm for this project which they felt had enabled them to very greatly improve their previous economic circumstances. Crops generally appeared to be in good condition. The principal maintenance problems are leakage and faulty sprinkler heads which occur mostly at hydrants and couplings, through broken or worn out gaskets. The leakage does lead to some shallow ponding and locally saturated muddy spots which reduces production on a small but not very significant part of the area. The sprinkler heads seem to be replaced fairly easily. They are available from ORMVAD or the local market. The farmers did not feel they had the technical capability to fix the leaks.

2. Chichaoua

a. General discussion

The Chichaoua Project is contiguous to the town of Chichaoua near the edge of the Atlas piedmont about 70 km west of Marrakech in West Central Morocco. The project serves an area of about 1,900 ha. The water supply is from a spring which provides a constant flow of 600 liters per second. The supply channel crossed the river, but floods destroyed the stream crossing. The spring now flows into the river and is diverted into an 18-km long channel to its first division point several kilometers upstream from Chichaoua.

The project was developed originally to serve a colonial enterprise. It was initially rehabilitated about 40 years ago. The principal work was lining the main channels. The project is operated by the users through several traditional and formal associations.

Rehabilitation including installing an inverted siphon at the river, relining and providing gates and other structures with World Bank support is planned at a cost of US$ 5,000,000.

b. Discussion of field visit

Small and medium projects come under the Agriculture Department rather than under regional ORMVA. We first visited the Provincial Director of Agriculture at his office in Manakech (March 8). The Director stated that small and medium projects are not specifically defined but maximum size is about 5,000 ha. Besides surface projects, wells and Qataras (horizontal tunnels) are developed or rehabilitated but Qataras are phasing out. Each ditch or canal has its own water users association. Water rights are not attached to the land and may be transferred. These are traditional and may or may not be recorded. Policy under government intervention for rehabilitation is to formalize water users associations by registry and to make a census of water rights. At present rehabilitation is at no cost to the farmers. Besides rehabilitation, the Agricultural Department provides extension and other support.

The Director thinks that in the future farmers on small and medium projects will be asked to pay for water service but stated that he could not be sure. Mandatory cropping rotations do not apply to small and medium projects. He sees no connection between water use charges and efficiency. Farmers are efficient because water is scarce, but delivery systems are inefficient. Principal crops for small and medium projects in the province are forage, vegetables and cereals. Under rainfed conditions (250-300 mm), cereal yields are 0.5-0.6 tons per ha; under irrigation, they could be as high as 3-7 tons per ha.

At Chichaoua, accompanied by two agricultural ministry staff members from Marrakech, we contacted the chief of the local service, visiting the first division point on the Chichaoua canal. We were told that the flow was about 400 liters per second, only two-thirds of the normal 600 liters per second because of losses through the brush diversion dam. We were joined by some local people including a ditch rider for one of the associations on a lateral serving an 85 ha area. The ditch rider verified that a number of associations on the various laterals maintained and operated their pieces of the system. There does not, however seem to be any overall federation which can make decisions relevant to the entire system. Charges collected essentially cover the costs of the ditch rider's salaries, in this case about DH 47per ha per year. Little is spent on maintenance. There is a water market. Rights are sold on an annual basis. A 60 liters per

second stream for one hour every two weeks costs DH 500. This works out to DH 0.089/$m^3$. (We think the exact agreement with the current water charge for large projects is coincidental.)

We also visited with a member of a cooperative in the lower part of the project area. The cooperative was formed from a colonial estate under the agrarian reform law. This member has nine ha, but half is in fallow because of lack of water. The cooperative hires a water master who is paid DH 25 per ha per year. Given that half the gross area is in fallow, the cost per irrigated hectare is essentially the same as for the ditch rider we talked to.

Observations of fields, crops and ditches did not impress us. Our impressions are confirmed by before project yields reported in the World Bank's appraisal: wheat, 0.9 tons per ha; barley, 1.2 tons per ha; maize, 0.8 tons per ha; forage, 25 tons per ha. Crops were not well tended, field ditches were only fair to marginal even in the upper area, which seemed to be well supplied with water. In the lower area there was considerable wastage of water at the tops of fields in distributing the water from the main ditch. Some of the old lining is in fair shape but much of it is eroded away and cracked. We asked Ministry of Agriculture officials how 600 liters per second could serve 1900 ha. According to them, the principal seasonal crop is small grains, which during the rainy season has a fairly modest irrigation requirement, but much of the land is left in seasonal fallow. Crops are grown during all three seasons, but on different fields. The World Bank rehabilitation is based on a water supply of 1100 liters per second, but where the additional flow comes from is not clear.

We only speculate about why the performance of this project was unimpressive. True, the water supply although reliable is short, but this could hardly be the reason. Most likely, we think it could be lack of a market outlet either for economic or organizational reasons, but we have no real data to support this view.

## D. Philippines

### 1. Upper Pampanga Integrated Irrigation Project (UPRIIS)

#### a. General discussion

UPRIIS consists of five systems located in the Pampanga River Basin, one of the country's largest, about 100-150 km north of Manila. About three-fourths of the UPRIIS area totalling some 103,000 ha was developed under the Upper Pampanga River Project (UPRC) which was planned using AID assistance during the mid 1960s and supported by a US$34 million World Bank loan in 1969. Main features include Pantabanga Dam, one of the country's largest, on the Pantabangan River to impound about 3,000 million $m^3$ of water, rehabilitation and improvement of existing systems and construction of new facilities to irrigate additional areas during the entire year. The remaining one-fourth of the area comes from the Aurora-Penoranda





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Project, completed in 1978, which was also World Bank funded. Because much of the data base available to the Team related to UPRC the discussion will focus on that project.

UPRC was planned as a rotational system to provide irrigation for paddy on 77,000 ha during the wet season and 72,000 ha during the dry season. Pantabangan Dam was finished in 1974 and project operations began that year. By 1979 yields were approaching those projected for full development four years later--3.5 tons per ha wet season, 4.0 tons per ha dry season. One feature of the development was a massive program of input and output monitoring during 1976-82 under an interagency council which guided both short- and long-term irrigation planning and input logistics involving other agencies as well as the National Irrigation Administration (NIA). Much of this still goes on, but under a different organizational arrangement.

UPRIIS is administered by an Operations Manager (OM) who reports directly to the NIA Assistant Administrator for Operations. For operations, the project area is divided into four districts, each under a district manager and further subdivided into zones of about 8,000 ha, divisions of about 750 ha and rotational units of about 50 ha. Distribution within rotational units is left to the farmers in the unit. The literature is somewhat ambivalent on average farm size, 1.6 ha is cited, but 2.1 ha is cited as well. This is probably because of the land reform activities going on which are designed to transfer ownership rights to tenants. World Bank estimates net income for an average 1.6 ha farm as about US$ 900 (1981 basis) or 5.6 tons of paddy equivalent.

Beginning in 1982, NIA initiated efforts to create Water User Associations (WUAs) in the UPRIIS command. This activity is under a staff division attached to the OM, but with responsibility directly to the institutional development department in the operations directorate at NIA headquarters. Using institutional development officers at zone level and working through water management technologists or water masters at division level, farmers are being organized into WUAs. These are arranged hierarchically with units at about 10 ha, 50 ha and 300-400 ha. Main functions of WUAs are to handle water distribution and O and M below 50 ha, collect water charges and take over O and M on laterals serving 300-400 ha. About one-fourth of the projected 282 WUAs have been organized. Part of them are formally registered so that they have juridical personality under law. More than 10 percent of the projected number of WUAs have entered into water charge collection agreements with NIA. Six have signed contracts to assume O and M responsibility for lateral canals. Under pressure to assume the cost of farmer subsidies, NIA sees WUAs as its hope for increasing water charge collections and shifting the burden of O and M toward users. The program is too new to evaluate, but it could possibly turn into a classic approach for mobilizing local resources for irrigation O and M on large public projects. Problems include what to do about displaced NIA staff.



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Collection of water charges in UPRIIS is not impressive nor did it improve significantly, as far as we were able to determine, with better technology and assured water supply reliability during the historical development of the project.

The Philippines case is midway between the Moroccan case where collections stay at local level and the usual case where they revert to the national general revenue account in the Treasury. They are held and reallocated by NIA. Water charges for O and M are nominal, 125 kg of paddy per ha in the wet season and 175 kg of paddy per ha in the dry season. Because of reservoir storage, water rates are higher than those set nationally (100 kg/ha for wet season and 75 kg/ha for dry season). Capital recovery is nil under present policy--50-year repayment at zero interest in unindexed pesos.

Technically and economically UPRC must be judged as successful. In simplistic terms, financial recovery has not been successful, but extreme caution is needed in interpreting this because the project's payment through the complex of indirect returns through price ceilings and subsidies is indeterminate.

b. Discussion of field visit

Several minor logistical misfortunes shortened our productive time in the field beyond that planned, nevertheless the field visit yielded a great deal of useful information which could not have been collected otherwise. We had hoped to spend the late afternoon (April 2) and most of the next day on UPRIIS, but the operations manager was called to Manila. With help of UPRIIS staff we were able to contact a local leader at his residence at Publacion Sur, an enclave of about 2,000 people in the environs of Cabanatuan, the headquarters city for UPRIIS. Several other farmer villagers and two or three NIA officers were present. The rather exuberant feedback (it was the beginning of Easter weekend) was that the project was successful with paddy yields in the 5-7 tons per ha range and that formation of the WUA at 50-ha level had definitely improved reliability and O and M, in his outlet block.

The Operations Manager (April 3) said that his biggest problem was collection of water charges. This is aggravated because the project lies in the typhoon belt and crops are injured or destroyed periodically. The second problem is management during drought years--in 1984 only a 34-percent water supply was available in contrast to about 90 percent normally. Maintenance of roads, which also provide access to markets, is a problem. Communications are good and utilizing radio, and canal officials are provided with motorcycles.

The Institutional Development director explained the program for forming water user organizations. He seemed to have considerable autonomy in how he approached this task. Farmers generally want additional turnouts and some corrections on turnout locations. Farmer associations are gradually getting into policing irrigation regulations.

2. Laur (Pinaburyuhan) Project

a. General discussion

Two community projects near the town of Laur in Central Luzon approximately 100 km from Manila were used beginning in 1976 as pilot projects in NIA's communal projects implementation program. Both were operated by traditional water users associations. The pilot studies were designed to explore ways of improving the effectiveness of these organizations, involve them in participation in planning and construction of a rehabilitated system and improve their capability fo continued operation of the rehabilitated project. One of these projects (Pinaburyuhan) was selected for a case study. This traditional project uses a brush and rock diversion dam to provide irrigation to some 800 ha of paddy and water and winter season mixed crops, mainly onions. Two crops of paddy are grown where irrigation is available.

Working with the users, beginning about 1980 NIA developed plans and completed partial construction of an extended and rehabilitated project to bring more reliable service to an expanded area of about 2,000 ha. During construction, a typhoon storm washed out the pile foundation of the new permanent dam causing NIA to re-examine the dam design. NIA evidently intends to finish the dam. Meanwhile irrigation has continued on the traditional 800 ha area. The recognized water users organization is still in place and functioning, at a reduced level of effectiveness over what might be expected had the project been completed. This is a rather economically poor area. About 10,000 people in 2,100 households live in the area. Average farm size is about two ha. In 1976, even among farmers who had irrigation water, 46 percent had incomes below poverty level. Others were markedly worse off.

b. Discussion of field visits

The group met with the Manager of the Irrigation Association and the Treasurer at Association headquarters in Laur on March 28. The Manager reviewed the history of the project and described the organization and its problems. The organization has 700 members up from 370 when it was first re-organized in 1976. The manager expressed great concern that the project had not been completed and felt confident that the association could repay the cost of the dam. (Repayment under current policy is normally at 50 kg/ha/year paddy at zero interest with a maximum of 50 years but is negotiated in each case.) The temporary dam washes out each year at least once

and sometimes three times. It must be replaced at a cost of about F₱ 35,000. Association dues for O and M, etc., are F₱ 70/ha/association but collections are only 20-50 percent. The manager thinks this could be raised to nearly 100 percent if the permanent dam is constructed so that the water supply is reliable. Paddy yields were reported to be 2.54 tons per ha. These could be raised to 5 tons per ha with a reliable supply. Introduction of HYV varieties over the past ten years has increased yields by about 2.5 tons per ha. Fertilizer and pesticides are consistently available. Tillage is by buffalo or tractor. Operation and maintenance is judged to be fair to good.

E. Indonesia

Since the 1960s, Indonesia has engaged in a major effort to rehabilitate old irrigation systems and to construct new ones both in Java and Outer Islands. The main objective has been to provide supplemental water for increased rice production by providing optimal growing conditions that increase yields. Irrigation development has contributed significantly to increased cropping intensities, sometimes making possible three rice crops per year.

There are three main types of irrigation systems in Indonesia--technical irrigation, semi-technical irrigation and simple irrigation. The technical irrigation systems are characterized by having permanent structures and water measurement and control devices as well as drainage channels, while semi-technical and simple systems have semi-permanent or temporary structures and no measurement or control devices.

About 4.2 million ha are in the service area of existing irrigation systems built and managed at the main system level by the Division of Public Works of the Directorate General of Water Resources Development (DGWRD). In addition, there are about 1.5 million ha of irrigated area managed by farmers at the local level independently of the government. More than 60 percent of the irrigated area is on Java.

The chief government agency responsible for irrigation is the DGWRD and although functions are theoretically decentralized, the provincial Public Works mainly operate on a budget provided by the central government. This is the sectoral budget known as the APBN. There are also routine budgets for salaries and wages, the Inpres Dati through which a proportion of funds is available for irrigation rehabilitation and for O and M and the Dati II which is used for infrastructure development. In general, current government allocations for O and M are insufficient.

Responsibility for O and M is divided between the government and local communities with the main and secondary structures being managed by the provincial government and the tertiary and quartenary channels by local communities. Some administrative problems arise because



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administrative and water management boundaries do not coincide. At the village level, Indonesia has a lengthy tradition of irrigation systems managed by users and although data are difficult to obtain, user involvement and payments for irrigation are considerable. Farmers contribute voluntary labor (gotong royong) to clean and maintain canals and ditches and make payments in money or in kind to the village irrigation official. Attempts to extend this principle and establish WUAs for managing the larger irrigation systems below the tertiary level have met with difficulties because farmers tend to regard such systems as the responsibility of the government which built them.

Cost recovery in Indonesia is geared towards recovering the costs of O and M and there is little discussion of recovering investment costs. Farmer payments to local irrigation officials for O and M represent a substantial amount in some places but data on these payments are not systematically maintained. In addition, there is the IPEDA or land tax which is designed to capture some of the benefits resulting from improved productivity due to irrigation. Water users pay the IPEDA in addition to the payments made for O and M at the tertiary level. A very small percentage of this tax is actually spent on irrigation, and it is mainly regarded as a development fund and not for O and M. However, some thought is now being given to increasing the IPEDA and applying it for O and M costs in irrigation.

The team made field visits to a large technical irrigation scheme, the Kaliprogo Irrigation Project and to a number of small irrigation systems developed under the Sederhana Program in West Sumatra. Discussion of these projects follows.

1. The Kali Progro Irrigation Project

The Kali Progo project is a technical irrigation scheme that provides water over 35,259 ha in and around the city of Yogjakarta. Aside from the hectarage under technical irrigation, semi-technical systems serve an additional 20,000 ha. The main service is provided by the 31 km Mataram Main Canal and 220 pick-up weirs divert water from tributary streams. On the western side, a 24-km canal conveys Progo water to coastal areas and about 1,600 ha along the west bank of the river. A new dam is being planned to provide 18 million cubic meters of reservoir storage. WUAs are being formed to manage the 1,080 tertiary units.

Farm holdings in the Progo Basin are very small (between 0.15 to 0.3 ha) and rice is the main crop. Cropping intensity is 2.25 and yields are eight tons per ha having gone up from five tons per ha before irrigation. Non-rice crops such as sugarcane and vegetables are raised for one season on a rotational basis after five to eight seasons of rice.

The system has just been rehabilitated and is in good condition and appeared to function well. The project administration has responsibility for management of the main and secondary canals and sometimes also the tertiary or quartenary channels, although these are intended to be managed by farmers. O and M on the main and secondary canals is fully subsidized by the central government except for voluntary farm labor. There was some disagreement about whether the allowance from the government of Rp. 15,000/ha was adequate for O and M. In addition, farmers pay 25 kg of paddy per hectare for maintenance of tertiary systems.

In order to promote WUAs, the project initiated a special program in 1980. The team met with the President of one of the WUAs that had been established in January 1984 and it seemed to be working well. Farmers paid fees of Rp. 8,000/ha in cash if they could, or contributed labor at the rate of Rp. 400 per half day. The success of this WUA is fairly unique because there are six other tertiaries on the same lateral who do not have functioning WUAs. It is still too early to assess the success of the WUA program as a whole.

2. West Sumatra Sederhana Program

The Sederhana Irrigation Program was instituted by the Government of Indonesia in 1974 in order to develop small-scale low-cost irrigation by rehabilitation or new construction outside Java. The United States Agency for International Development (AID) joined this effort in June 1975 with a combination of loan and grant funds. Some of the projects visited by the team were assisted by AID. The achievements of the Sederhana program include providing irrigation to a great many farmers who would not otherwise have had it and construction of more permanent structures which represent a cost savings in that they do not have to be constantly rebuilt as were the traditional structures they replaced. In many cases, the program has improved water security, facilitated double or triple cropping and increased rice yields.

Sederhana are run-of-the-river gravity-fed systems consisting of a diversion weir, a headworks canal, and channels to carry the water to the farm. The size of completed systems varies from less than 50 ha to 2,000 ha but most are about 300 ha.

The team visited five Sederhana projects in West Sumatra, three of them in Kabupaten Solok (Guguk Landuk, Bandar Kuok and Guguk Rantau) and two others (Punggung Kasiek and Bulakkan). The Punggung Kasiek project was located in a reclamation area and was the largest project with a potential service area of 4,243 ha. Agricultural data were only available for the three projects in Kabupaten Soloh. Rice is the predominant crop grown on plots of less than half a hectare. Improved irrigation has led to an even greater emphasis on rice which replaced palawija in the dry season. Following irrigation, rice yields increased from 7-22 percent, although irrigation may not be the only factor responsible.



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Management of the Sederhana projects is intended to be the responsibility of the farmers, but on each of the sites visited the team met government officials who were obviously responsible for O and M, at least of the main system. On the other hand, cleaning and maintenance of channels at the farm level is done by groups of farmers on a voluntary basis at least once a year. The channels seemed to be well looked after. Development of WUAs has not been very successful, although this is an important aspect of the Sederhana program. No data were available on cost recovery on these projects apart from the contributions of voluntary labor.

## IV. ISSUES AND ANALYSIS

A number of issues related to the pricing and management of irrigation water deserve examination and would yield useful information. Given the constraints of time and resources, five issues that appeared likely to be the most effective in accomplishing the study's objectives (Chapter I) were agreed upon. These issues focus on cost recovery and local farmer participation.

More attention was given to recovery of variable or recurrent than to investment costs, but the latter were not ignored. Recovery of investment costs directly or indirectly is highly desirable especially because of the financial crisis faced by most developing countries. However, full recovery generally can be regarded as unlikely in the near future. In economic terms, investment costs of existing schemes are sunk costs. To the extent that there is merit in marginal pricing in irrigation as means of improving management, recurrent costs are more relevant. From the financial point of view, donors are interested primarily in financing capital costs at a national level, but governments are having increasing difficulty in financing recurrent costs. Despite much debate and agreed OECD and USAID guidelines for donor support for recurrent cost, we merely note there is little if any donor provision at present in the irrigation sector. Similarly, the team focused primarily on the role of farmer participation as an avenue for mobilizing local financial resources for improving irrigation system O and M; however, improvement of irrigation systems management involves irrigation bureaucracy at national, and project levels. A complete analysis necessitates examination of a wide range of possibilities and attention was given to each level by the study.

### A. Statement of Issues

The five issues examined are:

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

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

3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water?

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



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For discussion and analysis in the following sections these issues are divided into two groups, one pertaining primarily to pricing and the other to management.

## B. Discussion and Analysis

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

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 usually are based on the share of the stream or canal flow, or the cropped area irrigated with variable charges depending on the crop. They may also be on a per irrigation basis or by direct volume measurement but these are not common. Such charges usually have the goal of collection reimbursement for recurrent costs, although sometimes all or partial capital cost recovery is also an objective. Another direct charge sometimes used is the betterment levy, in effect, a tax on the capital increase in the land value resulting from irrigation. Betterment levies are applied to capital recovery.

Indirect cost recovery may also occur. The most common is a sales tax on crop outputs marketed or on inputs purchased such as fertilizers, or by setting farm price ceilings below market value, but this may be offset by subsidies to agriculture. Indirect cost recovery is usually inadvertent as far as irrigation is concerned, coming under an umbrella of more general policy. Returns attributable to irrigation are very difficult to calculate especially for those associated with price regulation and subsidies, but attempts to estimate them should be made and taken into account in setting capital recovery targets by direct means.

The accumulated evidence on the efficacy of cost recovery through direct or indirect charges is not uniformly reassuring. Irrigation authorities encounter difficulties in determining the proper basis and amounts of the charges given farmer capacity to pay and its variation among farmers and/or the uncertainty of 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).[38] A 1984 review of Bank-financed projects showed that in at least two-thirds of the cases where there were covenants requiring O and M costs to be recovered from beneficiaries the goal was not

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



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achieved. The political costs of raising water fees are usually perceived to be high. In some cases they are set by legislation. However, even in these cases they may not in practice be achieved.

In a 1981 report, Bottrall suggests that low rates and low collection are symptomatic of the general problems with irrigation management systems.[39] Further, he cites four examples which suggest that the lower the charge the higher the rate of default, as shown in Table 2. This does not establish that the low charges give low incentive to pay or collect the fees; it is possible that both are associated with another factor such as low reliability of water deliveries. 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 is 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 problems involved in determining proper methods of assessing and levying 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 is an important factor affecting the ability of authorities to collect water charges. It affects farmer ability to pay through its impact upon the aggregate volume and usually the net value 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 3.

In the past, there have been a number of attempts to ensure financial integrity of irrigation systems. In pre-independent India, a very restrictive 'financial productivity test' was used to justify investment whereby revenue had to cover operation and maintenance plus earn interest on the investment, albeit at a low rate. This criterion was withdrawn in the 1950s and despite various government investigations (e.g., National Council for Applied Economic Research) the ratio of revenue to gross output has fallen in most states in

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



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Table 2: Water Rate Levels and Recovery Charges for Four Areas

| | Average Water Charge/ha (US$) | Recovery (percent) |
|---|---|---|
| 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 (Washington, D.C.: World Bank, 1981).

recent years.[40] In 1978, rates ranged mainly between 1 and 4 percent of gross output (see Table 3). Due to the unsatisfactory nature of data on O and M needs, it is not possible to judge whether even 4 percent is an appropriate level. Furthermore, any percentage level may change as production in agriculture changes and as systems age or water use patterns change.

The growing pressures on the public exchequer explains why governments are keen to mobilize farmers to carry the burden of irrigation cost. Irrigation farmers are readily identifiable beneficiaries of public investments. The benefits they obtain can be recognized through the widespread popularity of public irrigation schemes among farmers and the rise in land values that follows the announcement of a scheme and is sustained in the operation phase. There is a relationship between increases in land value and the net value of incremental production, but it is not a straightforward one because of the variety of motives for holding land assets.

Attempts to recover part of the public-funded increase in land value through betterment levies have not worked well. In some Indian states, they have been ruled to be illegal. The collection rate in India is low, generally less than one-third. Betterment levies present problems for farmers because they come in the early stage of farm development when on-farm expenses are greatest. In consequence, a grace period (commonly three years) is usually granted and payment is made over a number of years.

While betterment levies have not been particularly successful, neither have direct water charges. Levies need to be re-considered as a means of collecting reimbursement for capital costs. If governments are to tackle fees at levels beyond operation and maintenence costs, then the notion of a betterment levy with a predetermined duration has attractions that make it worth new experiments.

Given the macroeconomic difficulties facing many governments, it would be highly desirable for irrigation authorities to consider imposing user fees to recover at least O and M costs. It would be feasible to institute direct monetary charges or in-kind fees. There is a trend in thinking in many developing countries whereby user fees in many sectors are being simultaneously examined alongside the merits of a panoply of subsidies and support services. Irrigation authorities in re-considering user fees are not acting in isolation.

In selecting areas for lower cost projects for modernization or rehabilitation or for major augmenting investments such as drainage, governments might enter into prior negotiation with farmers about cost-sharing. The rationale for a betterment levy is widely understood

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[40]National Council of Applied Economic Research, Technoeconomic Study of Water Related Charges in the World Bank Assisted Haryana Irrigation Project (New Delhi: NCAER, 1981).

Table 3: Water Rate As Percentage of Average Gross Output[a]

| State | Rice (%) | Wheat (%) | State | Rice (%) | Wheat (%) |
|---|---|---|---|---|---|
| Andhra Pradesh | 3.9 | 5.9 | Maharastra | 2.0 | 4.8 |
| Assam | 17.8 | 5.9 | Manipur | - | - |
| Bihar | 5.6 | 3.5 | Nagaland | - | - |
| Gujarat | 4.1 | 4.5 | Orissa | - | -[b] |
| Harana | 2.5 | 2.6 | Punjab | 1.3 | 1.0 |
| Himachal Pradesh | 1.0 | 0.5 | Rajastran | - | 3.0 |
| Jammu and Kashmir | - | - | Tamil Nadu | 1.2 | - |
| Karnantaka | 2.0 | 2.7 | Tripura | - | - |
| Kerala | 3.0 | - | Uttar Pradesh | 8.2 | 6.0 |
| Madhya Pradesh | 2.3 | 1.0[b] | West Bengal | 1.3 | 3.2[b] |

[a]Charges at this level are not sufficient to cover the operation and maintenance of large-scale systems.

[b]In West Bengal, deltaic regions of Orissa and parts of Bihar and Madhya Pradesh where climatic conditions make it uncertain how much crop would be available in a particular year, leases for irrigation water are offered in advance, at a discount, for periods varying from a season to up to ten years. (National Council of Applied Economics Research 1981).

Source: National Council of Applied Economic Research, Technoeconomic Study of Water Related Charges in the World Bank Assisted Haryana Irrigation Project. (New Delhi: NCAER, 1981).

by farmers, but quite naturally resisted. Their farms are already developed and irrigation well-established. Farmers can be expected to appreciate the limited duration of repayment.

Even countries such as Indonesia, which traditionally admit no water charges, are devising mechanisms for financing irrigation consistent with their cultural norms. Sometimes the issue is merely semantic (e.g., water charges are renamed irrigation service fees). Sometimes the charges are more dramatic. In Indonesia, there is a land tax levied at approximately 5 percent of gross value of production. This tax is not now available for irrigation service and maintenance however. Suggestions that some of the land tax be reserved for irrigation purposes have been made. In addition, farmers generally pay informally for maintenance at the tertiary level by a levy of 25 kg paddy per hectare or labor services of equivalent value paid either to the Water Users Association or to a government-administered local group. As the Irrigation Department receives little if any of the land tax or local fees, there is a direct subsidy from government to cover O and M costs for the remainder of the system.

In the Philippines, on large-scale public schemes, water charges, though variable, are set at about 3 percent of gross production specified in kind and payable in cash or kind--about 125 kg rough rice (paddy) per hectare per season. On the UPPRIS scheme visited by the team, the higher level of 175 kg rice per season was justified by authorities and farmers alike because it had a water storage reservoir and hence a more reliable 12-month supply.

The Philippine system has two important advantages in that in-kind in-field grain payments are accepted and that by tying the water charge to grain prices a high degree of indexation is achieved. With global inflation currently at around 15 percent (and Philippine inflation at around 40 percent and Peru at above 100 percent), some form of indexation is essential. In countries such as Pakistan, where rates are specified in money terms and seldom adjusted, there is serious erosion of the real value of revenue over time.

One problem of specifying rates in kind, at a fixed weight of produce, is that all increments in production will go to the farmer and the government will fail to share in improved productivity. Furthermore, if the grain is an inferior foodstuff, or if for other reasons the government holds down the relative price of the grain, then the 'grain index' will fail to keep up its relative value and the real value of water revenue will fall or at least fail to grow in line with the economy. But this is a rather trivial objection or at least a long-term problem, considering the points of in-kind payments and indexing. One would not expect relative price increases to be dramatic and there is a good possibility that the rate can be adjusted for water fees with new repayment agreements.

The team concluded that there is ample empirical evidence that most farmers can pay a proportion of their farm production as a fee for irrigation service. The problem is one of devising the appropriate fee, impressing upon irrigation users the necessity for paying charges and/or structuring payment incentives so that farmers will be willing to pay for their water. There is something to be gained by specifying it in kind. The economic climate is now right, in many instances, to give previously hesitant governments courage to introduce or upgrade charges. The Indian Irrigation Commission (1972) suggested a charge in the range of 5-12 percent of gross income but most states charge between 0.5 and 4.75 percent. In the Philippines, the charge is about 3 percent.

In Pakistan, land revenue was recently abolished and a voluntary religious tax for social welfare projects substituted. This leaves the minimal water service rate which, in view of the size of the agricultural sector in the economy, combined with moves to pay farmers world prices for their crops and the absence of an agricultural income tax, gives some concern about public revenue mobilization. Irrigation rates are only about 50 percent of (inadequate) operation and maintenance expenditures.

Payment of irrigation fees may appear to be low when in fact the costs of water to farmers may be significantly much higher when cash and kind gifts to irrigation personnel or neighbors for water, labor services, rights of way, etc., are considered. From 1970-75, the NIA in the Philippines collected 39.3 percent of fee levied but De Los Reyes found additional sources of informal payment by farmers.[41] Evidence on such payments is, of course, hard to obtain but policymakers should be aware of the existence and extent of such costs in determining official charges.

Wade has made the most serious and comprehensive account of the extent of irrigation corruption in India that could at least double official charges.[42] Perhaps, more worrisome, the existence of such corruption reduces the extent and quality of operation and maintenance. In various ways, the illegal charges are maximized by an unreliable system. All levels, bureaucratic and political, share regardless of who collects. Rules for distribution are well understood and incentive posts are auctioned (see Figure 1). While the diagnosis, the causes and possible reforms are subject to considerable controversy, and beyond our scope here, the existence of a large gap between the value-in-use of a given irrigation supply and the official

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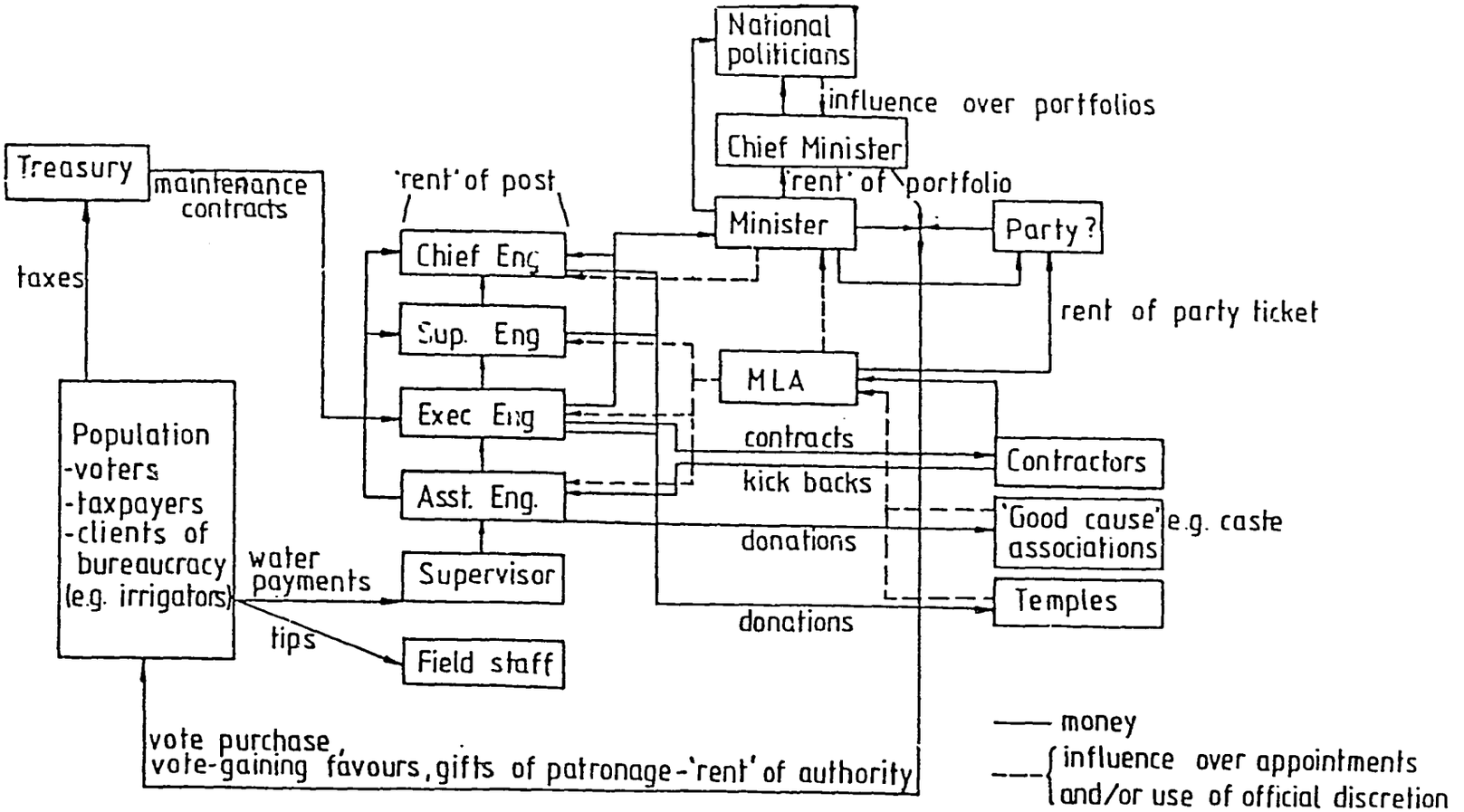
[41] R.P. de Los Reyes, "Stereotypes and facts in irrigation management: preliminary findings from a case study of a Philippine communal gravity system," in Irrigation Policy and Management in Southeast Asia (Los Banos, Philippines: IRRI, 1978).

[42] R. Wade, "The system of administrative and political corruption: canal irrigation in South India," J. Dev Studies 18, (3) 287-328.




Note: The figure takes the Irrigation O&M hierarchy by way of illustration. For further details see (Wade 1982).

IRRIGATION PRICING AND MANAGEMENT

Figure 1: The Flows of Money, Posts, Votes and Influence in the Transfer Model

charge is worth noting. Lack of public information on the actual availability of water and construction materials creates the opportunity to extract corrupt payments from farmers and for sub-standard work by contractors.

A clear distinction must be made between charges collected and charges levied. These can vary enormously from 90 percent as in Doukkala in Morocco in 1980 to less than 1 percent for a Nepal surface scheme in 1979-80. Even within a country there can be enormous variation. For example, a public tubewell scheme in Nepal collected 74 percent. In the same year, surface schemes collected less than 1 percent. Similarly, on a particular scheme the ratio can rise or fall depending upon various circumstances. The Nepal tubewell project in 1977/78 collected only 12 percent.

In most of the systems visited in Peru and the Dominican Republic, cost recovery rates and fee compliance rates are not the same. The low recovery rates indicate inconsistent policies within the various irrigation authorities, rather than problems with farmers. In Peru, responsible agencies have not been serious about collecting fees, and have made few efforts, if any, to apply sanctions for nonpayment. In many cases, it is not physically possible for authorities to cut irrigation water supplies for delinquent farmers. Even where this is possible, it is rarely done. In two small systems near Chiclayo, farmers must pay for water in advance, and they do. In all the other systems, water fees are assessed annually, sometimes long after the conclusion of the irrigation season, and payment rates are low unless officers of the WUA take a special interest in promoting collection.

In general, people in the Peruvian agencies believe that farmers should pay O and M costs, but they seem to be reluctant to enforce collection, either because they do not want to give farmers reason to question the quality of their service, or because they identify specific conditions which seem to limit the ability of farmers to pay, such as floods, droughts, or combinations. That is, they think farmers <u>ought</u> to pay but are not sure that they can afford to do so. Consequently, they do not enforce collection and never really find out whether or not their perceptions are correct. Two other incentives exist for officials to avoid enforcing collections. First, operating budgets have been independent of fee collection. Second, officials like tranquility, which could be disturbed by an effective collection program.

Rice farmers in the Tinajones and fruit producers in the Tacna area of Peru clearly can afford to pay irrigation assessments, and it is likely that assessment levels and payment rates will rise especially as farmers begin to realize that the fees are used locally to operate and maintain the systems. In the Plan MERIS II systems, farmers can probably pay the fees that are currently assessed, especially because most of the funds are recycled within the system in the form of



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payments to people who participate in maintenance activities. However, there is some question about the ability of farmers to pay the overhead operating costs currently borne by the Project.

In the Dominican Republic, a program is underway to raise irrigation fees to make each irrigation district self-sufficient in O and M over the next few years, and to enforce collection. There seems to be little opposition to the program, but it is clear from discussions in the field that farmers have not been informed about the whole program. They may know that irrigation rates have doubled over the last year, but they do not know what will happen next. Fortunately for INDRHI, farmers do not perceive the rates to be high. Indeed, many farmers pay their irrigation fees essentially without knowing about it because fees are routinely included in credit packages issued by the Agricultural Bank and by fruit export companies. These, in turn, make payments to INDRHI. The low recovery rates which have prevailed in the Dominican Republic are attributable both to the low level of the fees set by the government and to INDRHI's reluctance to enforce collection, not to the reluctance or refusal of farmers to make payments.

There are also examples in Nepal and Sri Lanka (IBRD Lift Irrigation Project) of low cost recovery due to institutional failure to implement cost recovery policies, rather than farmer refusal to pay fees.

In general, our conclusion is that collection of fees equivalent to 5 percent of the gross value of crops is practical. However, the issue of extreme poverty has to be faced. In most developing countries, a proportion of farmers will earn less than the critical consumption level--the level of consumption where governments value leaving income with consumers as much as having it in their coffers. In some parts of India, for example 85 percent of farmers are below this officially defined poverty level. Consideration must be given to whether or not to allow fee exemptions for such low-income farmers.

We conclude that poverty should not be grounds for fee exemption. While there is great variation in irrigation farmer income levels, they are, in general, better off compared with dryland farmers and hence more able to pay irrigation charges . As a result of historical and sometimes cultural factors which in the past resulted in neglect of cost recovery in many places, farmers often perceive water as different from other production inputs and therefore not requiring payment. However, water <u>is</u> comparable with other inputs such as fertilizer and crop protection chemicals. Poverty is not a basis for supplying tree inputs and, in our view, water is no different. Solutions to poverty are clearly needed but subsidized irrigation is an efficient and probably counterproductive solution. Farmers should be educated to this fact. Perhaps, the easiest way of doing so is to include the cost of water as one element in a combined input package as has been done successfully in Morocco, for example. (See Annex 3.)

Success in fee collection from all farmers can be substantially improved by decentralization of accounts. We firmly believe in 'earmarking' irrigation revenue and its retention, at least in part, at the system level. If officials' jobs are linked to fee collection and farmers see that they themselves are directly benefited by their financial sacrifices, fee collections is likely to improve.

In general, the issue of cost recovery in irrigation has gained prominence as governments face increasingly difficult financial circumstances and are therefore less able to subsidize irrigation. It is also now more widely recognized that subsidies result in serious economic distortions that are better avoided. Once the importance of cost recovery is acknowledged, issues arise with respect to the feasibility of each of capital and recurrent cost recovery; the appropriate level for setting fee rates considering system financial needs and farmer ability to pay; and the most effective means of collecting the charges. Evidence from countries around the world shows greater concern with recurrent rather than capital cost recovery, more widespread use of direct rather than indirect charges and considerable variation in amounts farmers are expected to pay. Although success in cost recovery varies considerably between and within countries and even within systems, the causes are identifiable and therefore can be remedied, even if on a case-by-case basis.

In summary, cost recovery is a feasible goal in irrigation systems. Direct recovery is considered to be best, but indirect recovery may be feasible under some circumstances. Essentially, all farmers in a system should assume some of the financial burden for O and M, however it is collected. The level of charges actually imposed should depend on real O and M costs, levels of productivity, amount of "hidden" charges, and operational characteristics of the system.

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

Many authorities believe that increased farmer participation is highly correlated with additional mobilization of local economic and non-economic resources for irrigation: however, 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. While indicative, it has not been shown that farmer involvement is either the sole or the most important element in this success. Other economic and socio-cultural 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. There may well be other reasons.

The high fee collection 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 their 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 intervention was partly a response to domination and exploitation of the associations by local political coalitions. In any case, the injection of government capital in the associations has improved irrigation service which is believed to be an important factor in the current high fee performance rate which stands at 88 percent.[43]

Two alternative bases of comparison could be used to examine this issue but they would both require long-term studies. 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.

No rigorous research is known to have been undertaken along these lines but this is considered to be highly desirable. One of the Team's central arguments is that a dearth of public finance will force governments to withdraw from the lowest level of involvement. Such a pull-out could lead to a deterioration of collections. Such action could compel formal or informal farmer participation in management. Such responsibility could improve cost recovery, especially if all or part of the fee remains with the local group. However, this is still not proven. Nor is there an adequate understanding of what factors inhibit or enhance the process.

In Peru, a hierarchical structure of water user associations is prescribed by law, and has been implemented in most coastal systems, to a greater or lesser degree. The situation in the Sierra is much more mixed. In Tinajones (coast), the role of the associations grew as the government maintenance budgets were cut. In this case, participation and control followed a withdrawal of government subsidies. Now, the water user groups control maintenance entirely, through a not-for-profit company which was formed with personnel and equipment transferred from the local development corporation. It is likely that the role and authority of the associations will increase in the future.

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[43]Mike Moore, personal communication.

In Tacna, farmers pay a much smaller part of the operation and maintenance budget, but they have institutional authority similar to that of the associations in Tinajones. The associations own the building in which the irrigation authority is located, they pay salaries of some sectoristas (as in Tinajones) and are trying to participate in discussions about future system developments. Nonetheless, because the maintenance budget in Tacna has not been entirely cut, there is no discernible relationship between participation and control and cost recovery.

In the Dominican Republic, participation is mandated but the WUA program has just begun to be implemented. The program assumes that the WUAs will help improve cost recovery rates and reduce maintenance costs but the mechanisms for achieving these ends do not appear to have been thought out clearly except to include WUAs in budget and programming discussions. Indeed, discussions about WUAs heretofore have been coupled with discussions about imposing sanctions for non-payment of fees. Thus, if the effort succeeds, it will be difficult to separate the impact of the carrot (associations) from that of the stick (sanctions). Until now, the level of payment of water charges has been directly related to the level of institutionalized credit available, and by implication, the incidence of indirect collection procedures.

On the other hand, the evidence obtained from Morocco indicated that farmer participation is not necessary to ensure cost recovery. The most successful cost recovery rates in the present sample were obtained from the Doukkala I project where farmer participation, though considered desirable, was minimal in practice. Yet cost recovery was high. Undoubtedly, one of the contributing factors was the method of collecting irrigation charges which were deducted as one of the input costs in the total technological package made available to farmers. Payment by farmers for inputs are made at the time the government purchases their sugarbeet production--the main commercial crop grown in the project area. However, it is also noteworthy that the irrigation system is very efficient, well-managed, and reliable and farmer productivity and incomes have improved greatly--even more than was anticipated.

On the other hand, NIA, the Philippines irrigation administration, is putting great faith in the potential of increased farmer participation to improve cost recovery. By the NIA's own analysis, they conclude that local water user associations, given the right incentives and organizational assistance, will be able to recover all O and M costs for their local systems. However, the NIA officials are quite doubtful about recovery of full capital costs in this way. This is primarily because they consider it financially infeasible for farmers to pay water charges up to 6 percent of their total production which is their estimate of what would be required to obtain total capital cost recovery.

Evidence on high cost recovery rates in countries such as Taiwan and Korea where farmer associations are entirely responsible for irrigation system management have caused some observers to conclude that increased farmer participation and control help improve cost recovery. However, available studies have been unable to establish that farmer participation is the sole or even the primary factor responsible for successful cost recovery. Other factors such as high productivity or more reliable irrigation service may be just as important. The present team, similarly, found an association between increased farmer participation and higher cost recovery in parts of Peru and in the Philippines communal systems. But this was not uniformly so nor could it be conclusively established as, for example, the Doukkala I project in Morocco which had high cost recovery but limited farmer participation.

In sum, there is widespread hope that increased farmer participation and control can contribute to improved cost recovery, but documented experiences are too few to date to permit empirically-based generalizations. Moreover, O and M cost recovery must be distinguished from capital cost recovery, which may be less feasible. Efforts underway to increase farmer participation in most of the case study countries bear observing over time, especially regarding the role of irrigation officials in stimulating or limiting farmer participation, and their response to the emerging roles of farmers and water user groups.

3. <u>To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?</u>

The concepts of reliability and adequacy can be considered from a technological (design and structure), managerial (allocation and distribution) and institutional (types of charges) perspective in the way that they affect <u>farmer incentives</u> to pay. Reliability and adequacy of water supply are variables that have been identified in the literature as particularly significant. 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 predictable quantities of water at the expected times. Adequacy of water supply is defined by crop needs and this varies between crops and for the same crop at different stages of plant growth. When water is scarce, agronomists generally recommend concentrating water supplies so that a particular crop or area planted has adequate water rather than spreading the water thinly across all crops (or the entire planted area), thus depriving all crops of the water they require to mature.

The predictable amounts of delivered irrigation water may or may not be equal to the design quantities. The design amount may or may not be adequate for maintaining correct soil moisture. 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. Similarly, flood water that is

diverted to low lying areas creates unreliable conditions. 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. Lack of reliability of water delivery is a major operational problem with irrigation projects' success. 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.

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 much 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.

Regardless of water price levels, patterns of overuse at the head of canals can also become established during the early years of a new system, while the command area is gradually expanded and water supplies exceed demand. The farmers first served become accustomed to abundant water supplies, and they may not reduce their consumption to accommodate the needs of "latecomers." Officials can unwittingly perpetuate this inequity.[44]

Overuse at the heads of canals becomes most evident during times of scarcity, causing the water supply to be depleted before reaching tail end users, who come to expect shortages. Their response to the uncertainty is to act as risk minimizers even in times of abundant water supply.[45] In tubewell systems such as the World Bank Second VP Tubewell project, a reliable but expensive supply is provided. O and M costs are covered but two-thirds of total costs are not.

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[44]N.S. Peabody, III. Gadkhar Irrigation Scheme, (Kathmandu, Nepal: Rasuwa/Nuwakot Rural Development Project, 1983), pp. 8, 17-18.

[45]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).

Corruption is another factor that increases unreliability and uncertainty of water supply in many countries. This has already been discussed under Issue 1, but particular points made by Wade are relevant here.[46] 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 of part of their system of operation and to tamper with water rotations. All these factors heighten uncertainty. Thus, in some cases the issue of reliability includes the parallel illegal market in water. In the Team's short field visits it was hard to obtain insight into this problem. The impression gained, however, was that the problem is most obvious where irrigable land exceeds water availability by a large margin and where dry crops rather than paddy are grown. While not wishing to belittle the scale of the problem, it did not appear to be anywhere near as flagrant or gross in the water allocation phase in countries visited as in the cases cited by Wade. O and M contract irregularities were not explored, although unsolicited allegations were received by the team.

Unreliable water supplies also appear to be heightened by differences in the power of irrigators. Some water users are able to irrigate at will and as amply as desired despite the lack of water and subsequent uncertainty generated for others by such actions.

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.[47] Chaudhary recommends that planned increases in water rates should be related to reliability of water supply if they are to be successfully

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[46] R. Wade, (1981) "The system of administrative and political corruption: canal irrigation in South India." J. Dev Studies 18, (3) 287-328.

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

instituted.[48] 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 and it is profitable to use it. The same is true for river pumping in Ecuador and the Dominican Republic. Building an index of reliability would make a worthwhile research study.

For the most part, the systems observed in Peru had reliable water supplies (not always adequate, however). In Peru and the Dominican Republic, there is a clearer link between the reliability of water charge collection and cost recovery, than between the reliability of water supply and cost recovery. In only one instance in the Dominican Republic farmers said that they had not paid fees because their water supply was irregular.

In general, the tariff levels were too low and collection patterns too irregular to indicate a relationship between compliance (fee collection) and the adequacy of water. However, in the Dominican Republic fee compliance was very high for rice producers who received generally adequate supplies. Once tariffs increase, a clearer linking pattern may appear.

None of the systems we visited has measurement technology which is applied at the farm turnout level. In Tinajones (Peru) and Azua (DR), measurement is possible on the main laterals, but not below. However, in the PRYN project in the DR measurements can be taken for smaller blocks. Still, in no system is it possible to do more than estimate the amount of water which may reach a farmer, and even in those cases, there is no indication that measurement and cost recovery are related.

There is a technology gap in the accurate measurement of small amounts of dirty water under field conditions. Emerging microelectronic solutions may resolve these measurement problems.

Pending such improvements in water measurement technology at the tertiary level, it may be possible to wholesale larger quantities of water more effectively measurable at the primary and secondary levels. The advantages to water measurement above the turnout level include lower measurement costs and greater potential for maintaining measurement devices in good repair.

In addition, wholesaling water to groups of farmers could be made the basis of a beneficial relationship between farmer groups and irrigation officials based on mutual accountability. Such a system would provide both an incentive for increased farmer participation and a mechanism for improved cost recovery. In this regard, the record of charging for tubewell irrigation water in India, Pakistan and

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[48] 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.

Bangladesh is encouraging. Farmers are willing to buy tubewell water as it is available to them on demand. Based on the premise that farmers are willing to pay for water when it is provided on demand, irrigator groups holding wholesale rights to canal irrigation water similarly provide water on demand to member participants for a price. This would be an opportunity for irrigator groups to exercise responsible control over water delivery and the setting of rates at the farm level. It would also provide donors with the opportunity to fund an important experiment on farmer participation in improved cost recovery and water management. Such experiments are worthy of encouragement.

A reliable water supply may be a necessary condition for improved fee compliances but it is not sufficient. This was clearly the case in the Philippines where the water supply on the UPRIIS project is reliable yet fee compliance levels are relatively low. On the other hand, farmers interviewed at Laur attested that if they had a more reliable water supply by the construction of a concrete dam, they would achieve 100 percent cost recovery. Some credence can be given to this assertion based on the fact that local farmers contribute voluntary labor and make payments to their WUA despite the fact that their water supply is unreliable. Presumably, with improved incentives, they would pay more and an improved water supply would give them the means to contribute better. However, at present, this is merely conjectural since they do not have the permanent dam they would require for more reliable water supply.

On the other hand, it may not be necessary to have an adequate water supply for improved cost recovery. In fact, in areas where water is scarce, as for example, at Chichaoua in Morocco, farmers are willing to pay for their water. They trade their water rights because it is so vital for them to maintain their production. They are willing to regard water charges as an input cost and pay about the same price as paid on the Doukkala project, despite the fact that their supply is not entirely adequate (especially in the drier months). Also, the farmers are much poorer at Chichaoua. Yet, scarcity creates a value for water that they have been able to price.

Finally, while some type of measurement technology is necessary for imposing charges, the technology does not have to be sophisticated. Thus, for example, Doukkala achieves high rates of cost recovery despite the fact that the water meters are damaged and nonoperational. Therefore, charges are now based on size of crop area. Since water is provided on demand there is no incentive to take more than one's neighbor. At Chichaoua, where the technology is quite unsophisticated, the system of charges operates quite well through calibration of water flow by gates at the diversion sites and then by time allocation at the farm level. The rotations are timed by the water master.

Reliability of water supply has been associated with improved cost recovery because, through its impact on improved productivity, it affects both ability and willingness to pay water charges. Some observers have thereby concluded that increases in water rates are likely to be more successful when linked with improvements in water supply reliability. Yet this team found that despite reliable water deliveries on the UPRIIS project in the Philippines, cost recovery was low. Further, on two small systems near Tinajones in Peru, the issue of reliability could be entirely circumvented by charging advance payments for irregular supplies of water. In the light of this evidence, the team concluded that a reliable water supply may be a necessary condition for improved fee compliances but it is not sufficient.

Further, we obtained evidence at Chichaoua in Morocco that inadequate water supplies may actually improve cost recovery as farmers are more willing to pay for water as scarcity increases. Finally, it was concluded that sophisticated measurement technology was not essential for improved cost recovery unless water rates are levied on an actual volumetric basis.

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water?

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.[49] 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."[50] 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.

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

[50] Hotes, The Experience of the World Bank. Op cit.

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 than was being used for O and M.[51] 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.

In Peru, government maintenance budgets have been cut or eliminated altogether, depending on the system, and systems are supposed to be maintained by local funds. This arrangement has been questioned by at least one international donor agency, presumably because it precludes using donor funds for this purpose. Nonetheless, the team believes that this strategy is correct, although it needs to be supported by a significant effort to involve water users more directly in the operation of individual systems, as is happening in Tinajones. Farmers themselves set the tariffs and quotas; officials can recommend fee levels but they cannot impose them. Thus, before water charges can be increased, as required, to cover maintenance costs, the authorities must convince farmers of the necessity of such an increase, as well as its possible beneficial impact. Even in Tinajones, this is expected to be difficult.

The situation in the Dominican Republic resembles Peru to the extent that individual systems and districts are expected to become self-sufficient. INDRHI officials have set the tariffs. Farmers have no say in the matter, although there are plans to allow farmers to participate in the formulation of annual maintenance plans, presumably through the WUAs. In the meantime, although the role is more

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[51] 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.

theoretical than real, there is not much problem yet because INDRHI local technicians concentrate on obtaining as much central budget O and M as possible for their individual districts and work on the most critical maintenance problems first.

Increased water charges can lead to improved O and M if funds are used within the system in which they are collected. Other things being equal, increased budgets are likely to result in improvements in O and M although the benefits may be unevenly distributed. The distributional equity and efficiency of O and M can be enhanced through increased charges if farmers are involved more actively in the operation of the system itself, in determining maintenance priorities, in identifying needed structural changes and in setting rotation and rationing programs. This is easier to say than to do because effective participation requires adequate preparation and understanding of technical and organizational questions, which means that both officials and water users have to do their homework.

Tinajones exemplifies many of the areas in which water users can and should participate in system operation but it also illustrates some of the limitations of this approach. For example, water allocation in Tinajones is based on the Plan de Cultivo y Riego which attempts to reconcile farmers' cropping preferences with projected water availability. For many reasons, farmers want to grow rice even though the total water supply is far short of the amount required and less than projected at the time the Plan was adopted. Nonetheless, farmers used political influence to get authorities to approve rice allotments far in excess of likely water supply and now farmers and officials alike are in a bind.

This situation illustrates three points. First, farmers do not believe official water estimates enough to curb their most blatant manifestations of raw self-interest. That is, officials are not felt to be technically credible. Second, farmers do not really understand the technical limitations of the system and thus are not prepared to make responsible decisions. Also, the farmers believe that the government is supposed to supply water and should make more available if there is not enough. In other words, the officials have not successfully performed their educational function. Finally, it shows how vulnerable such an arrangement is to political manipulation. Again, poor information and limited credibility contribute to this vulnerability.

On the other hand, the Yaque del Norte system in the Dominican Republic illustrates the possible utility or irrelevance of WUAs depending on the premises upon which they are formed. The INDRHI official who formed the groups on the old canal segment fostered an attitude of collaboration and cooperation by establishing a clear problem-identification role for the groups. He then attempted to resolve these problems through the cooperation effort of the group. In contrast, the official who formed groups along the newer canals established a more authoritarian framework in which group leaders

understood their role to be that of enforcing INDRHI allocations and equity directives. In the first case farmers have started to take an active part in maintenance, supplementing INDRHI's traditional role and even substituting for it. In the other, group leaders have assumed a more passive, regulatory function, which has had very limited impact so far, but the groups are very new. Equity may be much more important than other issues in that O and M is not a problem on the newer segements. At present, the new design reduces allocations to some farmers who had large water supplies before in order to ensure that tail enders get the water they need, too.

In Nepal, the availability of additional resources is likely to decrease O and M efficiency, particularly if officials control the funds. In this case, engineers are likely to prefer to use such funds to let out maintenance contracts, rather than to utilize force account or mobilize voluntary labor inputs for maintenance, either of which might be more cost effective.

It is plausible to expect that as water prices increase it becomes more rational for farmers 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. Such designs are difficult in the first instance because little is known about the relationship between water prices and physical efficiency per se. Moreover, as Neghassi and Seagraves suggest, it is the value of water rather than its cost that determines efficiency in use. Very little information exists on the value of water in different locations at different times of the year. Since the value of water is often low there is little economic incentive to improve physical efficiency.[52] 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.

In general, increasing the cost of an unreliable water supply is unlikely to increase efficiency of use. However, 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 water has high value. If water has high value and its supply is not ample with respect to the need for it, 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, generally due to circumstances beyond their control. (However, it also can reflect lack of leveling, water arriving too fast to handle, or lack of methods to lead the water where it is needed.)

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[52]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.

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 (say one in five dry years for each ten-day calculation period) 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.

Field work provided no data to support a conclusion regarding the relationship between water price and utilization efficiency in canal irrigation systems. In none of the systems are water charges related to water use in such a way as to encourage farmers to use less water than they have available. There are any number of instances in which application efficiency is affected by water scarcity, but not by charges. Nonetheless, many observers still adhere to the notion of "get the prices right".

Where water use is measured, and costs directly related, there may be some relationship between cost and efficiency. For example, in the Sri Lanka Lift Irrigation Projects (IBRD) when farmers were compelled to pay for the fuel they consumed, efficiency increased, delivery regularity improved and conflicts decreased. That is, when farmers were able to achieve some control over the systems, they did so to their individual and collective advantage.

In sum, increased water charges may improve O and M, but not necessarily. Any number of design, construction or management problems may lead to poor O and M, in addition to budgetary limitations. These problems will not automatically disappear simply by increasing water charges, particularly if the increased revenue is not invested in the system. Nonetheless, increased water charges, coupled with greater decentralization of authority, may lead to O and M improvements, especially where budgets have been cut or reduced. Water use efficiency is related to the <u>value</u> of water, not necessarily to its cost. It is unlikely that application efficiency will increase if water charges are increased unless water is measured and charged accordingly, a rare occurrence in gravity irrigation schemes.

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

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."[53] They argue, in addition, that appropriate incentives will be required to promote 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 non-economic resources (e.g., voluntary labor) that can be applied to improved O and M, improved adjudication of water rights and conflicts, more satisfactory water allocation and so on. At the very least, farmer participation is necessary to ensure bureaucratic accountability.[54] While it is generally accepted that increased farmer responsibility in local irrigation 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 participation 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.[55] 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).[56] It also contrasts sharply with the efficiency rates of

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

[54]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.

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

[56]G. 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.

25 percent in the Philippines and 40 percent in Malaysia.[57] He attributes this success to the human factor, namely, "A very high degree of farmer cooperation, reflected in the joint hiring of common irrigators to whom complete responsibility for water management is delegated...."[58] 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 committees.[59] 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 15 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.[60] Veeman also suggests that the lack of institutions for regulating water rights is frequently responsible for the unreliability of water supply.[61] It is possible that farmer participation and reliability of water supply are mutually reinforcing factors that together contribute

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[57]Ibid, pp. 53-54.

[58]Levine, pp. 55-56.

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

[60]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.

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



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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.

The record of communal systems is obvious: participation and O and M levels are essentially isomorphic. The record is not so clear in systems which are constructed or managed by irrigation authorities, primarily because participation is rarely encouraged. Our cases offer evidence to support a relationship between participation and control and improved O and M, although conclusions must be based on projection, rather than accumulated experience.

In Peru, WUAs in the areas of Tinajones and Tacna are assuming increased responsibilities for decisions affecting the maintenance, operation and expansion of the system. The institutionalization process is still in its initial stages, but there is ample reason to be optimistic about the future. In any case, the financial situation of the government is such that there is no alternative; if users do not participate in critical decisions, and thereby mobilize maintenance funds locally, there will be no funds at all.

In Plan MERIS II, one sees the consequences of officials attempting to impose irrigation development without encouraging participation. In some instances, they have had to re-design systems to overcome faults which farmers quickly identified; in other instances, farmers still refuse to utilize the systems. Apparently the approach will be modified in future systems, based on lessons learned to date, which have convinced officials of the need to involve farmers in early stages of planning and implementation, instead of waiting until after everything is complete.

The Dominican Republic has not encouraged user participation until recently, but the example of the old canal in Yaque del Norte supports the proposition. Given a proper orientation and minimal institutional encouragement and support, farmers started to take an active hand in maintenance.

Participation may be informal or formal. Both the DR and Peru have established formal mechanisms. In general, the degree of formalization required for effective participation can be expected to be related to the size and complexity of the irrigation system, the magnitude of financial input necessary to carry out O and M (vs. in-kind, labor inputs) and the size and degree of centralization of the irrigation authority.



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There is growing evidence that farmer participation in irrigation management can improve O and M. Farmer input can improve design errors, reduce O and M costs, reduce operational bottlenecks, increase system-generated revenues and ensure bureaucratic accountability. Participation can be manifest in different degrees, within more or less formal institutions, but it does not occur in a vacuum. Changes in farmer participation need to be accompanied by changes in the attitudes and behavior of officials.

## V. CONCLUSIONS AND RECOMMENDATIONS

### A. Overall Conclusions

Irrigation is increasingly important in developing countries for agricultural production as well as employment. It is becoming central to the overall economies of countries, because of both direct and indirect benefits.

However, there is universal agreement that irrigation is sub-standard; potential benefits are not being realized. One primary reason for the shortcoming is poor O and M. Systems either never function as intended or their effectiveness declines because they are not maintained properly. Frequently, tertiary and field channels are not included in the system design, systems are not completed as designed or the designs themselves are faulty. In many systems, efficient and equitable distribution schedules are never established.

A common factor leading to poor O and M is shortage of funds. Governments are increasingly experiencing severe macroeconomic problems: global recession, global inflation, the erosion of tax bases and over-stretched public sectors. Many of these problems result from a laudable attempt to improve the lot of the poor without having the means to do it.

Irrigation has felt the brunt of these problems alongside other public sector areas, but the impact has not been uniform. To some degree the sector has been protected because of its cost structure, which includes a high salary element, but non-salary elements have been badly hit by overall governmental cutbacks. While staff have been maintained, they work without fuel for transport, or with inadequate transport, or without operating budgets for maintenance work. In effect, the real impact of the government cutbacks has been much greater than apparent.

In many countries, this had led irrigation authorities to focus on increasing returns from beneficiaries. Water fees are complex, involving economic, social and political considerations, as well as financial. Currently, financial considerations are receiving great attention, but other aspects must also be considered, as any policies inevitably require trade-offs between various considerations. Overall, a new perception of priorities is developing, in which financial considerations are given precedence in establishing and collecting water fees because there are virtually no other sources of revenue available for O and M. This has led to attempts to get funds from even the poorest members of communities. Increasingly, fees are being transformed from facility taxes to user charges for service. In consequence, everyone is called upon to pay.



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Provided an irrigation system is minimally reliable, everyone who receives direct benefits should be able to afford to pay water user fees adequate to cover minimal O and M costs. The water charges themselves may be relatively low, about 5 percent of gross output, or 10 percent of the incremental output.

In some situations, even these fees will be difficult to impose. To do so will require the administrative and political will to transform irrigation from a public service to a public utility. This may require overthrowing decades of tradition in which the irrigation service supplied free water. Moreover, if minimal water service fees are levied, there may be no guarantee that there will be concomitant improvements in O and M.

There is a need to assess (a) what level user fees are required for O and M to keep the systems working properly; and (b) ways to make sure that the funds generated get into the proper hands. Many countries have established traditions of levying uniform water prices, which are allocated uniformly. Water fees are set nationally and the revenue is deposited directly into the central treasury, from which O and M budgets are allocated separately. However, if increased fees are to be emphasized, such centralized collection and allocation systems may have to be changed to keep revenue in the hands of local development corporations, or local or regional entities, rather than transfer the funds to central treasuries. Indeed, one might expect fees to be collected and retained in the same system.

It may be easier to change water fee practices to increase O and M revenues if the changes are tied to rehabilitation efforts which make more water available, upgrade system elements, and so on. However, some countries cannot wait for such opportunities; they need additional funds just to keep systems operating.

The stress on financial priorities in setting water fees does not necessarily require as many tradeoffs on social, economic and political grounds as apparent. If one argues that water fees should be based on economic prices, the result would be about equal to the marginal cost of O and M. On political grounds, if a system is improved (water supply and O and M) and the result approaches the equity and reliability parameters of the system design, increased fees should be acceptable.

However, if a government is corrupt, it may be complicated to tie rehabilitation to fee increases because officials benefit from poor water supply, and farmers often already pay much more for the water than the official charges. Where this is the case, official increases in water fees would reduce the scope of taxing farmers' profits. When water fees are low, a poor water supply encourages corruption. The opportunity cost of water when it is in short supply leads to irregular payments to officials to guarantee deliveries. That is, the greater the discrepancy between the official cost of water and the value of

water, the greater the margin for corrupt charges. Increasing official water rates would not necessarily eliminate the gap between the water charge and the value of water, but it would reduce it.

It is often said that increased water charges should lead to reduced water use, that is, to greater application efficiency. However, there is no evidence that increasing water charges directly affects application efficiency. Other factors such as the price of inputs, the reliability of supply, the nature of water rights, scarcity, and the pricing method employed may have more impact on application efficiency. Higher water charges may be necessary to reduce water use, but they are not sufficient. This notion needs to be dispelled.

One factor to consider in assessing the proper level of water charges is the notion that ability to pay is based on average conditions. However, within irrigation systems, there are usually great variations between farmers and between years in the distribution of benefits. Benefits often are skewed, thus any assessment must be sensitive to differences in access to benefits, particularly to the existence of poverty, even within an ostensibly prosperous setting. Traditionally, when officials imposed water charges, they responded to the poverty issue by not collecting charges from individuals deemed to be poor, or by avoiding collection altogether during bad years. Over time, the proportion of people exempted has increased, as has the frequency of declaring annual moratoria.

Given the difficulty of mobilizing central funds for O and M, these attitudes and practices need to be changed. The current pressing question is how to get small amounts of money from poor people.

New measures will have to be adopted to ensure collection, rather than avoid it, as happens in many countries. These measures should be part of a program which addresses three issues at the same time: higher fees, more consistent collection, and more dependable and equitable water delivery. One can argue that such policy changes will be beneficial even to poor people if they mean that their water supplies will be forthcoming. At the least, such measures will keep their systems from falling apart.

One way for irrigation authorities to handle the financial crisis is to hand O and M responsibilities over to farmers and water user groups. In many developing countries, especially in Asia and Latin America, farmers are better educated and have more experience in irrigated agriculture than their predecessors. In the Philippines, which is a pioneer in transferring O and M responsibility to farmer groups, engineers are finding that farmers can handle tasks which they would not have undertaken ten years ago. Farmers assume responsibility not only for field channels, but also for main canals, flood gates, and other structures which engineers previously jealously guarded. In Peru, farmers in one large system have formed a non-profit company to handle all system maintenance, and the arrangement may be duplicated in



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other systems. This change in orientation is not only an admission of the obvious, making a virtue of necessity, but also a recognition of real changes underway from below, as well as from above. From the top, administrative and financial responsibilities are being devolved; concurrently, from below is a growing trend of privatization. In the Philippines, at least, the processes are being held up because no mechanism is available which can be used to dismiss civil servants who become redundant. Low level employees of irrigation administrations stand in the way of attempts to transfer O and M authority and responsibility to farmers individually and, through contracts, to water user groups. USAID may be able to help find solutions for this problem.

B. Study Issues: Conclusions and Recommendations

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

a. Conclusions

- It is essential to devise politically-supported policies that will raise revenue at least to the level of full O and M costs;

- Cost recovery through direct charges to farmers, particularly for O and M, feasible;

- It is not essential for fees to be monetized. In fact, there may be advantages to fees collected in-kind, particularly in the largely subsistence agricultural sector of many developing countries. In addition, there is an element of automatic indexation inherent in in-kind payments;

- The feasibility of increased cost recovery through direct charges in each specific case is dependent upon decision makers understanding, in-depth, the complex financial problems they face and acting firmly upon the basis of this understanding to develop and implement appropriate policies and regulations. These decision makers would include farmers as well as irrigation system and other government officials. One example of devising an appropriate policy is to make provisions for gradually phasing in a full fee over a period of years, particularly on new schemes which take several years to achieve full operational capacity;

- Indirect charges can be used to pay for irrigation, as well, but they are a second best alternative to direct charges, as they do not inform farmers about the system or put them in a responsible position vis-a-vis its operation;

- It is useful, however, to distinguish the method of assessing water charges (indirect or direct) from the actual vehicle for collecting the water charges. In Morocco and the Dominican Republic, collection rates are high when water charges are paid, as part of a production credit package. Such indirect collection procedures are more efficient and simpler than direct collections, as well as less obtrusive, thus they are attractive; and

- Highly subsidized water supplies are an inequitable and inefficient means for supporting farm income levels. Irrigation farmers, though often poor, are seldom ultra-poor and often they have a relatively satisfactory and secure income compared to non-irrigation farmers.

b. Recommendations

- Increases in direct or indirect charges to farmers should be an accepted policy goal. However, all charging schemes should be subject to provisions which are sensitive to variations between years, which allow for adjustments for real hardship situations, and which establish dependable water distribution patterns to guarantee equitable access to system benefits. In itself, the existence of poverty cannot be regarded as a reason for levying low or zero costs for irrigation service, as even poor farmers are direct beneficiaries of such public investment. Although farmers in a system may be poor, they are usually better off than their compatriots who do not benefit from irrigation service. Nonetheless, inequitable access to water within a system can perpetuate poverty, thus such inequities must be overcome before the disadvantaged can be expected to contribute significantly to meeting O and M costs;

- Direct charges should be favored because they inform farmers about their systems and tend to give them more responsibility in the operation of their systems;

- Wherever possible, programs should be established to collect water charges indirectly, as part of the input credit repayment process, such as occurs in Morocco and the Dominican Republic. This method is simpler and more efficient than direct collection by irrigation or internal revenue authorities. However, such indirect payment procedures must provide mechanisms for farmers to withhold payments if water deliveries are irregular or inadequate;

- Research has shown that intra-household income distribution is complex and often unequal in many developing countries. The incidence of incomes within the household must be understood and taken into account in devising schemes for increasing water service charges; and

- If indirect charges are used, it is necessary to ensure that sufficient resources are transferred to the irrigation systems to make it possible to maintain proper service.

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

a. Conclusions

- Increased farmer participation and control do seem to contribute to improved cost recovery. However, this answer is more of an affirmation of faith than a proven conclusion. Our field visits generally supported the proposition, although not always in the manner in which it is phrased. In the Philippines, the available data indicate that systems in which farmers have been organized have higher rates of payment of water charges than other systems. In Peru, there are clear indications that water users are beginning to fill the vacuum created by the withdrawal of public funds for O and M. Other examples show that farmer participation is increasing, by design or default, and the net impact is positive; and

- Increased participation may help cost recovery directly, if a higher proportion of farmers accept more responsibility, thereby paying user charges or accepting increases in user charges so as to improve the financial status of systems. On the other hand, participation can help cost recovery indirectly, if farmers themselves assume responsibility for work, thereby reducing government financial liability for O and M and reducing public costs.

b. Recommendations

- Much needs to be learned about ways to stimulate participation, ways to organize, and so on, with minimal financial and manpower inputs. Thus, action research on methods of transfer responsibilities to farmers for support services from which they benefit should be undertaken. For such policies to work, farmer benefits will need to be increased. Such research should be conducted with an awareness of the inconsistency between many initiatives sponsored by donors, which tend to expand government commitments, and current policies in many governments, which seek to limit field obligations. In irrigation, this inconsistency is seen when donors advocate projects such as command area development projects, which call for increased field staffing, expanded extension services, and the extension of delivery costs down to the outlet group, while governments are increasingly compelled to withdraw staff and funds from the field; and



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- As suggested above, action research should be formulated to be consistent with government policies and financial practicalities, so that proposals which emerge will not contain unrealistic demands to increase government obligations.

- Pilot programs designed to implement the findings of such research should receive donor financial support.

3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?

a. Conclusions

- The weight of informed opinion suggests that unless a water supply is reliable, unless farmers can gamble reasonably on receiving water as expected, cost recovery is unlikely to improve. (This is true in part because seldom is financial performance satisfactory when the main system supply is unreliable.) However, it is hard to prove systematically that improved cost recovery depends on a reliable water supply;

- Consequently, although reliability is a necessary condition for sustained cost recovery, cost recovery also may need to be improved to generate funds for investment to ensure reliable supply. It is generally possible to develop short-run cost recovery improvement by intensifying cost recovery efforts; the funds from such efforts can then be used to increase the reliability of supply for the longer term. Another strategy to bypass such circularity is to rehabilitate a system before initiating a concerted cost recovery program;

- It is hard to contend that there must be an adequate water supply before cost recovery can be improved, because it is difficult to establish what constitutes an adequate supply. The water supply in most systems is inadequate in some areas and under some circumstances. Farmers rarely consider their supply to be adequate, and few systems seem to be able to guarantee unlimited water at all times. Indeed, one might expect cost recovery (official and unofficial) to be inversely related to the adequacy of water supply if delivery is reliable; and

- On-farm water measurement is unsatisfactory almost everywhere, and the deficiency may be intractable. Consequently, "measurements" inevitably must be estimates. Even under the best of circumstances, there is rarely a close link between the amount of water which arrives at the farm

gate and the amount of water for which the farmer is charged. Such measurement, however, is not necessary for improved cost recovery.

b. Recommendations

- Reliability and adequacy of water supplies, although not demonstrably essential to improved cost recovery, should be an important part of efforts to increase direct or indirect charges because, at a minimum, they provide long-run insurance that improved cost recovery can be maintained. Direct charges should be used when possible because they are the most appropriate means for linking improved cost recovery with reliability and adequacy of water supplies. They (1) enable farmers to assess their water charges in light of the strengths and weaknesses of their irrigation system and (2) open more avenues for farmers to participate in system decisions and to take responsibility for and contribute to the O and M of their system; and

- Pending improvements in water measurement technology at the tertiary level, it may be possible to experiment with wholesaling larger quantities of water as these can be more easily and effectively measured at the primary and secondary levels. The water could be wholesaled to groups of farmers (rather than the individual farmer) and this could be made a basis for improved interaction between irrigation authorities and farmers based on mutual accountability. Such an experiment has potential for improving cost recovery and is deserving of donor assistance.

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water?

a. Conclusions

- Increased water charges appear to be necessary for improved O and M in most places, but they may not be sufficient. However, it is difficult to substantiate this contention because there are few examples in which charges have been increased. In most cases, real water charges have decreased due to inflation and other factors, and collections have declined, while O and M costs have gone up. Thus, conditions are inappropriate to test the hypothesis;

- Experience does suggest, however, that efforts to raise water charges may be more successful if they are combined with other initiatives, such as investing to assure reliability and earmarking to keep proceeds within the system in which they are collected; and



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- There is little evidence to suggest a direct relationship between the cost of water and application efficiency. Gravity systems rarely present the conditions of delivery measurement, volumetric pricing, demand delivery, and precise control which would permit a proper test of the hypothesis. In the absence of systematic data, experience suggests that application efficiency is related to the value of water, not its cost, and that both efficiency and water value vary over the years and between years. For example, the relationship between water value and application efficiency has been demonstrated in tubewell systems. The cost of water from tubewells is higher than that from gravity systems, but control is also greater, thus tubewell water is generally used for high value crops, and very sparingly.

b. Recommendations

- Water charges should be used as an integral part of efforts to improve O and M. They are, however, only part of the solution and must be integrated into other aspects of O and M improvement; and

- Water charges should vary more between and within developing countries. There are two guiding principles for developing such charges. First, there should be separate budgets for each irrigation scheme. Second, revenues collected from each scheme should be retained for use by that scheme. The budget and scheme charging would develop sharper awareness of cost effectiveness and efficiency by indicating the cost of new, technically difficult and ambitious improvements (or schemes). For example, the high costs of specific improvements such as pumped drainages would become apparent quickly. Retaining revenue effectively shifts irrigation departments from being only public service entities to being public utilities; and

- Efficiency of water delivery and use, cost of water and value of water should be studied more intensively to determine the relationship between cost of water and efficiency of water use for specific crop regions and environments. Attempts to make water cost a proxy for water value should be made for specific irrigation projects. This will provide financial resources needed to improve O and M and may increase application efficiency if the cost can be made to accurately reflect the value of water to the individual farmer.

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

e. Conclusions

- Institutionalized farmer participation probably leads to improved O and M. For example, tubewell systems which have high levels of participation tend to have good O and M, and private tubewells have even better O and M than public ones. However, it is unclear whether this generalization can be applied to canal irrigation systems or, if so, how far up the canal it could be expected to apply. Participation can be elusive and control even more so. Even in small (500 acre) public irrigation schemes it is often difficult to get widespread collective participation because head farmers, without any effort, enjoy advantages which tailenders get only after they have cleaned all the water courses. The problem is compounded in large, complex systems. Such intrinsic inequities are hard to overcome institutionally once they are established, particularly if an irrigation system is implemented by an external authority, rather than by the farmers themselves.

- Moreover, there are few instances in which irrigation officials have transferred O and M responsibility or authority to farmers. Generally, officials either develop new irrigation systems for farmers who are unorganized, or they upgrade traditional systems and usurp control from farmers in the process. In either case, officials tend to retain control over "their" systems. They rarely encourage farmers to participate actively in O and M, and even more rarely do they relinquish control over significant aspects of the system. Consequently, farmer groups lack both institutional support and organizational rationale.

  The Philippines has embarked on perhaps the most extensive official effort to organize irrigation water users and to devolve O and M responsibility and authority to user groups. Early experiences show that O and M has improved in the systems which have been organized. However, initial results may be deceptive. As with other pilot efforts, the first experiences in the Philippines may benefit from exceptional leadership, they may include easy areas, and their success may be influenced by the barrage of publicity they have received, all of which can distort the applicability of the results obtained. Time will tell if early results will be sustained, if initial resource levels will be maintained and if similar successes will be achieved elsewhere, as the effort extends beyond the first locations.

As another example in Peru, farmers are paying a greater share of maintenance costs and, in some instances, assuming management responsibility as well. However, it remains to be seen whether maintenance levels will deteriorate, remain the same, or improve. Thus, in general, since the transfer of O and M responsibility is not yet widespread, any positive results must be regarded as promising but not yet generalizeable.

b. Recommendations

- By design or default, farmers are being called upon to assume new roles in O and M. At the very least, farmers are expected to bear a greater share of the cost of running irrigation systems. This development is desirable, as well as necessary, and should be an important part of all irrigation system policy and management. This can be expected to contribute positively to several aspects of irrigation system improvement, even though it is still too early to know whether this will significantly improve O and M;

- Efforts should be made to ensure women's participation in irrigator groups to an extent at least equal to their contributions to farmer production; and

- Specific institutional arrangements adapted to each socio/cultural environment and irrigation system should be identified and experimented with to provide additional foundation insights to increase farmer participation in irrigation projects. Donors should support these experiments financially, being careful to avoid programs which involve high financial commitments which cannot be adopted more broadly.

C. Related Conclusions and Recommendations

1. Indexation is needed

a. Conclusion

To avoid erosion of cost recovery by inflation an indexation mechanism may be needed. This is less important in the case of in-kind payments than for cash payments.

b. Recommendation

Where fees cannot be set readily each year to provide for projected O and M requirements, an indexing mechanism should be developed to adjust direct water charges to a level that realizes needed cost recovery levels.

2. Everyone should pay

a. Conclusion

Means need to be found to require poor farmers to pay for irrigation just as they do for other inputs.

b. Recommendation

More experimentation is needed to discover better ways of realizing needed irrigation fee collections. Better results may be obtained if there is (a) local retention of fees at the regional or project levels, (b) earmarking, and (c) improved accountability.

3. Incentives to improve water charge collections are appropriate

a. Conclusion

Several different incentive systems seem to work well in improving water charge collections (e.g., Philippines) and such incentives/rewards should be encouraged.

b. Recommendation

Better record keeping of landownership, who is paying, etc., should be instituted to help in devising appropriate incentive systems.

4. Water charge levels depend upon the specific system involved

a. Conclusion

As an illustrative target, irrigation departments should get 5 percent of the gross value of agricultural product for O and M. Evidence from India on collections shows achieved ranges of 7-8 percent. However, the correct amount will vary a great deal depending on the O and M requirements of the system involved. The nature of payment--cash, in kind--is not as important as the relative value of the payment.

b. Recommendation

Annual water charge fees should be set according to projected O and M needs and historical farmer compliance rates. Special efforts should be made to ensure 100 percent compliance, preferably by collecting fees through input credit repayment mechanisms.

5. Higher water charges should result in system improvements

a. Conclusion

Increases in rates charged for water are easier to make if some investment in the irrigation system or related systems is made (e.g., additions to the system, rehabilitation, etc.). There should be different rates for different schemes and these should be tied to the quality of service rendered.

b. Recommendation

Fees should not be set at a national level; instead, they should be differential, appropriate to the situation. Collection should be as cheap as possible, whether direct or indirect means are used. Increases in water charges should be linked to visible physical improvements in the existing system.

6. Previously sustained drainage damage may require indirect collection of water charges

a. Conclusion

Drainage damage has often been caused in previous generations so it is difficult to get the current generation to pay for correcting it.

b. Recommendation

Indirect charges should be utilized to correct drainage problems stemming from prior users. These charges should include levies against consumers and others benefitting from the irrigation system as well as farmers. They also should be levied against any source of the problem that is external to the specific costs and benefits of the specific irrigation system.

7. Betterment levies are appropriate in some cases

a. Conclusion

Betterment levies should be reconsidered. Arguments against such levies are only applicable in the early stages of new projects. On rehabilitated systems, the issue may be qualitatively different.

b. Recommendation

Betterment values resulting from irrigation development or rehabilitation should be recovered by direct charges whenever possible, set at a level to recover the capital used in project development or improvement. Indirect recovery methods should complement these direct betterment levies.



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8. Appropriate user group and government complementary organization and activities are a fruitful area for further research

a. Conclusion

Appropriate organization and activities for communities of water users and for governments that are mutually supportive and sufficient to improve irrigation system management need to be further identified and analyzed.

b. Recommendation

Pilot research should be continued to identify and analyze appropriate complementary organization and activities for water user groups and governments; special attention should be given to various means of mobilizing user group resources and keeping the costs of organizing groups to an absolute minimum.

9. Distribution of work, income and other costs and benefits resulting from irrigation development or improvement often are not equal among family members

a. Conclusion

Nuclear family decision making, whether male or female, often results in unequal costs and benefits from irrigation systems for different family members.

b. Recommendation

To the extent this uneven distribution of benefits and burdens disadvantages specific groups (such as women), it should be taken into account in the design of a project or rehabilitation effort. Further study also should be undertaken in this general area to identify further specific and general areas of concern.

ANNEX 8

Characteristics of the Irrigation Projects Visited

Table 8-1: Classification of Irrigation Project Sites in Five Countries

| Project | Size | | Irrigation Type and Design | | Types of Charges | | Cost Recovery | | Organization for O and M[a] | | Effectiveness of O and M | | Modern Measurement Technology | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Large >10,000 ha | Small <10,000 ha | High Tech.[c] | Low Tech. | Direct | Indirect | High | Low | User Mgmt.[d] | Admin.[b] Mgmt. | Good | Poor | Yes | No |
| **A. MOROCCO** | | | | | | | | | | | | | | |
| 1. Chichaoua | | X | | X | X | | | | X | | | X | | X |
| 2. Doukkala I | X | | X | | X | X | X | | X | X | X | | X | |
| **B. INDONESIA** | | | | | | | | | | | | | | |
| 1. Kali Progo Project | X | | X | | X | X | Variable | | X | X | | | X | |
| 2. Western Sumatra Sederhana Projects | | X | | X | X | X | Variable | | X | X | Variable | | | |
| **C. PHILIPPINES** | | | | | | | | | | | | | | |
| 1. Upper Pampanga Project | X | | X | | X | | | X | X | X | | X | | X |
| 2. Laur: Communal Irrigation System | | X | | X | X | | | X | X | | | X | | |
| **D. PERU** | | | | | | | | | | | | | | |
| 1. Cajamarca (Sierra) | | X | | X | X | | Not Known | | | | | X | | |
| 2. Chiclayo/Tinajones (Coastal | X | | X | | X | | Not Known | | X | X | Not Known | | X | |
| 3. CARE Projects (Sierra) | | X | | X | X | X | X | | X | | X | | | |

Table 8-1: Classification of Irrigation Project Sites in Five Countries (continued)

| Project | Size | | Irrigation Type and Design | | Types of Charges | | Cost Recovery | | Organization for O and M[a] | | Effectiveness of O and M | | Modern Measurement Technology | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Large >10,000 ha | Small <10,000 ha | High Tech.[c] | Low Tech. | Direct | Indirect | High | Low | User Mgmt.[d] | Admin.[b] Mgmt. | Good | Poor | Yes | No |
| E. DOMINICAN REPUBLIC | | | | | | | | | | | | | | |
| 1. San Juan Valley (Sabaneta Dam) | | X | | X | X | X | | X | | X | | X | | X |
| 2. Azua | | X | Not Known | | X | | | X | | X | | X | Not Known | |

[a]O and M = Operations and Maintenance.
[b]Admin. = Administration.
[c]Tech. = Technology.
[d]Mgmt. = Management.

Table 8-2: Descriptions of Irrigation Project Site Classifications in Five Countries

| Project | Irrigation Type and Design | Types of Charges | Cost Recovery | Organization for O and M[a] | Effectiveness of O and M |
|---|---|---|---|---|---|
| A. MOROCCO | | | | | |
| 1. Chichaoua | **Low-Tech.**[b]: a. Spring fed b. Gravity. | **Direct:** WUA's[c] service for O and M. **Indirect:** a. Incremental income tax. b. WUA investment charge. | Not Known | **User Mgmt.**[d]: 1. Nonformal traditional. 2. WUAs planned. | Poor: At times of water scarcity. |
| 2. Doukkala I | **High-Tech.**: a. Reservoir b. Gravity c. Sprinklers. | **Direct:** a. Volumetric charge. b. Supplementary charge for pumping. **Indirect:** Land betterment levy. | **High:** a. 89% (O and M)[e] b. 14%[f] (IC)[g] | **Farmer Mgmt.**: WUAs planned (formal). | **User Mgmt.**: Undeveloped. **Admin. Mgmt.**: Poor planning for O and M. |
| B. INDONESIA | | | | | |
| 1. Kali Progo Project | **High-Tech.**: Reservoir fed. | **Indirect:** Official land tax: 5% of net value of production. | Not Known | Not Known | Not Known |
| 2. Western Sumatra Sederhana Project | **Low-Tech.**: a. Diversion weir, canals, gravity fed. | **Indirect:** Official land tax: 5% of net value of production. | Not Known | **Farmer Mgmt.**: Non-formal traditional associations. | Not Known |

Table 8-2: Descriptions of Irrigation Project Site Classifications in Five Countries (continued)

| Project | Irrigation Type and Design | Types of Charges | Cost Recovery | Organization for O and M[a] | Effectiveness of O and M |
|---|---|---|---|---|---|
| C. PHILIPPINES | | | | | |
| 1. Upper Pampanga Project | **High-Tech.:** Dam and reservoir. | **Direct:** Water charges P152/ha[e]. | **Low:** | | |
| 2. Communal System | **Low-Tech.:** Pumps. | | **Low:** 42%[h]. | **User Mgmt.:** Formal WUA's. | |
| D. PERU | | | | | |
| 1. Cajamarca (PLAN MERIS) (Indigenous) | **High Tech.:** a. Diversions-gravity flow b. Lined canals. | **Direct:** Quotas. **Indirect:** Labor. | Not Known | **User Mgmt.:** | **Poor:** a. Poorer farmers get less water. b. Water over used. (Abundant water) |
| 2. Chiclayo/ Tinajaones | **High Tech.:** a. Reservoir b. Canals - regulated. | **Direct:** Quotas | Not Known | **User Mgmt:** Juntas **Admin. Mgmt.:** | Not Known (Scarce water) |
| 3. CARE Project (to be selected) | **Low Tech.:** a. Spring b. Diversion weirs c. Individual village projects | **Direct:** Quotas for O and M costs. **Indirect:** Labor (Voluntary) | **High:** | **User Mgmt.:** a. Traditional b. Formal | **Good:** Complete farmer maintenance. |



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Table 8-2: Descriptions of Irrigation Project Site Classifications in Five Countries (continued)

| Project | Irrigation Type and Design | Types of Charges | Cost Recovery | Organization for O and M[a] | Effectiveness of O and M |
|---|---|---|---|---|---|
| E. DOMINICAN REPUBLIC | | | | | |
| 1. San Juan Valley (Sabaneta Dam) | Low Tech.[b]: a. Diversion dam b. Earth canals and ditches. | Direct: Low changes (subsidized) Indirect: Land tax in kind through land sharing. | Low: | Admin. Mgmt.[d]: | Poor: a. Underutilization of Infrastructure. b. High losses because of poor design and construction. |
| 2. Azua (Sabana Yegua Dam) | Not Known | Direct: Low charges (subsidized) | Low: | Admin. Mgmt.[d]: | Poor: (scarce water) |

[a] O and M = Operation and Maintenance.

[b] Tech. = Technology.

[c] WUA = Water User Association.

[d] Mgmt. = Management.

[e] In 1980.

[f] In 1982.

[g] IC = Investment cost.

[h] In 1981.

# IRRIGATION PRICING AND MANAGEMENT

## ANNEX 1

## Peru

Submitted to: Ms. Joan Atherton
Social Science Analyst
U.S. Agency for
International
Development
Office of Policy
Development and Program
Review
Bureau of Program and
Policy Coordination

Submitted by: Ian D. Carruthers
N.S. Peabody, III
A.A. Bishop
A.D. LeBaron
Rekha Mehra
Ramchand Oad
Dean Peterson
Dennis H. Wood

DEVRES, INC.
2426 Ontario Road, N.W.
Washington, D.C. 20009
(202) 797-9610
Cable: DEVRES
Telex: 440184

Contract No.: OTR-0091-C-00-4466-00

September 30, 1985

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a. Conclusions . . . . . .

b. Recommendations . . . . . .

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

a. Conclusions . . . . . .

b. Recommendations . . . . . .

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3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology? . . . . .

a. Conclusions . . . . . .

b. Recommendations . . . . . .

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water? . .

a. Conclusions . . . . . .

b. Recommendations . . . . . .

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

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

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

3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology? . . . . . .

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water? . .

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

a. Conclusions . . . . . .

b. Recommendations . . . . . .

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

a. Conclusions . . . . . .

b. Recommendations . . . . . .

3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology? . . . . .

a. Conclusions . . . . . .

b. Recommendations . . . . . .

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water? . .

a. Conclusions . . . . . .

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

a. Conclusions . . . . . .

b. Recommendations . . . . . .

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a. Conclusion . . . . . .

b. Recommendation . . . . . .

2. Everyone should pay . . . . . .

a. Conclusion . . . . . .

b. Recommendation . . . . . .

3. Incentives to improve water charge collections are appropriate . . . . . .

a. Conclusion . . . . . .

b. Recommendation . . . . . .

4. Water charge levels depend upon the specific system involved . . . . . .

a. Conclusion . . . . . .

b. Recommendation . . . . . .

5. Higher water charges should result in system improvements . . . . . .

a. Conclusion . . . . . .

b. Recommendation . . . . . .

6. Previously sustained drainage damage may require indirect collection of water charges . . . . . .

7. Betterment levies are appropriate in some cases . . . . . .

a. Conclusion . . . . . .

b. Recommendation . . . . . .

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8. Appropriate user group and government complementary organization and activities are a fruitful area for further research . . . . . .

a. Conclusion . . . . . .

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ANNEX 1

Peru

N. S. Peabody III, Team Leader
and Social/Institutional
Specialist
A. A. Bishop, Irrigation Engineer

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| CEDEP | Centro Estudios para el Dessarollo y la Participation |
| DEPTI | Dirección Ejecutivo Proyecto Especial Tinajones |
| DGASI | Dirreción General de Aguas, Suelas e Irrigaciones |
| EMTECO | Empresa Técnica de Conservación Chancay-Lambayeque |
| GDP | Gross Domestic Product |
| IDB | Inter-American Development Bank |
| INADE | Instituto Nacional de Desarrollo |
| INAF | Instituto Nacional de Ampliación de la Frontera Agricola |
| O and M | Operations and Maintenance |
| PEPMI | Proyecto Especial Pequeñas y Medianas Irrigaciones |
| Plan MERIS I | Plan de Mejoramiento de Riego en la Sierra (I-American supported) |
| Plan MERIS II | Plan de Mejoramiento de Riego en la Sierra (II-German supported) |
| Plan REHATIC | World Bank supported agricultural project |
| SENAPA | Office administering water supply to city of Tacna |
| USAID | United States Agency for International Development |



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## CURRENCY EQUIVALENTS

US$ 1.00 (22 March 1985) = S/ (Peruvian Soles) 8,250

## WEIGHTS AND MEASURES

| | | |
|---|---|---|
| 1 hectare (ha) | = | 10,000 $m^2$ |
| | = | 2.471 acres |
| 100 hectares (ha) | = | 1 $km^2$ |
| 1 kilogram (kg) | = | 2.204 pounds |
| 1 metric ton (MT) | = | 1,000 kg |
| | = | 2,204 pounds |
| 1 kilometer (km) | = | 0.621 miles |
| 1 square kilomter ($km^2$) | = | 100 ha |
| 1 millimeter (mm) | = | 0.04 inch |
| 1 cubic meter ($m^3$) | = | 1,000 liters |
| 1 liter (l) | = | 1.066 quarts |
| 1 liter per second (l/s) | = | 1.066 quarts per second |



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## LIST OF PEOPLE INTERVIEWED

Lima

Mr. Pablo Venistes Castro
Director, Tarifas
Dirección General Aguas Suelos y Irriaciones (DGASI)
Instituto Nacional de Ampliación de la Frontera Agricola (INAF)

Ing. Onorato Puaa
Director, Distritos de Irrigacion
INAF

Mr. Leonardo Armas Nuñes
Director General
Proyecto Especial Pequeñas y Medianas Irrigaciones (PEPMI)
INAF

Ing. Hugo A. Galvez Paredes
Director Adjunto
PEPMI

Ing. Luis Haro
Director, Plan de Mejoramiento de Riego en la Sierra II
(Plan MERIS-II)
PEPMI

Mr. David Bathrick
Chief, Agriculture
USAID

Mr. Ray Waldron
Project Officer, Agriculture
USAID

Dr. Fred Mann
Director, Agricultural Policy and Analysis
USAID

Mr. Robert Burke
USAID

Ing. Vito Aliaga
Grupo de Analisis de Politica Agricola (GAPA)

Ir. Manuel Castillo
GAPA



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Tinajones

Ing. Milton Luna Sosa
Director Regional
Dirección Aguas y Suelos

Ing. Leonardo Romero Matos
Director Ejecutivo
Proyecto Especial Tinajones (DEPTI)
Instituto Nacional de Desarrollo

Ing. Edmundo Illoa
Subdirector
DEPTI

Ing. Luis Moreno
Administrator Tecnico
Cancay-Lambayeque Irrigation District

Director
Empresa Técnica de Conservacíon Chancy-Lambayeque (EMTECO)

Tacna

Ing. Angel A. Eguiluz
Director Regional
Dirección Aguas y Suelos

Ing. Luis E. Navarrette Rejas
Director Regional
Dirección de Aguas

Mr. Victor Hugo Gutiérrez G.
President, Comisión de Regantes
Subsector de Riego Uchusuma
Uchusuma Irrigation District

Cuzco (Plan MERIS II)

Ing. Americo Caseres
Director Regional
Dirección de Aguas

Ir. Jesus Melga Mejo
Administrator Tecnica

Ir. Agrón Jorge León
Subdirector, sarrollo Agriculo
Plan MERIS II



Devres

Mr. Rudolf K. Fernsebner
Chief Technical Advisor
Plan MERIS II

Mr. Johann Berg
Economic Advisor
Plan MERIS II

Engineer, social worker, farmers
Sacca Irrigation System
Plan MERIS II

Water User Group Chairman, Mayor, Plan MERIS II Agricultural
Extension Officer
Cusipata Irrigation System



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ANNEX 1

Peru

A. Background

1. Economic Background

a. Macroeconomic conditions and policy

The Peruvian economy has grown only slowly over the past fifteen years. (See Table 1-1.) During the 1970s per capita Gross Domestic Product (GDP) grew at an annual rate of less than one half of 1 percent. While government services, mining and power grew substantially during this decade, agriculture stagnated and manufacturing declined in the second half of the decade.

During 1979 to 1981, the economy grew at a rate of about 4 percent per year in real terms, or a per capita real growth rate of slightly over 1 percent per year. This improvement was short-lived, and following stagnation in 1982, the economy suffered a severe depression in 1983/84--caused in part by natural calamities, unsustainable public deficits, extremely weak export markets, high foreign debt service and a shortage of external credits to help finance investment.

The droughts, floods and landslides of 1983 disrupted the lives of over 1.3 million persons and caused economic losses estimated at over $1 billion. In 1983, GDP plunged 11 percent, export earnings decreased $400 million, inflation exceeded 125 percent, tax revenues declined by more than 20 percent, and the public budget deficit reached nearly 12 percent of GDP.

In 1984 climatic conditions reverted to normal and some recovery occurred in commerce, agriculture and, in particular in Fisheries. Overall real growth in GDP in 1984 was about 4 percent higher than in 1983. However, output of goods and services was still below the level reached in 1981/82, and manufacturing, construction, utilities and government expenditures remained depressed.

After years of expansion of the state's role, efforts were undertaken by the Morales administration, starting in 1978/79 to stabilize the economy including devaluation of the sol, reduction of the public deficit and measures to liberalize trade. Following the reinstitution of democratic government in 1980, the Belaunde administration undertook sectoral reforms designed to address structural and institutional weaknesses. By 1984, nearly all subsidies were removed from foodstuffs, petroleum and utilities and the prices of these items were brought close to world levels. The Belaunde administration continued the process of liberalizing trade by eliminating anti-export tariffs and regulations and by price and fiscal policies designed to help make industry and agriculture more



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IRRIGATION PRICING AND MANAGEMENT: PERU

Table 1-1: Gross Domestic Product by Sectoral Origin
(Producer Prices in M of Sols 1973)

| Year | Agriculture | Fishing | Mining | Manufacturing | Other | Totala | Import Duties | Total |
|---|---|---|---|---|---|---|---|---|
| 1970 | 51,701 | 7,673 | 24,930 | 87,238 | 170,771 | 342,313 | 10,283 | 352,596 |
| 1971 | 52,759 | 6,670 | 24,798 | 93,214 | 131,822 | 359,263 | 11,073 | 370,336 |
| 1972 | 51,490 | 3,549 | 26,693 | 93,862 | 191,878 | 367,472 | 9,029 | 376,501 |
| 1973 | 51,687 | 2,571 | 26,924 | 99,524 | 202,457 | 383,163 | 9,396 | 342,559 |
| 1974 | 53,582 | 3,591 | 27,927 | 110,401 | 219,468 | 414,969 | 6,964 | 421,933 |
| 1975 | 53,564 | 3,186 | 25,243 | 114,959 | 234,745 | 431,697 | 9,376 | 441,073 |
| 1976 | 54,372 | 3,754 | 26,762 | 119,566 | 239,261 | 443,715 | 6,272 | 449,738 |
| 1977 | 54,302 | 3,278 | 32,909 | 114,469 | 239,973 | 444,931 | 4,807 | 449,738 |
| 1978 | 53,478 | 4,141 | 36,033 | 110,026 | 238,571 | 442,249 | 5,221 | 447,470 |
| 1979c | 55,575 | 4,640 | 39,324 | 114,697 | 246,097 | 460,333 | 5,606 | 465,939 |
| 1980c | 52,339 | 4,538 | 39,477 | 121,275 | 259,086 | 476,715 | 7,133 | 483,848 |
| 1981c | 58,643 | 4,309 | 38,245 | 121,031 | 271,621 | 493,849 | 8,814 | 502,663 |
| 1982d | 60,330 | 3,960 | 40,750 | 118,010 | 273,982 | 497,032 | 7,419 | 504,451 |
| 1983d | 54,524 | 2,554 | 37,612 | 99,128 | 250,173 | 443,991 | 5,655 | 449,646 |

[a]Producer prices

[b]At market prices

[c]Preliminary

[d]Estimates

Source: The World Bank, Country Economic Memorandum for Peru, (Washington, D.C.: The World Bank, November 1984)



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efficient and labor intensive, and more competitive and export-oriented.

In 1985 the Administration made further price adjustments of basic commodities and foodstuffs, and utilities and succeeded in reducing the deficit on public account. However, the country continues to experience high rates of inflation, unemployment and underemployment and widespread poverty. The economic problems faced by the country are severely compounded by its large external debt and debt service, and by weak export markets.

Total foreign debt amounted to about $13.5 billion at the beginning of 1984 equivalent to about three quarters of 1983's GDP. Service on the foreign debt amounted to about 30 percent of export earnings in 1983 and unless restructured will grow as a percentage of export earnings and GDP. The debt service is such that nearly half of domestic savings in 1983/84 were mobilized by the government and went to cover the debt service, thus severely limiting use of savings for financing domestic investments and development.

Export markets are weak. The outlook for increasing foreign exchange earnings from traditional exports is considered limited. At the end of 1984, export prices for minerals--which make up two-thirds of total exports--were, with the exception of silver and petroleum, the lowest (in real terms) since before the 1930s. (Export prices for coffee and sugar were also low.) Moreover, World Bank analysts project only a modest increase in world market prices for metals: the Bank's consolidated metal and minerals real price index is expected to remain at its 1984 level through 1986 and then increase at only 3 percent per year through 1990. Bank analysts also project only limited prospects for increased volume of exports of minerals.[1]

Following recent elections, a new administration under Alan Gárcia assumed office in July 1985. A major challenge for the new administration and its overseas partners will be to achieve a coherent program for fiscal, monetary and balance of payment stabilization to set the basis for accelerated investments in the economy and longer term growth.

Prospects for longer term growth in the next decade are considered to be very dependent on improving productivity in the use of resources in agriculture and other sectors of the economy. It is unlikely that the economy will be able to grow by exporting minerals, as noted above, and protecting its industry and agriculture, or by an expansion of government services which was a major growth factor in the 1970s and early 1980s.[2]

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[1]The World Bank, Country Economic Memorandum for Peru (Washington, DC: The World Bank, November 1984) p. 23.

[2]Ibid, p. 22.



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The scope for improving productivity and stimulating exports of nontraditional agricultural and industrial products is considerable. The fact that agriculture and industry are characterized by relatively low levels of efficiency and labor productivity means that well designed efforts to increase productivity from existing low bases could result in very appreciable gains, at least in the early years of a productivity effort. Within agriculture, the increase of farm land under irrigation from projects now in execution (Table 1-2) as well as opportunities for increased efficiencies in irrigated farming offer significant opportunities for expanding production and marketing, increasing farm income and generating jobs.

b. The rural and agricultural sector

Natural resources in Peru are limited, at least by comparison to its neighbors in Latin America. The country has a total area of 128.5 million ha of which only 2.9 percent, or about 3.7 million ha are cultivable and about 22 million ha are natural pastureland (17 percent). The main opportunities for additional land with soils suitable for cultivation are found on the well watered lower eastern slopes of the Andes (requiring expensive development of access routes and basic infrastructure) and in the coastal zone (requiring substantial investments in irrigation). Overall, about 0.34 hectares of land per person is cropped.

There are three principal and very different agroecological zones: the coast, the Andean Highland zone or Sierra, and the Forest zone or Selva, east of the Andes mountains. The Sierra zone supports over half of Peru's rural population. Much of the Sierra has poor soils; most of the holdings are based on low to primitive production technology carried out on minifundia where low yields, poverty and recourse to off-farm employment is the norm.

About 50 percent of the total population of Peru (19.1 million people as of mid-1984) live in the coastal zone. Coastal agriculture is limited to irrigated river valleys. This zone is more prosperous, productivity is higher and farmers are technically more advanced and have more access to credit and support services than in other areas. It has ideal growing conditions and produces 40 percent of the country's gross value of crop production. It also accounts for the main agricultural exports, sugar and cotton.

Only about 10 percent of the population live in the Forest zone. Most farming there is concentrated in four river valleys in the Ceja de Selva with tea, coffee, and fruit the main crops. Despite poor soil quality, the Forest zone is gaining economic importance with oil exploration and the construction of two trans Andean highway projects which are expected to promote agricultural development in the zone.



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Table 1-2: Land Added and Improved by Irrigation Projects
(ha)

| | New Areas | Improved Areas | Reclaimed by drainage | Total Area |
|---|---|---|---|---|
| Built between 1906 and 1983 | 183,523 | 338,231 | 4,375 | 526,129 |
| In execution | | | | |
| Large projects | 249,000 | 368,000 | 0 | 617,000 |
| Small projects | 22,013 | 53,922 | 14,456 | 90,414 |
| Total | 454,536 | 760,153 | 18,831 | 1,223,543 |

Source: Roger Sanchez Velez, "Resumen del Informe de Peru." Document prepared for Seminario Latinoamericano de Irrigacion, (Santiago, Chile: 1983).



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Overall, agriculture provides employment for about 38 percent of the labor force and contributes about 13 percent of the GDP. Peruvian agriculture today does not produce enough to meet domestic requirements for consumption or provide for possible exports. The situation has been brought about by rapid increases in the total and urban population of the country and by the poor performance of the agricultural sector as a whole. Poor performance of the sector in the 1970s is attributable to the impact of a sweeping land reform and excessive Government regulation instituted following the military takeover in 1968[3], aggravated by consecutive years of drought, 1978 through 1981, and by the abnormal growing conditions of 1983.

Per capita agricultural output has declined as shown in Table 1-3. As a result, Peru has become dependent on food and feed imports including wheat, corn, rice, soybeans, grain sorghum, milk products, vegetable oils and beef. Peru has even had to import sugar, a traditional export.

This situation of declining per capita output clearly requires policies and programs to support improved use of land and water resources. Moreover, these policies must take into account the fact that improvements in agriculture are essential to the welfare of poor, the majority of whom are found in the Serra zone. A favorable factor is an apparent decline in fertility and population growth apparently in recent years.[4] Another is the increasing integration of Peru's rural poor into the rest of the economy as indicated by a recent study.[5]

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[3]Under the Ararian Land Reform Law of June 1969, 11.6 million ha of land (representing 48 percent of land in agricultural units) in 16,500 farms was expropriated. By 1981/82, 8.9 million ha of this land had been distributed to 389,000 families with the balance remaining under state control pending adjudication, state afforestation or other tax incentives for agricultural investments and re-opened agricultural marketing to the private sector.

[4]According to the World Bank's Country Economic Memorandum for Peru (page 20), 1981 census data indicate a decline in the population growth rate to about 2.2 percent, a level earlier expected to be attained only by 1990s. However, this trend has still to be confirmed.

[5]Adolfo Figeroa, Capitalist Development and the Peasant Economy in Peru, 1984.

Table 1-3: Per Capita Agricultural Output

| Period | Farm Output Index | Population Index | Per Capita Farm Output Index |
|---|---|---|---|
| 1970-73 | 100 | 100 | 100 |
| 1974-77 | 104 | 111.7 | 93 |
| 1978-81 | 106 | 124.2 | 85 |
| 1982 | 116 | 132.7 | 87 |

Source: Derived from Tables 1.1 and 2.1, World Bank, Country Economic Memorandum for Peru," (Washington, DC: The World Bank, November, 1984)



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2. Irrigation development in Peru

Peru has vast amounts of hilly desert on the coast, rough peaks in the Andes and lush jungle in the Amazon. Only 2.34 percent of the surface, 3,021,600 ha, is farmed. (See Table 1-4.) Of this, 706,400 ha in the Pacific coastal valleys are totally dependent on irrigation year round. These highly productive valleys, 53 in all, appear from the air to be thin lines of green running from the Andes to the west. Sometimes they fan out into broad fields on the Pacific slopes. In many cases, the flat lands near the ocean have been damaged by salinity and high water tables with an estimated 20 percent to 35 percent of the irrigated land having these problems.

Most of the land that is farmed is in the Sierra or highlands, and of this about one-fourth is irrigated. Most of the irrigation in the Sierra is supplementary, i.e., it assists the germination of the main rainy season crop grown from October to April. Some irrigation is also used to grow a second crop in the dry season--June to November.

Supplemental irrigation is also used in the Selva, or forest zone, or, more properly, in the foothills between the Andes and the jungle. Both the highlands and the jungle have an abundance of water. The Atlantic Ocean side of the Andes accounts for 74.5 percent of the surface area of Peru and has 97.8 percent of the water. The Lake Titicaca basin receives 0.5 percent of the water and represents 3.8 percent of the land area. That leaves the Pacific slopes with 21.7 percent of the land and only 1.7 percent of the water. Water which naturally flows to the Pacific is now being supplemented slightly by water brought through tunnels from the Atlantic side. Electricity production is the main motivation for these tunnels.

Irrigation projects in Peru often involve long canals of large size. Table 1-2 shows the number of hectares added between 1906 and 1983; the number of hectares to be added by projects now in construction actually exceeds the number already built in this country. Some of these are extremely expensive projects per hectare irrigated.

B. National Irrigation Administration and Policy

1. Organization of irrigation administration

The agricultural sector is served by the Ministry of Agriculture and by semi-autonomous public agencies set up to administer special loans. The Instituto Nacional de Desarrollo (INADE), one such organization which reports directly to the Prime Minister, oversaw the Tinajones Project (DEPTI) which was financed mainly by a German loan. INAF, the Instituto Nacional de Ampliación de La Frontera Agricola, is another decentralized organization and is the one that administers Plan REHATIC (World Bank), Plan MERIS I (American), Plan MERIS II (German) and Linea Global IDB (Inter-American Development Bank) loans. These decentralized agencies are reported to have better salary scales and



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Table 1-4: Distribution of Farm Land According to Region and Irrigation Status
(ha)

| | Coastal | Sierra Zone | Forest Zone | Total |
|---|---|---|---|---|
| Not Irrigated | 0 | 1,276,200 | 497,600 | 1,773,800 |
| Irrigated | 706,400 | 434,800 | 106,600 | 1,247,800 |
| Total | 706,400 | 1,711,000 | 604,200 | 3,021,600 |

Source: Roger Sanchez Velez, "Resumen del Informe de Peru." Document prepared for Seminario Latinoamericano de Irrigacion, (Santiago, Chile: 1983).



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esprit de corps than does the Ministry of Agriculture. The loan projects have something specific to do, and someone specific to whom they must report--the foreign lender.

a. Organizational structure of ministries and agencies

Figure 1-1 shows a list of the "organic structure" of the Ministry of Agriculture. The figure is deceptive, however, because action is now supposed to take place at the regional or departmental level in the direcciónes regionales. The list puts these direcciónes regionales in fifth place, below the "Central Line" agencies which includes the Dirección General de Aguas, Suelos e Irrigaciones (DGASI). In fact, the line agencies have very little executive authority. DGASI, for example, mainly espouses norms and tries to aggregate regional data. The "Alta Dirección" actually has very little chance of making a dirección regional carry out a suggestion of the DGASI and vice versa.

Figure 1-2 lists the main direcciónes (departments) within the GASI. They are relics from the past when the military government, with its 1969 Ley General de Aguas (General Water Law) attempted to run all the irrigation systems and crop plans from Lima. The Dirección de Tarifas has never been able to enforce the collection of water fees or even make all the regions report what they are collecting. It does have some things it can do, however, such as helping irrigation districts determine how to save money for engineering studies and emergencies. It can also help to resolve the complex problems which arise when two irrigation districts decide to join their water supplies.

Figure 1-3 shows the complex list of offices in each dirección regional (regional agricultural office). Most of the central line agencies are repeated at this level, including the Dirección de Aguas y Suelos. Most valleys also have an oficina agraria which should be an agricultural extension office. Under that office is the Administración Tecnica of each irrigation district. Therefore, there are at least two levels between the government appointed Administrator of water in an irrigation district and the Ministry of Agriculture: the oficina agraria and the dirección regional. The line from the Dirección de Tarifas in Lima to the Junta de Usuarios, who actually sets the water fees, is circuitous--up through the DGASI to the Minister and then down through Departmental and Valley Agricultural Offices to the Technical Administrator and finally to the junta. The Technical Administrator collects the tarifa, the mandatory fee, and passes, most of it to the junta; the junta collects any others.

b. Responsibilities and functioning of irrigation agencies

Figure 1-4 shows an idealized concept of a Technical Administrator's Office in an irrigation district. Figure 1-5 describes the structure we observed in Chancay, which is similar to that in Tacna. In these two cases, the juntas seem to get along well with the

La estructura orgánica del Ministerio de Agricultura es la siguiente:

a) Alta Dirección

-- Despacho Ministerial

-- Vice-Ministro

b) Organo de Control

-- Inspectoría General

c) Organos de Apoyo

-- Oficina General de Administración

-- Oficina de Catastro Rural

-- Oficina Sectorial de Estadística

-- Oficina General de Comunidades y Relaciones Públicas

-- Oficina General de Igeniería

d) Organos de Linea Centrales

-- Direccíon General de Agua, Suelos e Irrigaciones

-- Direccíon General de Agricultura y Ganadería

-- Direccíon General de Agroindustria y Comercialización

-- Dirección General Forestal y de Fauna

-- Dirección General de Reforma Agraria y Acentamiento Rural

e) Organos de Linea Desconcentrados

-- Dirección Regionales

f) Organos de Coordinación

-- Comité Central de Coordinación

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Figure 1-1: Main Agencies Within the Peruvian Ministry of Agriculture



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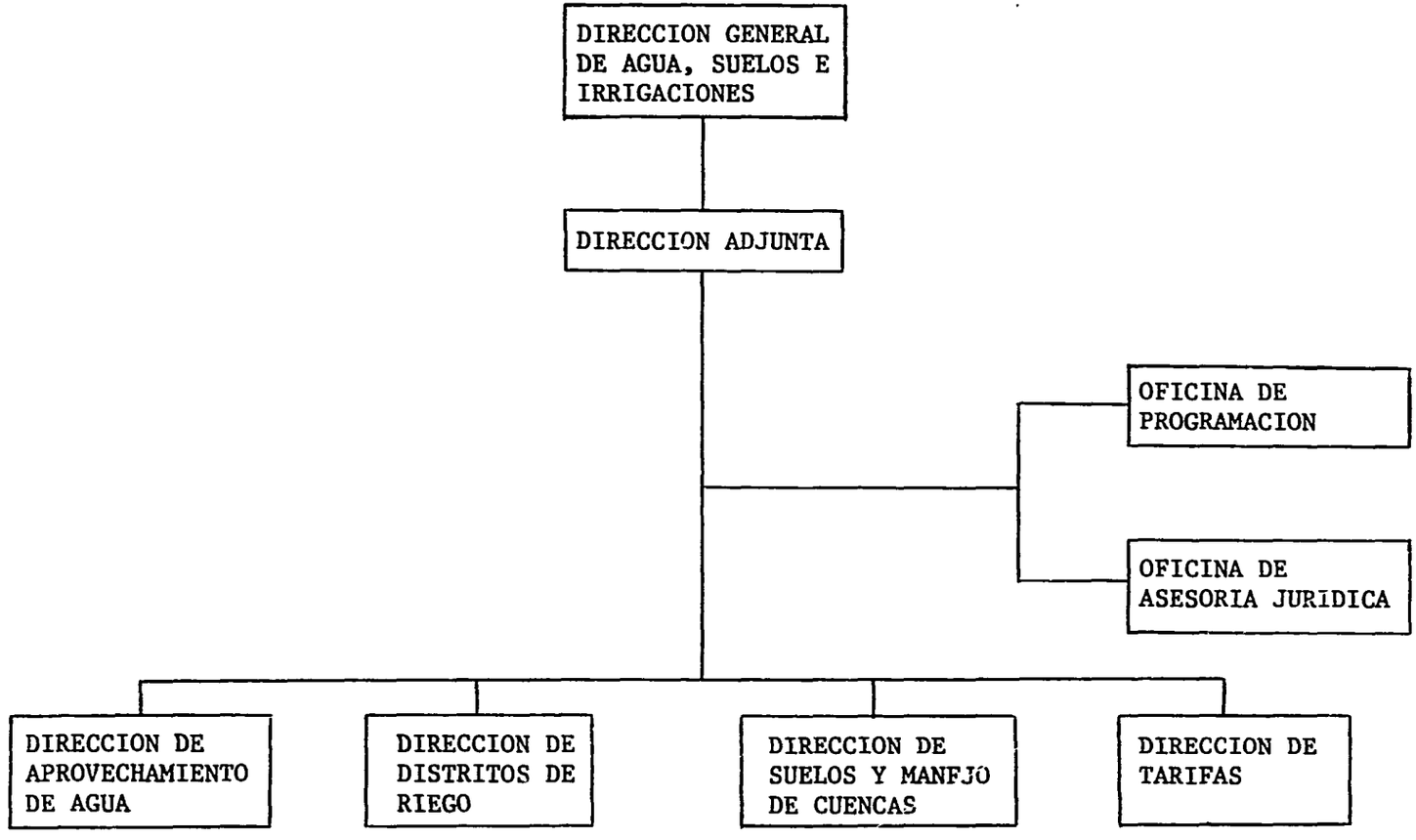


IRRIGATION PRICING AND MANAGEMENT: PERU

Figure 1-2: Departments within the DGASI



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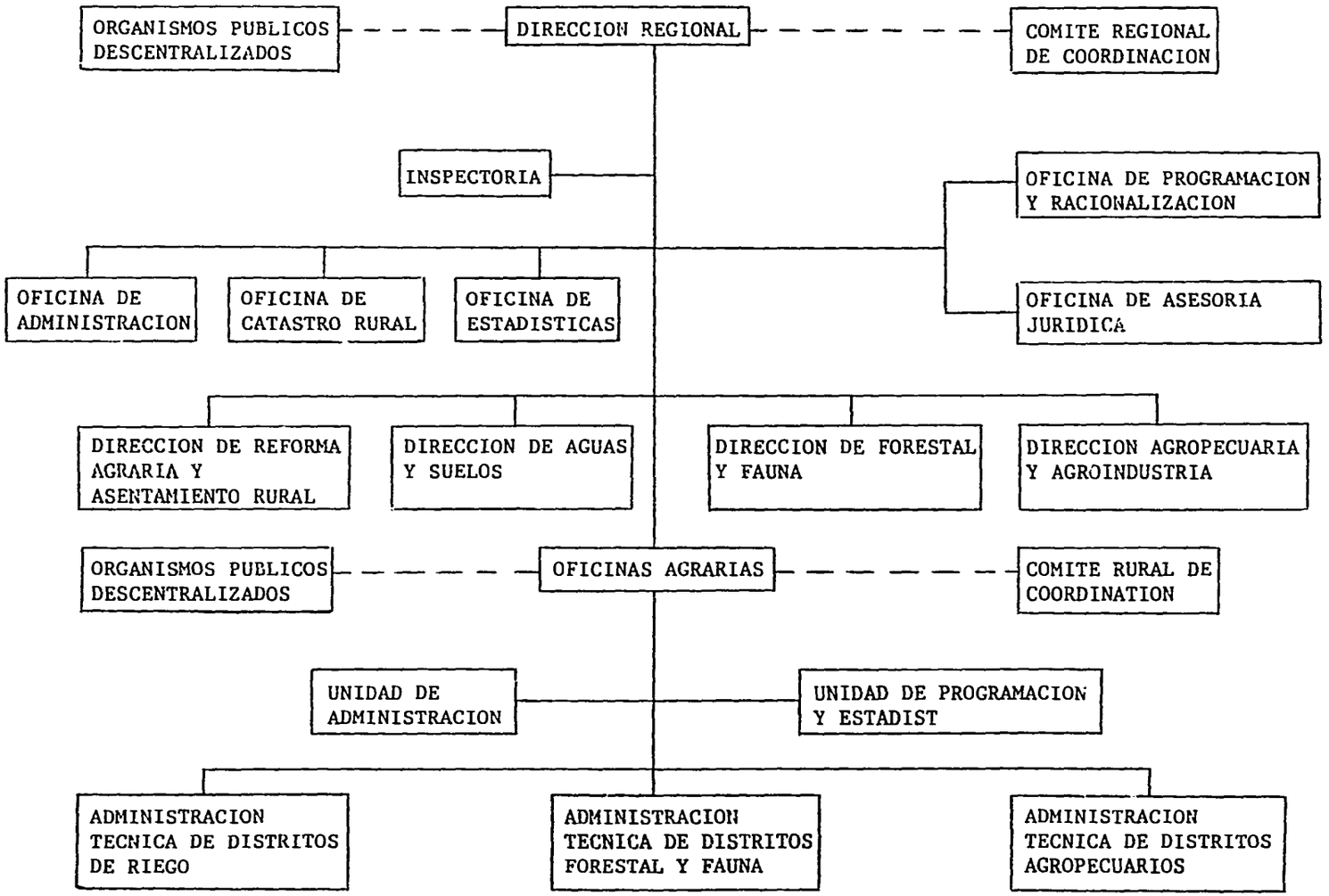
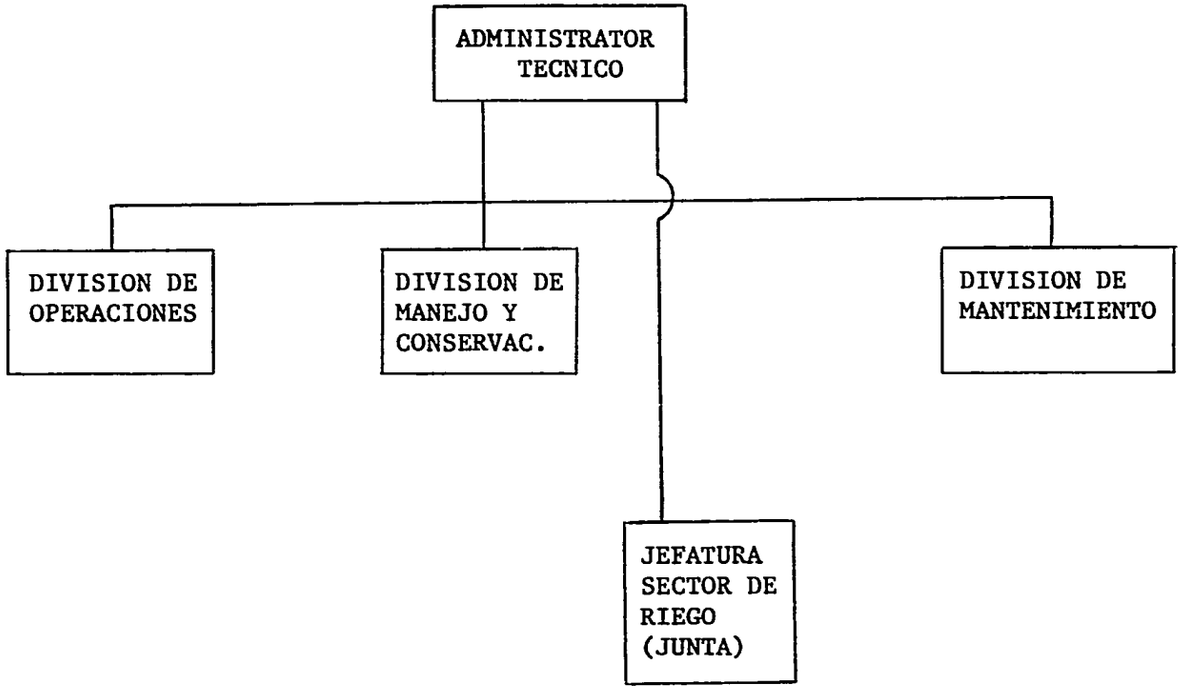


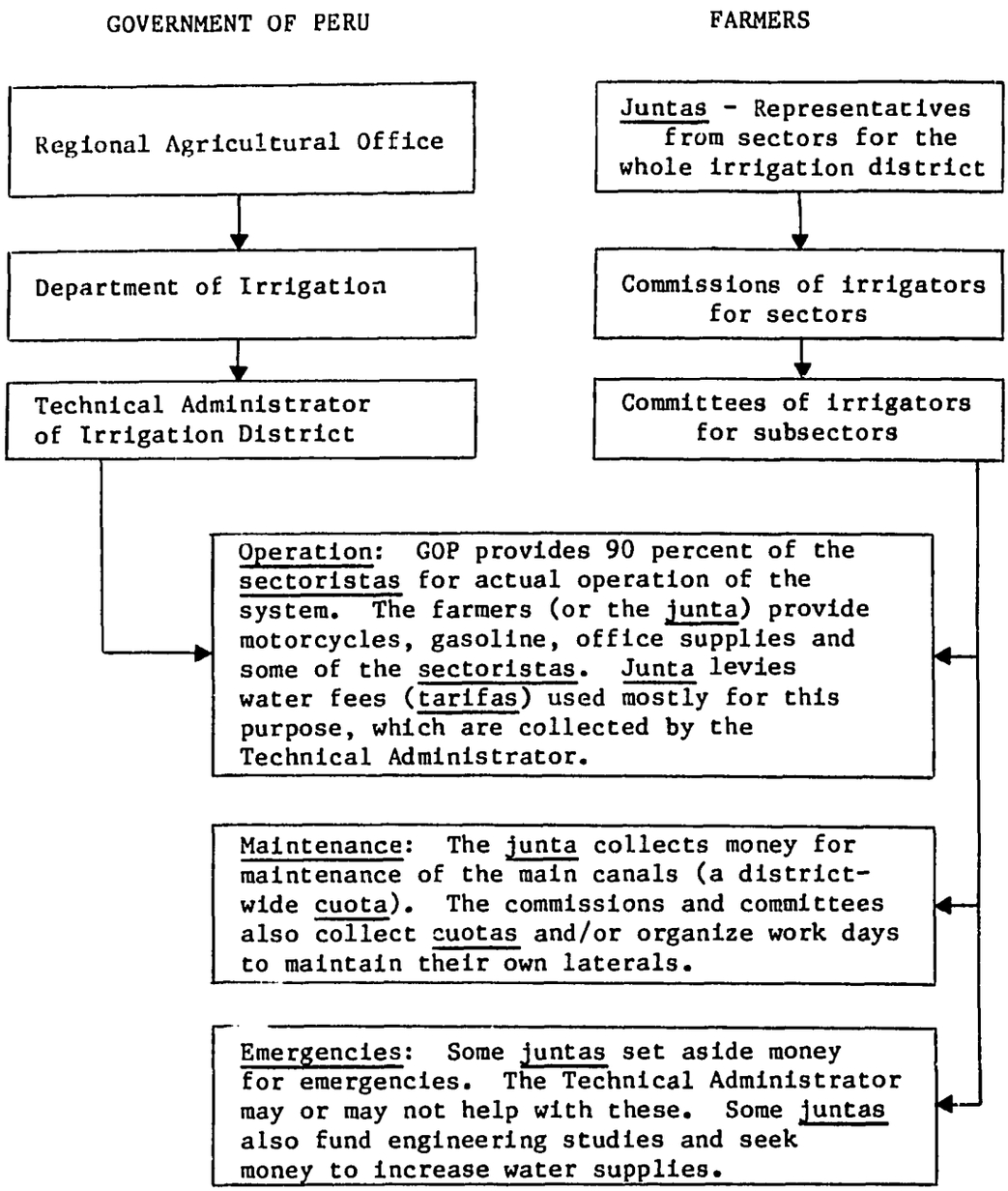

IRRIGATION PRICING AND MANAGEMENT: PERU

Figure 1-3: Organogram of the Regional Directorates and Agrarian Offices




IRRIGATION PRICING AND MANAGEMENT: PERU

Figure 1-4: Idealized Concept of the Technical Administration of a "Typical" Irrigation District




IRRIGATION PRICING AND MANAGEMENT: PERU

Figure 1-5: Rough Descripiton of the Actual Operation and Maintenance Coastal Irrigation System in Peru



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Technical Administrator, who functions as an executive officer. The junta is primarily a legislative group. The Administrator and the junta pool their resources in order to accomplish the basic task of distributing limited supplies of water to the farms. The Administrator helps plan and supervise maintenance, even though the farmers through the junta provide money for that function.

It is said that in other valleys cooperation between the juntas and the Technical Administrators is poor, and that farmers actually operate some systems because the Technical Administrators are not able to do so. The Sarria study[6] says that money from the central government for the operation of the irrigation districts fell in real terms, between 1981 and 1983, and that tariff money collected from the users of the irrigations systems fell in absolute terms.

2. Irrigation policies

a. Policy framework for irrigation development

Peru's irrigation policies are in a state of transition. For about ten years, 1968 to 1978, there was an experiment with centralization and technocracy. The 1969 Ley General de Aguas proclaimed that all the water belonged to the people and that the government was to decide how to best use it, but this system never really worked. During the past seven years, 1978 to 1985, there has been a timid move toward less centralized government and delegating more power to the regions. The government gave less and less money to the irrigation districts and in places where water was really valuable (or where irrigation systems were complex and breaks in canals were serious) the farmers, through their juntas, have been compelled to fill in the gap--i.e., they provided some money and leadership and tried to collaborate with the Technical Administrators.

It is hard to know whether this process of regionalization will be continued, whether new power actually will be given to the sugar cooperatives, and whether a strong central government will emerge. It is possible that all three things will happen: the sugar coops will get more definite water rights, a "strong" central government will reduce the size of the government; and the taxation powers of both the local governments and the juntas will be increased.

The basic tenets of the present water law are:

- There are no private water rights and transfer of assumed rights is illegal;

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[6]Sarria, Carlos R. Analysis de los Mechanismos Institutionales y Economicos Para Optimizar el Uso de Agua Agricola (Lima, Peru: Grupo de Analisis de Policitica Agraria (GAPA), 1984).

- Water is to be used in the social interest and only with permission from the government. (The government establishes priorities: human use, industry, animals, permanent crops, and animal crops taking into account social needs.); and

- The line of judicial appeal is administrative to the Technical Administrator, then to the DGASI, and then to the courts. (In practice, the Technical Administrators first refer individual appeals for more water back to their juntas because the juntas help the Administrator decide on the rules for water allocations and crop preferences.)

b. Functioning of current policies on water rights, irrigation charges and maintenance

In practice, the farmers have a lot to say about their water rights. Where water rights are extremely valuable, as in Tacna, traditional arrangements have not been modified. Where and when water is not valuable, people simply ignore the dictates of the Ley General de Aguas and use it as they see fit.

Current interpretations of the water law require the juntas to set their own tarifas and cuotas and to keep the money in the irrigation districts.

Our impression is that during the past several years farmer participation in irrigation management is more evident. It appears that current policies are reasonably effective even though many aspects of the water law are ignored.

The basic problem with the concept that all the water belongs to the state and the state will decide how to make rational use of it is that the state is unable to use markets to help implement that notion.

For example, the government says water should be allocated according to a plan de cultivo y riego, which requires farmers to request permission to plant certain crops and modify their plans according to directives issued by a District Coordinating Committee. In a water-short valley such as La Leche[7], the Coordinating Committee give preference to the permanent crops, allocating 14,379 cubic meter per hectare per year for sugar cane, for example. That leaves an expected 4,219 cubic meter per hectare per year for the annual crops based on the total area available--not that seeded. There is no regulating reservoir and the farmers only know that their share of a tiny amount of water will come, primarily between December and June with most of it in March, April and May. The farmers must submit a plan for the crops they want to plant, but it is merely a formality.

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[7]Ibid., pp. 102-104



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After receiving requests, the Administrator goes through another formality of cutting back requests, but there is no follow-up to determine whether an individual farmer actually plants the amounts he says he will plant or whether or not he adjusts his acreage according to the Technical Administrator's directive.

In Chancay de Lambayeque, the Technical Administrator, claims to allocate water according to the plan de cultivo y riejo. However, the functioning system seems to be a slight modification of the old system of water rights with a few annual adjustments. In Tacna, where water is very valuable farmers are allocated water in time units according to landholding size, irrespective of crop.

3. Official perceptions at the national level

Officials at the national level seem to minimize the extent to which the farmers are running their own irrigation systems; however, those associated with autonomous projects are perhaps more cognizant of this than those in the Ministry of Agriculture. At the national level in Lima one needs to distinguish clearly between the perception of the officials, which is usually sharp, and the "official line" which is often unworkable. The "official line" is that plans de cultivo y riego work, that support for technical administration is adequate and that the government manages the water for the welfare of all.

C. Irrigation Projects

1. Chancay de Lambayeque

a. Background

The area constitutes one of the oldest irrigated valleys of Peru, having been irrigated since Inca times. The old system included the area presently in sugar cane which was expanded during the colonial period. A considerable part of the area included in the 1968 expansion was irrigated from the La Leche River.

The Chancay de Lambayeque project is different from most of the coastal irrigation projects of Peru in that some regulation of the highly fluctuating water supplies is made possible by the Tinajones Reservoir. This reservoir with a capacity of 320 million cubic meters (MCM) was completed in 1968 along with its feeder canal diverting water from the Rio Chancay and the discharge canal supplying water back to the river for irrigation. The project was in the planning stage for 30 years (1928 to 1958) and ten years in construction (1958 to 1968) to its present state. Phase II including diversion tunnels tapping the east slope of the Andes is yet to be built. Prior to 1968 the area was served by a number of canals diverting directly from the river and its tributaries and the irrigation was "run of the river", subject to the high streamflow variation and periods of drought and excess.



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(1) Description

The project consists of the old canal systems diverting water from Rio Chancay and lesser streams including Rio Lambaysque and Rio Rique serving some 70,000 ha. Superimposed upon this old system is the new project to provide storage and supplemental water to the existing area and develop new lands bring the total area to approximately 100,000 ha. Main features of the project include the "off stream" Tinajones Reservoir, 320 MCM; the reservoir feeder canal, 70 cubic meter per second with its diversion dam, Bocatoma Roca Rumi; the supply canal back to the river, 70 cubic meter per second along with new diversions and new lined canals linking the new system with the old.

The advantage of off-stream storage, besides being available where it is, is that the sediment can be removed and left in the river and thus not deplete the reservoir capacity as much as if it were on the main channel. On the other hand, if the flow in the river exceeds the capacity of the feeder canal any excess will be bypassed even though the reservoir is not full and the additional water could be used. Since its completion in 1968, the reservoir has filled only five times.

An integral part of the planned project is yet to be constructed, namely Phase II, consisting of trans diversions from the higher watersheds to bring water to the Pacific side of the Andes. Diversion dams, canals and nearly 15 miles of tunnels are being planned. Water for the new lands is expected to come mainly from these waters now draining to the Atlantic.

(2) Agriculture in the project area

The main crops are sugar cane and rice. In the past, cotton and beans were much more important than today. Table 1-5 reflects the large fluctuations in rice production, which have continued in 1984-85 and a small reduction in sugar cane harvests. About half of the coops formed by agrarian reform in the late 1960s have chosen to subdivide themselves into individual parcels of land. The average size farm is small--two to three hectares--and the number of hectares on the sugar coops is about the same--2.6 per member.[8]

Alfalfa and milk production are also important. In 1983, the valley produced 4,771 MT of milk and 1,051 MT of cattle meat. They also produced 4,719 T of chicken meat and 869 T of eggs.[9]

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[8]Centro de Estudios para el Dessarollo y la Participation (CEDEP). Diagnostico-Economico de la Actividad Agropecuaria del Valle de Chancay-Lambaque (Lima, Peru: CEDEP, 1984) p.1.

[9]Ibid., Cuadro (Table) No. C-IV-8.



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Table 1-5: Principle Crops Harvested in the Valley as a Whole and by Cooperatives in Chancay Lambayeque, 1978 and 1983
(ha)

| Crop | Valley 1978 | Valley 1983 | Cooperatives 1978 | Cooperatives 1983 |
|---|---|---|---|---|
| Rice | 16,636 | 31,298 | 3,327 | 4,168 |
| Sugar | 19,441 | 15,888 | 15,911 | 13,043 |
| Cotton | 2,392 | 1,217 | 677 | 101 |
| Corn | 1,776 | 1,584 | 192 | 25 |

Source: Centro de Estudios para el Desarrollo y la Participacion (CEDEP), Diagonostico Tecnico-Economico de la Actividad Agropecuaria del Valle de Chancay-Lambayaque (Lima, Peru: CEDEP, 1984), Cuadro (Table) No. C-IV-3.



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b. Project management and administration

(1) Roles and responsibilities

The administrative structure of the Tinajones Project corresponds to the official pattern described in Sections A.2.a and A.2.b above, in virtually all aspects. The Development Corporation, DEPTI, executes activities which utilize foreign funds: studies, construction and major rehabilitation and repair. The Technical Administrator of the Chancay-Lambayeque District is responsible for system operation and the junta de usuarios has recently assumed responsibility for maintenance. Operational policies are set by a District Coordinating Committee, which consists of representatives of the users, DEPTI, the Agricultural Bank, the Ministry of Agriculture, and other non-agricultural water users. The office of the Technical Administrator, located in Lambayeque, has three divisions: operations, maintenance, and management and conservation. Suboffices are located in each of the five Sectors, which correspond to the area served by a major lateral. For operational purposes, Sectors are divided into subsectors, or sublateral units.

The farmers are organized in a parallel structure. In some turn-out units, they have formed comites de regantes (Irrigator committees). Otherwise, there are comisiones de regantes (Irrigator commissions) on the subsector level, and a system-wide Junta de Usuarios, which includes representatives of individual comisiones.

The Technical Administrator and his staff establish cropping parameters, maintain records of cropping and water delivery, set delivery schedules, distribute water to the farm turnout, and advise the junta and comisiones on maintenance needs. The junta assumes responsibility down through the laterals; the comisiones are responsible for smaller units.

(2) Operation

As indicated above, the Tinajones Reservoir allows some control over the flow of water through the system. Nonetheless, the prevailing situation is that of water shortage during critical periods, even in good years. The project was designed to increase the available water supply by storing excess flow and by diverting other mountain rivers, to regularize the supply on the existing 68,000 ha command area, and eventually to expand the command area to 100,000 ha. However, the command area has already been expanded to approximately 90,000 ha without an increase in the water supply, thus water allocation remains a chronic problem.

Water is allocated through a detailed process which attempts to reconcile technical limitations and farmer preferences. Near the end of the calendar year, farmers are required to submit a cropping plan to the office of the Technical Administrator. These data are aggregated



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by crop and estimated water requirements are prepared, using standard water requirement coefficients for each crop. At about the same time, the hydrology unit of the Directorate of Water and Soils in Lima submits an annual water availability projection, based on river flow, rainfall patterns, and the status of the Tinajones Reservoir. The Coordination Committee meets to review both sets of data and establishes a crop adjustment formula which is then to be applied to the requests of each farmer. Sugar cane, fruit and other permanent crops are given first priority in water allocation, and no adjustments are made. Normally, other grains and vegetables are also left untouched, but rice allottments are adjusted almost every year.

Uniformly, technicians and administrators contend that the system cannot support more than 25,000 ha of rice production, even in good years. Consequently, each year a formula is developed which theoretically reduces the total cropped area to that amount or even less, if the water supply is inadequate. In final allocations, the amount of rice permitted on large units (over 10 ha) is reduced disproportionately more than small units. Individual cropping plans are then approved after the formula is applied and the final product becomes the annual Plan de Cultivo y Riego. Farmers whose allotments have been reduced are supposed to substitute crops, but there is no follow-up to determine whether or not this is done in practice.[10]

The process does not always follow the above pattern. In 1984-85, for example, the Coordination Committee attempted to impose a ceiling of 25,000 ha of rice cultivation, but farmers protested to political figures, who intervened to raise the ceiling to 40,000 ha, despite the contrary advice of technicians. As rainfall was less than anticipated, the reservoir was depleted faster than planned and water was already deficient by the time of the team's visit in late March. Consequently, farmers had abandoned some of their paddies, and the Technical Administrator was about to request the Coordinating Committee to cut water supplies altogether in the low priority areas of the system.

Once the Plan has been established, water is delivered by rotation. Generally, rice paddies receive water every eight days at a rate of two hours per hectare, and other crops receive water every two weeks. When supplies are low, the frequency is reduced and/or the duration of the turn is shortened. Normally, rotation occurs within each lateral. However, during the team's visit, a new procedure was introduced on the new canal which brought water to one lateral at a time and reduced deliveries to one hour per hectare. At one field site, the sectorista (water master) estimated the stream flow to be 140 liters per second, which translates into a gross application of 50.4 mm, or about 2 inches.

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[10]Recharte, Jorge, "Ethnography of Irrigations in Peru with Special Reference to the Coast," 1983, (typewritten), pp. 25-26.

The day before his turn, each farmer must go to the suboffice of the Technical Administrator to request water. His request is added to his annual irrigation card, and a time is fixed for water delivery. The turnout gates are opened and closed by a sectorista in the presence of the farmer. If a farmer fails to appear when his turn is scheduled, he misses the turn and must wait for the following rotation.

(3) Maintenance

Until 1983-84, DEPTI took care of the maintenance of the main canal, laterals, and drains. The oficina agraria formally assumed maintenance responsibility in 1981; however, as the office had no operating budget, DEPTI and the oficina agraria collaborated with the junta de usuarios to establish EMTECO, a non-profit maintenance company under the control of the junta. DEPTI provided basic staff and the oficina agraria transferred to EMTECO the machinery which DEPTI had acquired with German funding. EMTECO started operations in 1984, working on an uncertain budget from the collection of delinquent tariffs and quotas, concentrating its efforts primarily on maintenance of major drains. For the 1984-85 season, EMTECO prepared a complete work plan and a budget which included funds to purchase new heavy machinery. As of the end of March, EMTECO was about to ask the junta to provide a budget of S/ 4 billion (approximately $500,000), three times as great as that of the previous year.

It is too early to say how successful EMTECO will be. It has started with a strong institutional base, but it remains to be seen whether the junta will actually be able to perform the managerial role anticipated, and whether the technicians currently managing EMTECO will function well under the control of the junta. If this does succeed, the arrangement may be duplicated in other coastal systems.

The comisiones are responsible for repairs and maintenance below the laterals. The staff of the Technical Administrator prepares an annual maintenance program for each subsector, complete with cost (labor), and submits it to the comision. The comision, in turn, reviews the program, decides on an appropriate assessment, and assigns mobilization and supervision responsibilities to apuntadores, who oversee the work.

c. Farmer participation

The Tinajones Project is characterized by a high level of formalized, officially integrated participation of water user organizations. The organizations were created by fiat, but they have clear roles in the operation of the system, they have unique responsibilities, and they have control over the resources they generate. Moreover, their roles and responsibilities have increased in importance over time, and their resources have also grown. This discussion will proceed from the bottom of the hierarchy to the top.



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Some subsectors have comites de regantes, which are formed at the small turnout level. However, they are not common, and there is no indication that the system functions better in subsectors where they exist. This question bears further exploration.

Comisiones are apparently well established in each subsector of the system, and their role is legitimized by farmers and technicians alike. Farmers in each subsector elect a slate of candidates for the executive committee of the comision, which carries out the routine functions of the comision. Each farmer and each cooperative has a single vote in the election, and each slate is apparently composed of a cross-section of farmers, large and small. Members of the Committee can serve two two-year terms before being retired for at least one term. Officials contend that small farmers are well represented on the Committees because they represent the majority of the farmers, and because large farmers do not have the time to devote to such activity. This bears further exploration, but it is clear that the leadership is not an elite clique.

Each Committee elects one of its members to represent it in the junta de usuarios, which also serves a two-year term. Although members of the junta have always assumed administrative, as well as regulatory responsibilities, they have been known to maintain close ties to their constituents. Until now, they do not represent an independent leadership group, nor are they identified with officials. However, the creation of EMTECO may change the situation. Members of the junta will be required to demonstrate higher levels of managerial and technical competence as the overall responsibilities of the junta increase in magnitude and complexity. In consequence, a cadre of semi-professional managers may emerge to lead both the comisiones and the junta.

There is little evidence to suggest that farmers have had a substantial role in the development of the Tinajones Project, except for the study funded by the junta in 1982. However, the user groups do have a primary role in setting tariff and quota rates and, most recently, they have assumed responsibility for the whole maintenance operation. These tasks were thrust upon the groups, rather than sought by them, thus they have been supported by the administration, rather than opposed. Until now, the junta has had a passive role in cost recovery, but it can be expected to take a more active role in the future.

Farmers have shown the ability to mobilize political support to change the plan de cultivo y riego, and thus modify water allocations. In the short run, this has had the detrimental impact of depleting reservoir supplies and threatening significant crop shortfalls. At the moment, chronic water shortages are handled essentially by administrative fiat, with very little collaborative involvement of the farmers or their representatives, which leaves the system vulnerable to political interference. In the longer run, however, if the current crisis is managed properly, a satisfactory resolution of the apparent conflict between farmers and technicians may lead to a more widespread



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and sophisticated understanding of the technical limitations of the system, more precise and equitable cropping allocations, improvements in water delivery efficiency, and the mobilization of development resources, both internal and external, to complete the system as planned. The present expansion of the maintenance role of the junta provides a good opportunity to involve farmers in other aspects of system operation which greatly affect their livelihoods.

Conflicts are resolved administratively; user groups have no apparent formal or informal role in conflict resolution. Water theft is the most common source of conflict. Infractions are reported to the Technical Administrator, who fines perpetrators from S/ 10,000 to S/ 30,000. Although most fines are appealed to Lima, they apparently are seldom overturned.

In short, farmer participation in the Tinajones Project is rather like a bureaucratic extension of the irrigation administration. Farmer organizations represent their constituents in aspects of the system in which they have been granted authority; increasingly, they assume responsibility for functions which previously were performed by administrators and technicians. There are few signs that the authority or responsibilities of the users groups have increased as the result of their own initiatives. Rather, farmers participate in response to the initiatives of officials. Although there are some underlying problems, the arrangement works fairly smoothly.

d. Cost recovery

Farmers in the Tinajones Project are subject to four types of water charges: a tariff, which is collected by the Technical Administrator; the quota and the development assessment, which are collected by the junta; and a special quota, collected by the comisiones. Each charge is assessed, collected and utilized differently, but all charges are decided by the farmers themselves or their representatives; none is set by an external authority. In total, the charges constitute a small fraction of the cost of production. Although the special quotas are recovered regularly, the record of other charges has not been as successful, primarily because of weaknesses in the collection and enforcement procedures.

(1) Tariff

The water tariff, the only charge mandated by law, is levied on the basis of the volume of water delivered, multiplying standard crop coefficients by the area planted in a particular crop. The rate levied per cubic meter of water is decided by the junta, but cannot exceed five percent of the cost of production. The tariff is levied for crops included in the plan de cultivo y riego, which covers the major annual agricultural season; second crops are not subject to the tariff. In 1982 and 1983, the tariff in Tinajones was set at 1 Sol per cubic meter, or Soles 14,000 per hectare of rice and Soles 6,800 per hectare of maize



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($1.70 and $0.82, respectively, as of 22 March 1985). The rates were not adjusted to account for the great inflation over the 1982/1983 period, thus the impact of the tariff declined significantly. In April 1985, the rate is to be set retroactively for 1984. Although it was assumed that the 1984 rate would be increased, officials were unable to predict the outcome of the discussion.

The Technical Administrator collects the tariff and is supposed to give part of it to the junta for operation and maintenance (75 percent), and send part to Lima for "amortization" (10 percent) and the "canon" (10 percent), a water right tax.[11] In practice, very little of the tariff goes to Lima. Approximately 10 percent of the tariff is retained in an emergency fund, in lieu of the amortization and canon payments. The remainder is allocated to the junta, but most of these funds ultimately are transferred to the Technical Administrator to be used for vehicles, fuel, and salaries of some sectoristas, in addition to other routine administrative costs of the office. According to EMTECO, only about 15 percent of the tariff collection is used for maintenance.

To enforce its authority to collect the tariff, the Technical Administrator and is given the power to impose fines for late payments or to cut off the water supplies of delinquent farmers. However, collection rates have been low, however, primarily because of reluctance to enforce sanctions. Since the creation of EMTECO, which coincided with the disappearance of maintenance budgets from Lima, the junta has begun to encourage farmers to pay current and past tariffs. The effort has achieved some degree of success, apparently without resorting to sanctions.

Two small systems located nearby Tinajones have more successful collection records. In both of the systems (La Lache and Motupe) the tariff is based on water volume, calculated as in Tinajones. The tariff has been lower in each of the systems, but that does not account for the differences in collection rates. Rather, farmers are required to pay the tariff in advance of each turn. Consequently, although water supplies in the systems are uncertain, and highly variable, farmers pay their tariffs. Officials say that the procedure was not instituted in Tinajones because that system is much larger and thus frequent collection would present great administrative problems. Although this may be the case, it does indicate that collection, not payment, is the problem in Tinajones.

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[11]Bazo, Jose Louis, "Sondeo Descriptivo Sobre Irrigacion en el Peru" (Lima, Peru: 1982.) (Mimeographed), pp. 20-23.

(2) Quota

The quota is an optional water charge levied by the junta for maintenance. It appears to be levied in systems with major civil works, rather than in smaller systems like La Leche and Motupe. The quota is paid directly to the junta, which maintains complete control over the funds. However, as the tariff and quota are generally levied and paid together, collection rates for the two are similar.

Traditionally, the quota and tariff are set at the same rate and based on the same volumetric surrogate system, (which means that a rice farmer was assessed a quota of Soles 14,000 per hectare in 1982 and 1983; the 1984 rate will also be set in April, 1985). The relationship between the tariff and the quota may change. The Regional Director predicts that the junta will be asked to approve rates of Soles 2.80 per cubic meter for the tariff and the quota; however, EMTECO seems to think that farmers will resist an increase in the tariff, thus it may recommend a slight increase in the tariff (to Soles 1.25 per cubic meter) and a larger increase in the quota (to Soles 3.00 per cubic meter).

The quota is the principal source of funding for EMTECO, which claims to pass some of the funds to the comisiones. It was not clear, however, whether these are direct payments to the comisiones, or payments in kind in the form of maintenance services rendered. Nonetheless, it is clear, that quota funds remain in the system.

(3) Development assessment

Tinajones and a few other major coastal irrigation systems have been given the authority to collect fees to be utilized for future system development. Strictly speaking, the junta is supposed to levy a charge and transfer the funds to DEPTI, which will commission studies, or award construction contracts, as relevant. Funds were collected under this law only once, in 1982. At that time, DEPTI commissioned a German consulting firm to prepare a plan for tapping additional water sources in the mountains, at a cost of 300 million soles. Rather than transfer the funds to DEPTI, however, the junta retained financial control over the project. No development funds have been collected since 1982 because of the poor harvests and floods which have plagued the system. Once the situation improves, it is expected that this will be continued, and that the junta will again retain control over the funds that are collected.

(4) Special quotas

The special quota is levied by comisiones for the repair and maintenance of sublaterals and minor drains. The Technical Administrator recommends a work program, which is ratified or modified by the comision, which then sets the quota. Farmers are assessed according to the size of their landholdings, at a fixed rate per hectare, and payments are made in cash or kind. The amount varies



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according to the comision, but was generally about Soles 8,000 per hectare in 1984, which was equal to two days of work. Farmers who labored in excess of their requirement are paid for the work with funds collected from other farmers, generally the larger landowners. In addition, people are also mobilized to contribute labor and/or funds for emergencies, sometimes on a more localized basis. All of the special quota funds are used within the subsector, and collection seems not to be a problem.

2. Tacna

a. Background

(1) Description

Irrigation systems of the Tacna area are typical of most of the coastal irrigation systems of Peru. Diversions of the steep mountain stream are accomplished with concrete structures and lined canals. Sediment is a major problem requiring sluiceways at the diversion structure. Even so, sediment still gets into the canal and causes problems. Parshall measuring flumes are installed at the main canal intake and at each lateral turnout. Laterals, like the main canal, are lined with rubble masonry. Water is delivered to individual users on a rotation basis with irrigation being practiced on a 24-hour basis. The basic water allocation is 20 minutes per hectare each 7-1/2 days with a stream of 120 liters per second. This translates into a gross water applications of only 14.4 millimeters every 7-1/2 days and explains why so much land is idle. Basic water requirements of growing crops range from 2 mm per day to as much as 10 mm per day. At one point, we heard that the basic water allocation was 33 minutes per hectare with a flow of 350 liters per second. On a 7-1/2 day rotation basis, this translates to 9.24 minutes per day which agrees quite closely with the general "rule of thumb", 1 liters per second hectare or 8.64 mm per day. This latter figure of 33 minutes per hectare with 350 liters per second is undoubtedly the goal whereas the 20 minutes per hectare and 120 liters per second is the actual.

At Tacna, the team also visited La Yarada, an area of some 5000 hectares supplied entirely by wells and irrigated using both sprinkler and surface application. The wells were equipped with electric powered deep well pumps fielding directly in to the distribution system for surface application. Booster pumps at the well supply the pressure required for the sprinklers. Here the water is available on demand and power and operating costs are paid directly by the farmers. Pumps are operated and controlled by the farmers.



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(2) Agriculture in the project area

In Tacna, there is only enough water to irrigate about 2500 hectares[12], and nearly every farm has dry land that is not used. There were 4,471 hectares in the farms served in 1975. The farms in the valley proper had an average size of 3.95 hectare in 1975.[13] Small farms produce alfalfa, fruits, chile peppers, potatoes, vegetables, olives, corn, and even wheat. Two or more crops per year are common. A typical allocation of water in Tacna is 20 minutes per cultivated hectare every 7-1/2 days with an average flow of 120 liters per second, which works out to 7,008 cubic meters per hectare per year. Although water rights are not actually sold, officials in Tacna estimate that a water flow equal to one-half of the water allocation above typically might be worth S/ 15 million (or US$ 1,807.23). If this allocation's value is amortized over 20 years, its average annual value would be US$ 90.36 or US $0.02 per cubic meter. This relatively high value illustrates that excess water would be worth selling in Tacna.

b. Project management

(1) Roles and responsibilities

Similar to Tinajones, the Tacna System is managed by a Technical Administrator. He has a staff of 23, 14 of whom are sectoristas. Administrative units and roles are similar to those described above. Compared to Tinajones, however, the Tacna System is easier to manage, and both formal and informal relations between officials and farmers are better than in Tinajones.

Water users in Tacna are organized into three comisiones and a junta. The comisiones were established in 1973, formalizing the traditional irrigation groups which already existed. The comisiones are each based on a major unit of the system, thus they are operationally discrete. Farmers elect members of the comision, which then elects a representative to serve on the junta. Compared to Tinajones, the comisiones in Tacna are active, cohesive groups which manifest their strength in many informal interactions with irrigation officials and which contribute much voluntary labor to maintain and improve the system.

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[12]Leindo Gil, Nancy. "Marco Historico-Economico del Aprovechamiento del Agua el el Agricultural del Valle Viejo de Tacna." M.A. Thesis (Lima, Peru: Universidad Particular Ricardo Palma, 1976), p. 9.

[13]Ibid, p. 9.



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(2) Operation

Water is chronically short in Tacna and the land under irrigation has essentially decreased over the last decade. An annual plan de cultivo y riego is prepared in Tacna, but it has no bearing on water distribution. Water is allocated on the basis of land area, irrespective of the crop grown.

Water charge rates are supposed to be set at the beginning of an irrigation year and levied at the end. To establish individual payments, the total annual flow is divided by the number of delivery "minutes" in the system, and each farmer is billed according to his time allottment.

The rotation is systematic, based on traditional arrangements, but the water flow is reduced during periods of water shortage. The rotation sequence and time allotments are so well known that the system almost works by itself. Indeed, sectoristas open and close gates during their eight-hour daytime shift, and farmers themselves manage the system during the night.

(3) Maintenance

Theoretically, the junta is responsible for the maintenance of major canals and laterals, as in Tinajones, as well as the pumps located in the highlands. In practice, however, the Tacna system benefits from a special maintenance project, funded through the oficina agraria. Farmers and their organizations contribute to maintenance, but the bulk of the maintenance budget is provided externally. Comisiones organize and execute maintenance below the laterals. As virtually all of the channels are lined, such responsibilities are minimal, however.

(4) Urban water use

In addition to irrigation, the Caplina and Uchusuma Canals also supply drinking water to the city of Tacna. The urban supply has increased over the last decade as the population has doubled. The urban water supply is administered by SENAPA, which negotiates an annual water fee with the junta. Farmers do not object in principle to this use, but there are many complaints that too much of the urban water use is unregulated, and thus wasted, doubly depriving farmers of their needed supplies.

The urban water is not totally lost to agriculture. Discharge water from the Tacna water treatment plant has been diverted to a 200 ha settlement project area near the airport. Farmers are permitted to use the "treated" water only for above-the-ground crops, no root crops or low vegetables. Local people contend that the water is so rich in nutrients that farmers receive good yields with minimal inputs. This is not surprising; on more than one occasion during its brief visit to Tacna, the team saw mounds of detergent suds billowing



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from drop structures on the canals leading to the settlement area. However, even though the water is ultimately used for agriculture, this fact is little consolation to long-term residents, the farmers, who have lost part of their traditional water supplies.

c. Farmer participation

Farmers are actively involved in the Tacna system, both formally and informally. Their participation is less bureaucratic than that of farmers in Tinajones, and less systematic, but more pervasive on an everyday operational level. Farmers, their representatives, and officials seem to maintain a close collaborative relationship, rather than the strict division of labor which is evolving in Tinajones. Nonetheless, there are limits to farmer participation in Tacna which should be overcome.

User groups have not participated officially in questions of system design, but they are likely to do so in the future, at their own initiative. Two circumstances have prompted farmers to take an active interest in future developments of the system. First, urban consumption steadily decreases the supply of irrigation water available, and threatens the very survival of agriculture in the Valley. Farmers know that they will continue to lose the battle unless new water supplies are tapped. Second, they have already experienced the burden of short-term, energy-intensive responses to their need for more water. When the diesel pumps were installed high up on the Uchusuma Canal, the water supply increased and became more regular. However, the fuel costs, maintenance requirements and logistical problems associated with the diesel pumps have been so great, and so continual, that farmers now question the benefits they derive. Although there is no move to eliminate the pumps, the user groups will surely object to any further developments which place huge recurrent cost burdens on them.

Farmers participate informally in many maintenance operations beyond those required of comisiones. However, the junta in Tacna has not assumed formal responsibility for maintenance, nor is it likely to do so as long as external funds are available. If required, the junta could probably become an implementation agency, but it cannot be expected to seek out such responsibilities as long as the Technical Administrator has the funds and manpower needed for such work. Nonetheless, it is clear that the junta participates in discussions to set maintenance priorities and schedule work.

For the most part, the junta has played a passive role in cost recovery. It sets tariff and quota rates and leaves collection to the Technical Administrator, primarily because the funds are ultimately managed by officials, not by the junta. Consequently, recovery rates have been low. As in Tinajones, however, such low rates reflect collection problems, not payment problems. For example, once the Chairman of the Uchusuma Comision decided to take an active interest in recovering outstanding charges, most delinquent farmers complied



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long before sanctions would be imposed. The system would benefit financially and administratively if other Chairmen would also undertake such a campaign.

Water theft, the most common problem in the system, occurs principally at night during the months of short water supply--September, October and November. If caught, farmers are sanctioned by the comisiones, which also resolve other conflicts. Overall, traditional social control patterns prevail over bureaucratic ones, thus the Technical Administrator rarely is called upon to assume a juridical role, as in Tinajones.

d. Cost recovery

Farmers in Tacna pay three types of water charges--the tariff, a quota, and a special quota. In addition, they informally contribute much labor to assist the staff of the Technical Administrator in carrying out both routine and emergency repair and maintenance works. Finally, the junta is paid by SENAPA for the water diverted to the city of Tacna. Nonetheless, because of the high cost of operating the pumps in the highlands, Tacna farmers ultimately assume a smaller proportion of the total operation and maintenance costs of their system than their peers in Tinajones. Despite the lower charges, and despite the greater solidarity among users, recovery rates in Tacna are no better than in Tinajones, primarily because of lax collection procedures.

(1) Tariff

In 1984, the tariff in Tacna was 0.40 Soles per cubic meter. The proposed 1985 tariff, to be decided in early April, was 0.60 Soles per cubic meter, a 50 percent increase. Ten percent of the tariff is sent to Lima for "amortization," and nothing is sent for the water canon. The remainder is allocated to the junta, and much of it ultimately returns to the Technical Administrator to cover fuel, vehicles, office expenses, and the salaries of two sectoristas.

(2) Quota

The quota, also decided and levied by the junta, is used exclusively for maintenance, through the Technical Administrator's office. The quota was 1.50 Soles per cubic meter in 1984, and was expected to be increased to 1.80 Soles per cubic meter for 1985. The Chairman of the Uchusuma Comision expressed the need to raise the quota to 3.00 Soles per cubic meter, but doubted that such an increase would be approved by the farmers.



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(3) Special quota

The comisiones assess an annual special quota for the maintenance of minor canals. The amount of the special quota varies from one year to the next, but it is always minimal. It is calculated in Sol, in an amount equal to a number of labor-day equivalents, generally on the order of one day per 20-minute irrigation turn. As in Tinajones, this special quota is honored by farmers. Cash payments are used to reimburse farmers who work more days than required.

(4) Urban water charges

The city of Tacna is the largest single consumer of water from the canals, and its share increases annually. In 1984, SENAPA obtained 1.80 liters per second from the Uchusuma Canal and 0.60 liters per second from the Caplina Canal. The two Uchusuma Comisiones received a total of S/ 11 million for their share of the water in 1984, which they added to the maintenance fund.

e. Summary

Tacna is an interesting system because it contains a healthy mixture of tradition and new technology. The water supply is inadequate, but the system runs smoothly because farmers are experienced in managing irrigation water, individually and collectively, and they know the value of the water, as it is linked to their very survival. The irrigation administration and the official water user structure are institutional facades covering a basically sound traditional system of relationships and controls. Water delivery is dependable and equitable and it is said farmers "lend" water to one another at times. The system is threatened by competing water use demands, increasing fragmentation of landholdings and the cash requirements of higher standards of living. There are signs that farmers and officials are trying to find ways to obtain additional water.

Cost recovery for O and M is feasible in Tacna, in terms of the farmers' ability to pay, but farmers will not easily agree to substantial increases in the tariff and quota. Currently, Tacna still has access to maintenance funds, thus water collection has not been emphasized systematically by either the junta or the Technical Administrator, nor has the junta been given responsibility for maintenance. One comision has launched a campaign to collect water charges, but the team understands that this is not a general trend.

Tacna has a high level of farmer participation in O and M, both formal and informal. Although this undoubtedly reduces overall system costs, the participation has not affected direct cost recovery. As in Tinajones, cost recovery deficiencies seem to relate to the collection side, rather than the payment side. That is, very little effort is made to collect the funds, the level of collection only partially



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affects the O and M budget, and sanctions really are not imposed for non-payment. Consequently, farmers have little incentive to pay, and many do not. As in Tinajones, water application efficiency is not likely to improve if the cost of water increases. Farmers use water efficiently when it is scarce, and they are not known to over-water when it is abundant. Until now, water price has nothing to do with this practice and it is unlikely to affect it unless a number of basic physical characteristics of the system are changed.

3. Plan MERIS II

a. Background

(1) Description

Plan MERIS (Plan de Mejoramiento de Reigo en la Sierra) provides for small scale irrigation projects with the general objective of improving the quality of life for the farmers of the mountain areas through increased production under irrigation.

Plan MERIS II projects in the Cusco area have been funded by the German government along with technical support to design and initiate the operation of the projects. Eleven such projects are now in various stages of completion, two of which were visited by the team, Cusipata and Salcca. At Cusipata, the team only talked with farmers at project headquarters, at Salcca a trip was made to the diversion structures and along the canal and distribution system. Both systems are located in the high mountain valleys above Cuzco at elevations upwards of 11,000 feet.

Both projects divert directly from the river. Unlike the coastal irrigation projects, these systems have ample water in the river, thus the operational plan anticipates only daytime irrigation with release of water back to the river at night. This requires more capacity in the conveyance system but provides some insurance against erosion damage and poor distribution associated with nighttime irrigation.

The Salcca system includes the diversion and sluiceway structure and 28 km of main canal with a rubble masonry lining. The diversion gate is below the river bed and a diversion weir is not required. There are approximately 14 km of laterals serving 1200 ha with 600+ farm families. This project is an enlargement of an old project which served some 350 families. The process of integrating the old and new system is apparently still underway.

The Cusipata project is similar in design with a diversion higher than the one serving the old project to make possible an increase of approximately 30 percent in the area served. This project includes approximately 11 km of main canals and 11 km of laterals serving a total area of 476 ha with 679 families.



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(2) Agriculture in the project area

Most of the farms are small, some less than 1/3 ha, the terrain is rugged and the altitude above 10,000 feet. These farms exist as a source of security for the families and especially for the women. Traditionally, they only produce one crop per year in the rainy season--October to April. The crops are mainly for consumption--corn, beans, potatoes and quinoa. If complementary irrigation is available, they use it twice; once in June to sprout seeds and a second time in October, before planting, to guarantee germination. A German agricultural economist estimates that it would take at least 1.8 ha to feed a family of six and provide enough marketable surplus to exist. Yet the average size is much smaller than this and subdivision is continuing.

These little valleys near Cuzco are not major crop exporting areas. The main export crops are alpaca wool, which comes from higher elevations (12,000 to 14,000 feet) with less irrigation, and coffee which is produced at much lower elevations in the high jungle. Many of the men work outside of the valleys for six months of the year. They return for celebrations and sometimes to help with planting and harvests.

The main emphasis in the individual irrigation projects is on growing a second crop and maintaining home gardens during the period May to October. The projects as much as double the existing gravity fed command areas and they are designed to allow double cropping in the whole area served. The concept may have merit as far as home gardens are concerned, although this will not automatically result in improvements in the nutritional status of people in the project area. However, the idea of using the second crop to increase family incomes directly is very problematic. Local demand inelasticities and the absence of viable marketing channels may cause farm incomes to fall, rather than rise, if second cropping becomes prevalent. Nonetheless, incomes may increase indirectly if the second crop enables more people to remain in the project area to produce handicrafts, knit sweaters and other products that can be exported from the region. Plan MERIS is apparently considering honoring requests to install small hydro-electric systems which could supply electric power for small mills and sewing machines. However, this aspect of the program has not been well developed to date.

b. Project management

(1) Roles and responsibilities

The Plan MERIS II projects are both more complex and simpler than the irrigation systems described above. They are more complex because, theoretically at least, they involve a number of different agencies at different stages in the planning, implementation and operation of the individual systems. However, they are institutionally simpler than the other projects because only one



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agency really is actively involved in the program, Plan MERIS II itself. Much of the cooperation and collaboration implicit in the project design, including that of the farmers, has yet to materialize.[14]

With the assistance of a team of six expatriate advisors, Plan MERIS II staff design, construct and repair the irrigation channels and plan and implement an agricultural development program. Initially, the design work was contracted to private firms, but the experience was not satisfactory and the Plan has since developed the in-house capability to undertake the work. Virtually all other types of expertise that might be needed for the program, from agricultural extension to social work, are included in the Plan office or are made available through the technical assistance budget, without reference to other line agencies. This does not mean, however, that staffing levels are necessarily commensurate with the amount of work to be done, or the extent of the area to be covered.

It is hoped that the regional irrigation and agriculture offices will assume responsibility for their respective programs when Plan MERIS II concludes, but this may not happen. There is little substantive communication between Plan MERIS II and the other offices at present, and it is doubtful that the offices will be given the manpower or financial resources needed to continue the programs once the Plan office is dismantled. This prospect very much worries Plan staff.

In effect, the Plan MERIS II administration is a self-contained, virtually autonomous authority which has its own funds and staff to carry out its mandate in the villages. In addition, it has resources to mobilize for investment in supplementary social infrastructures, such as health posts and pre-schools, that frequently are used as bargaining chips in negotiations with villagers. However, many of the ancillary programs--extension, nutrition, education, health, and so on--are ad hoc activities without adequate planning or staff either to guarantee that the desired impact will be achieved or to ensure continuity.

Once construction is completed, the Plan calls on farmers to establish water user organizations, generally consisting of Comites de Regantes on the lateral level, and a system-level comision. The Plan provides tomeros, ditch tenders, who are responsible for water scheduling and distribution, and pays their salaries. After a threeyear operational shake-down period, Plan Meris II intends to withdraw, leaving the systems entirely in the hands of the water users.

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[14]Many of the problems in this project are similar to those of Plan Meris I. See Wilkinson, John L.; McKeon, C., Meyer, R.; Nunberg, B., Weil, C., and Martinez, H. Peru: Improved Water and Land Use in the Sierra. AID Project Impact Evaluation No. 54 (Washington, DC: US Agency for International Development (AID), 1984).



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(2) Operation

Cusipata can be seen as an example of how simply the Plan MERIS II systems operate. The system provides supplemental irrigation during the rainy season, normally once or twice for a crop. When he needs water, a farmer approaches the tomero early in the morning to request a place on the day's schedule. The tomero sets the schedule, which generally allows five or six hours per hectare, and then opens and closes the gates. Crops are irrigated more frequently during the dry season, but only about 50 farmers crop during the dry season, so the demand system is still easy to operate.

Overall, the system operates essentially as it did before being upgraded by Plan MERIS II, with five principal exceptions. First, the command area has increased, but the previous distribution pattern has been maintained. Second, in the old command area, four farmers can get water at the same time, rather than one at a time. Third, more people irrigate during the dry season--about fifty, rather than four. Fourth, there are three salaried tomeros, paid by the Plan, rather than one tomero position which rotates among farmers in the system. Finally, in most aspects of system operation, farmers and their representatives are subject to the influence of Plan staff, rather than independent.

(3) Maintenance

Once construction is completed, Plan MERIS II takes care of major maintenance for a period of approximately three years. This has been essential, because most of the first systems encountered substantial maintenance costs at the outset, which farmers would not have been able to afford to undertake themselves. Plan officials say that current and future projects are to be designed to minimize recurrent maintenance costs, even though that means higher per hectare construction costs.

The comisiones are responsible for minor maintenance. Such work is recommended by Plan staff or farmers themselves and organized by the comisiones. A number of different activities have been undertaken quite successfully in Cusipata. Farmers are already familiar with the kinds of work required, thus they need no special encouragement or training to set the process in motion, once an organizational mechanism is established.

c. Farmer participation

Farmer participation is an exceedingly important issue which Plan MERIS II has just begun to face seriously. Until recently, the Plan has discouraged participation, seeing it as a threat, rather than a benefit. In their zeal to implement the projects, Plan staff took pains to avoid giving farmers or local leaders any opportunities to provide input into decisions affecting the projects, because they feared they would meet opposition, not support. In practice, they did



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encounter much opposition, but it is not clear whether the opposition resulted from the recalcitrance of farmers, or was a reaction to the heavy-handed approach of Plan staff. The Plan has modified its approach lately, but only after wasting much time and money.

It is indicative of the Plan approach that the local language Quechua, is used as a medium for defusing opposition, not for initiating communication, despite that fact that many Plan staff speak the language. This bias may be inevitable, given the origins of the project (Lima) and the presence of the expatriate advisor cadre. Nonetheless, it is a source of discontent among Plan staff and certainly limits the impact of the project.[15]

In early stages of Plan MERIS II, farmers in many villages opposed the Plan's proposal for their villages. Sometimes the farmers believed that the proposals were not feasible; sometimes they feared they would be forced to pay for all the water they would receive; sometimes they said they did not need the proposed project because they already had irrigation water. Whatever the reason, opposition was common. In most cases, Plan staff ultimately convinced people to accept the systems, often by promising additional facilities, and then proceeded with construction. In at least one case (Chectuyoc) construction started and concluded despite local opposition, and farmers have never really used the system. Now that the Plan has successfully completed some systems, however, additional villages have approached project staff seeking assistance.

Initially, project designs were not discussed with farmers. Technical staff alone reviewed the designs and attempted to implement them. Farmers were expected only to give their consent to a project as a whole. In the field, Plan staff found that some farmers challenged specific design elements, such as the placing of laterals and sublaterals, and even the number of laterals in the system. Often, staff discovered that the challenges were reasonable. Subsequently, Plan staff started to review detailed designs with farmers and adopted many of the suggestions they received, including the placement of diversion structures.

One basic element of the Plan MERIS II approach was to use local laborers for construction. This was expected to upgrade local skills and to provide employment opportunities. In practice, local project managers decided who can work. In some projects, the manager used local farmers as laborers; in others, outside laborers were brought in to do the work. In all cases, laborers were paid slightly more than

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[15]Jack Keller, et al., Peru: Irrigation Development Options and Investment Strategies for the 1980s, USAID Water Management Synthesis II Project, Report No. 14 (Logan, Utah: Utah State University, 1984), Annex IV, by Percy Aitken, pp. 86-87.



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the prevailing daily wages, and beneficiaries were not expected to work without pay. This strategy probably served to dissuade farmers from thinking of the systems as their own.

Despite the fact that the traditional irrigation systems each had some sort of water user institutional structure, Plan MERIS II staff chose to ignore the existing structure and, at the conclusion of construction, attempted to create their own water user committees and comisiones. Had they tried to use existing group structures instead of establishing their own, and had they tried to start the associations at the beginning of a project instead of the end, undoubtedly Plan staff would have found farmers to be much more receptive and cooperative. The Plan has recently modified its approach to follow this suggested plan of operation.

Prior to Plan MERIS II, each of the systems was operated and maintained entirely by the farmers. Since the Plan, however, farmers have lost many of their responsibilities, and much of their authority. Ultimately, the plan may want to relinquish the authority and responsibilities it usurped, and the farmers may not be willing to accept them again.

Comites and comisiones have full authority to levy and collect the quota. The charge is low and should stay low until the economic viability of the irrigation investments are firmly established, and until the agriculture development program has had an impact. In order to speed up the process, the Plan has recently started to introduce the agriculture program before construction, rather than wait until afterwards.

The principal area of conflict in Plan MERIS II systems is the question of the allocation of water between old and new parts of the systems. This sort of conflict is inevitable, but it is probably exacerbated by two factors: disparate traditions in old and new parts of the system; and the strategy of forming groups at a late stage in system development. That is, farmers in the old command areas have long experience in working together in irrigation, but those in the new areas do not. It is difficult for a comision to handle conflicts between comites until the comision itself is well established and until the comites individually develop some sort of legitimacy. This will take time. Secondly, the Plan strategy of forming groups only after construction makes it even more difficult for the new groups to establish themselves. Consequently, Plan staff undoubtedly are called upon to resolve conflicts which the comisiones themselves should handle.

d. Cost Recovery

Like other PEPMI projects, Plan MERIS II makes no attempt to recover investment, shake-down or operating costs from farmers. The comisiones levy an annual quota, but not a tariff. In Cusipata, the quota for 1984 was S/ 500 per topo, or about



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S/ 1,500 per hectare. The comision recommended an increase to S/ 3,000 per hectare for 1985, but the proposal was voted down by the farmers. Until dry season cropping becomes more prevalent, and is shown to be remunerative, it is not realistic to expect the quota to be increased enough to cover the full cost of maintenance.

In Cusipata, and presumably in the other systems, the quota is used for at least two purposes. First, it covers the cost of establishing the comision itself, including such things as furniture and office supplies. Second, it is used to buy food and drinks (chaquipa) for farmers who participate in maintenance activities, as well as to pay them a minimal honorarium.

e. Summary

Until the Plan MERIS II projects are shown to bring substantial economic benefits to the farmers, it is not feasible to expect the full cost of operation and maintenance to be recovered. By the same token, however, the plan should discontinue policies which unnecessarily raise recurrent costs, like paying salaries of tomeros, instead of utilizing the traditional tomero appointment and payment procedure.

Because of the many problems encountered in its earlier attempts to impose its projects on the villagers, Plan MERIS II has begun to encourage farmers to participate in various aspects of project planning, design and operation. If Plan staff take this approach seriously and adopt such measures as communicating in Quechua at the outset, instead of doing so only as a way of defusing opposition, there is hope that the Plan will ultimately have a beneficial impact, and that the Plan will be able to withdraw and leave the systems completely in the hands of the farmers.

For too long, however, the Plan has used an approach which is inconsistent with its long term goals. The only way for the Plan to succeed is to construct improved irrigation systems, to help farmers establish farming systems which can make good use of the irrigation water, and to withdraw. Plan MERIS II still needs to demonstrate that its agricultural recommendations are viable, but at least it seems to have learned the lesson that it cannot help farmers become more competent and independent by imposing its will upon them.

D. Summary and Conclusions: Study Issues

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

If the discussion is limited to recurrent (O and M) cost recovery, our evidence supports the conclusion that cost recovery is a feasible goal, in general. Although individual farmers vary considerably in their ability to pay water charges, even within systems, the water charges are so low in each of the systems that this factor does not appear to affect payment rates.



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Cost recovery has been low in most of the systems we visited, but the low recovery rates indicate inconsistent policies within the various irrigation authorities, rather than problems with farmers. In Peru, it is clear that responsible agencies have not been serious about collecting fees, and have made few efforts, if any, to apply sanctions for non-payment. In many cases, it is not physically possible for authorities to cut irrigation water supplies for delinquent farmers. Where this is possible, however, it is rarely done. In two small systems near Chiclayo, farmers must pay for water in advance, and they do. In the other systems, water fees are assessed annually, sometimes long after the conclusion of the irrigation season, and payment rates are low unless officers of the users' association take a special interest in the collection process.

In general, irrigation staff believe that farmers should pay O and M costs, but they seem to be reluctant to enforce collection, either because they do not want to give farmers reason to question the quality of their service, or because they identify specific conditions which seem to limit the ability of farmers to pay, such as floods, droughts, or combinations. That is, they think farmers ought to pay, but are not sure that they can afford to do so. Consequently, they do not enforce collection and they never really find out whether or not their perceptions are accurate. Moreover, until recently maintenance budgets were unrelated to collection rates, thus there was little institutional incentive to enforce collection provisions.

Rice farmers in Tinajones and fruit producers in Tacna clearly can afford to pay irrigation assessments, and it is likely that assessment levels and payment rates will rise as it becomes clearer that the fees are essential and that they are all used locally to operate and maintain the systems. In the Plan Meris II systems, farmers can probably pay the fees that are currently assessed, especially because most of the funds are recycled within the system in the form of payments to people who participate in maintenance activities. However, there is some question about the ability of farmers to pay the overhead operating costs currently borne by the Project.

The situation is not as clear regarding the recovery of sunk costs, major emergencies, and investment in future developments. A small amount of the tariff is supposed to be transferred to Lima for "amortization" of previous investments. The amount is insignificant and officials feel that farmers resent the transfer, thus they increasingly ignore this provision. This decision reflects a reasonable assessment of the farmers' desirability to pay such sunk costs, especially in Tacna and Tinajones, where water supplies are still too limited to provide dependable service.

Major emergencies, such as the 1983 flood damage in Tinajones, and shakedown costs, such as those in Plan MERIS II, are still covered by external funds. It is not likely that these costs could be borne by the water users, especially in the Plan MERIS II systems.

There is some indication that farmers may be able, and willing, to assume some of the costs of future system developments, especially if the investments ultimately guarantee regular, adequate water supplies. However, this applies only in some systems, and on an irregular basis. In Tinajones, the junta has already paid for one technical study and may make other such investments in good years, but not in poor years. This means that it is difficult, if not impossible, to establish the sort of long-term plan which is needed for major investments. Consequently, water users should be included more actively in the development process, but it is unrealistic to expect them to assume major investment burdens until after they already start to benefit from the investments.

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

In Peru, a hierarchical structure of water user associations is mandated by law, and implemented in most coastal systems, to a greater or lesser degree. The situation in the Sierra is much more mixed. In Tinajones, the role of the associations has grown as the government maintenance budgets were cut. In this case, participation and control followed a withdrawal of government subsidies. Now, the water user groups control maintenance entirely, through a not-for-profit company which was formed with personnel and equipment transferred from the local development corporation. It is likely that the role and authority of the associations will increase in the future.

In Tacna, farmers pay a much smaller part of the O and M budget, but they have institutional authority similar to that of the associations in Tinajones. The associations own the building in which the irrigation authority is located, they pay salaries of some sectoristas (as in Tinajones) and are trying to participate in discussions about future system developments. Nonetheless, because the maintenance budget in Tacna has not been entirely cut, there is no discernible relationship between participation and control and cost recovery.

In Plan MERIS II systems, cost recovery is now limited entirely to activities of the comisiones and participation has essentially been discouraged. It remains to be seen whether or not the farmers will eventually be given control over their systems; whether or not they will accept responsibility if it is given to them; and whether or not cost recovery will be related to either of the above. Recent changes in the Plan's operational approach may improve the prospects of achieving a smooth transition from Plan control to local control.



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3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?

a. Reliable water supply

The team expected to find evidence of a relationship between cost recovery and the reliability of water supply, but found none in the systems visited. Indeed, two of the small systems near Tinajones with irregular supplies require advance payments, indicating a possible inverse relationship between reliability and cost recovery. For the most part, the systems we saw in Peru had reasonably reliable, but not adequate, water supplies. Instead, the team identified a clear link between the reliability of water charge collection and cost recovery.

b. Adequate water supply

As above, the tariff levels were too low, and collection patterns too irregular to indicate a relationship between cost recovery and the adequacy of water supply. Once tariffs increase, some linkages may become apparent, but the data available and the experience so far do not support such conclusions.

c. Water delivery and measurement technology

This possible relationship also was not discovered in our cases. In none of the systems we visited can water be measured at the farm turnout level. In Tinajones, measurement is possible on the main laterals, but not below. Consequently, in no system is it possible to do more than estimate the amount of water which may reach a farmer, and even in those cases, there is no indication that measurement and cost recovery are related.

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water?

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

In coastal systems in Peru, increased water charges are necessary for improved O and M, and they may be sufficient, if the funds are used in the system in which they are collected. In the Sierras, the answer is not so clear.

Government maintenance budgets have been cut or eliminated altogether, depending on the system. Systems are supposed to be maintained by funds generated locally at levels set by the farmers themselves. This arrangement has been questioned by at least one international donor agency, presumably because it gives too much power to consumer groups and precludes using donor funds for such purposes.



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The team believes that the existing strategy is correct, although it needs to be supported by a significant effort to involve water users more directly in the operation of individual systems, as is happening already in Tinajones.

Farmers themselves set the tariffs and quotas; officials can recommend fee levels, but they cannot impose them. Thus before water charges can be increased, as required, to cover maintenance costs, the authorities must convince farmers of the necessity. Even in Tinajones, this is expected to be difficult.

Other things being equal, increased budgets are likely to result in improvements in O and M, although the benefits may be unevenly distributed. The impact of higher charges can be increased if farmers are involved more actively in the operation of the system itself, in determining maintenance priorities, in identifying needed structural changes, and in setting rotation and rationing programs. This is easier to say than to do, because effective participation requires adequate preparation and understanding of technical and organizational questions, which means that both officials and water users have to do their homework.

Tinajones exemplifies many of the areas in which water users can and should participate in system operation, but it also illustrates some of the limitations of this approach. For example, water allocation in Tinajones is based on the plan de cultivo y riego, which attempts to reconcile farmers' cropping preferences with projected water availability. For many reasons, farmers want to grow rice, but the total water supply is generally short of the amount required to honor all cropping requests. This year, the supply is much less than predicted at the time the Plan was adopted. Nonetheless, farmers used political influence to get authorities to approve rice allottments which far exceed even the projected water supply. Now farmers and officials alike are in a bind.

The situation in Tinajones illustrates three points. First, farmers do not necessarily accept official water estimates. That is, they question the technical decisions of officials. Second, farmers may not really understand the technical limitations of the system, thus they are not prepared to make responsible decisions. In other words, an essential educational role of the officials has not been successfully carried out. Finally, it shows how vulnerable such an arrangement is to political manipulation. Again, poor information and limited credibility contribute to this vulnerability.

b. To what extent does efficiency of water use vary with the cost of water?

Our cases turned up no situations conducive to linking water prices and application efficiency. In none of the systems is water cost related to water use in such a way as to encourage farmers to use less water than they have available. There are any number of instances in which application efficiency is affected by water scarcity, but not by charges.

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

The record of communal systems is obvious: participation and O and M levels are essentially isomorphic. The Plan MERIS II systems around Cuzco were self-sufficient before the Plan imposed itself, for instance. The record is not so clear in systems which are constructed or managed by irrigation authorities, primarily because participation is generally restricted, if it is even encouraged. Our cases offer evidence to support the relationship between participation and control and O and M, although our conclusions are based on projection, rather than accumulated experience.

In Tinajones and Tacna, user associations are assuming increased responsibilities for decisions affecting the maintenance, operation and expansion of the system. The institutionalization process is still in its initial stages, but there is ample reason to be optimistic about the future. In any case, the financial situation of the government is such that there is no alternative; if users do not participate in critical decisions, and thereby mobilize maintenance funds locally, there will be no funds at all.

In Plan MERIS II, one sees the consequences of external attempts to impose irrigation "development" without encouraging participation. In some instances, Plan staff have had to re-design systems to overcome faults which farmers quickly identified; in other instances, farmers still refuse to utilize the systems. Apparently the approach will be modified in future systems, based on lessons learned to date, but the question remains as to the future role of farmers vis-a-vis their systems.

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# IRRIGATION PRICING AND MANAGEMENT

## ANNEX 2

## Dominican Republic

Submitted to: Ms. Joan Atherton
Social Science Analyst
U.S. Agency for
International
Development
Office of Policy
Development and Program
Review
Bureau of Program and
Policy Coordination

Submitted by: Ian D. Carruthers
N.S. Peabody, III
A.A. Bishop
A.D. LeBaron
Rekha Mehra
Ramchand Oad
Dean Peterson
Dennis H. Wood

DEVRES, INC.
2426 Ontario Road, N.W.
Washington, D.C. 20009
(202) 797-9610
Cable: DEVRES
Telex: 440184

Contract No.: OTR-0091-C-00-4466-00

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ANNEX 2

Dominican Republic

N.S. Peabody, III,
Team Leader and Social/Institutional Specialist
A.A. Bishop,
Irrigation Engineer
A.D. LeBaron,
Resource Economist

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AEA | Agente de Extensión de Area |
| AID | Agency for International Development |
| ASPIRE | Association Para Inversion y Empleo, Inc. |
| BAGRICOLA | Banco Agricola |
| C por A | Compaña por Acciones |
| CADR | Centro de Administracion del Desarrollo Rural (ISA) |
| CDE | Corporaciòn Dominicana de Electricidad |
| CEDOPEX | Centro Dominicano de Promociòn de Exportaciones |
| CIAZA | Centro de Investigaciòn Agricola en Zonas Aridas |
| CNA | National Agricultural Council |
| COCOPSA | Comite de Coordinacion de Planificacion Sectorial Agropecuaria |
| CONAPOFA | Consejo Nacional de Poblacion y Familia |
| DR | Dominican Republic |
| EEF | Extended Fund Facility |
| EMESIRE | Estudio para el Mejoramiento de sistemas de Riego Existentes |
| FAO | Food and Agriculture Organization of the United Nations |
| FEDA | Fondo Especial Para el Desarrollo Agropecuario |
| GDR | Government of the Dominican Republic |
| IAD | Instituto Agrario Dominicano |
| IDB | Inter-American Development Bank |
| IDECOOP | Instituto de Desarrollo y Crèdito Cooperativo |
| IICA | Instito Interamericano para Cieucias Agricolas |
| IMF | International Monetary Fund |
| INDESUR | Instituto para el Desarrollo del Suroeste |
| INDRHI | Instituto Nacional de Recursos Hidràulicos |
| INESPRE | Instituto de Establizacion de Precios |
| IRR | Internal Rate of Return |
| ISA | Instituto Superior de Agricultura |
| mcm | Million cubic meters |
| NARMA | Natural Resource Management Project |
| O and M | Operations and Maintenance |
| OAS | Organization of American States |
| ODC | Oficina de Desarrollo de la Comunidad |
| ODESIA | Oficina para el Desarrollo Integral Agropecurio del Valle de Azua |
| ONAPLAN | Oficina Nacional de Planificaciòn (del Secretariado Tecnico de la Presidencia) |



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| | |
|---|---|
| ONE | Oficina Nacional de Estadistica |
| PRYN | Proyecto Riego Yaque del Norte |
| PROSEMA | Proyecto de Servicios y Maquinarias Agricolas |
| SEA | Secretaria de Egtado de Agricultura |
| UNDP | United Nations Development Program |
| URPRE | Unidades Regionales de Planificacion Economica |
| YSURA | Proyecto Yaque del Sur - Azua |



7/03

## CURRENCY EQUIVALENTS

US$ 1.00 = RD$ (Dominican Republic pesos) 1.00

US$ 1.00 = RD$ 3.14 (free market rate as of June 26, 1985)

## WEIGHTS AND MEASURES

| | |
|---|---|
| 1 hectare (ha) | = 10,000 $m^2$<br>= 2.471 acres |
| 1 tarea (t) | = 0.063 ha |
| 100 hectares (ha) | = 1 $km^2$ |
| 1 kilogram (kg) | = 2.204 pounds |
| 1 metric ton (MT) | = 1,000 kg<br>= 2,204 pounds |
| 1 bushel (bu) | = 28 pounds |
| 1 quintale (qq) | = 100 pounds |
| 1 libre (lb) | = 16 ounces |
| 1 square kilometer ($km^2$) | = 100 ha |
| 1 millimeter (mm) | = 0.04 inch |
| 1 cubic meter ($m^3$) | = 1,000 liters |
| 1 liter (l) | = 1.066 quarts |
| cubic meters per second ($m^3/s$) | = 1,000 liters per second |

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## LIST OF PEOPLE INTERVIEWED

Santo Domingo

Dr. Gilberto Reynoso
Director, Departamento de Distritos de Riego
Instituto Nacional de Recursos Hidraulicos (INDRHI)

Ing. Agró. Jose Fco. Guillén
Chief, Tariffs and Quotas
INDRHI

Ing. Jesus Pichardo
INDRHI

Ing. Antonio Sanchez
INDRHI

Ing. Rafael Sanchez
INDRHI

Dr. Bruce Anderson
Chief, Technical Advisor
On-Farm Water Management Project
INDRHI

Dr. Rafael Rojas
Advisor
On-Farm Water Management Project
INDRHI

Dr. Santiago Tejido
Coordinator
Unidad de Estudios Agropecuarios
Consejo Nacional de Agricultura

Dr. Agustin A. Millar
Instituto Interamericano para Ciencias Agricolas (IICA)

Ing. Jesús Reyes M.
IICA

Mr. Marion H. Ford
Chief, Agriculture
USAID

Dr. Roberto Castro
Economist
USAID



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Ms. Deborah Maxwell
Project Officer
On-Farm Water Management Project
USAID

Ing. Cesar Cruz
On-Farm Water Management Project
USAID

Azua

Ing. Omar Sandeaux
Chief
Valle de Azua Irrigation District

Ing. Agrón. Reyito Abrahanson
Chief, Operations
Valle de Azua Irrigation District

La Vega

Ing. Agrón. Freddis José Pérez T.
Chief, Irrigation and Drainage
Yuna-Camú Irrigation District

Ing. Rosfancy Moreta
Chief, Supervision
Yuna-Camú Irrigation District

Committee Members and Farmers
Assoc. de Agricultores Santa Eduvigis
Sabana Rey, La Vega

Santiago

Ing. Agrón. Silvio Carrasco
Chief
Alto Yaque del Norte Irrigation District

Ing. Agrón. Nelson Cruz Santos
Chief, Operations
Alto Yaque del Norte Irrigation District

Ing. Agrón. Marcelo Sanchez
Chief, Esperanza Irrigation Zone
Alto Yaque del Norte Irrigation District

Water User Committee Members
Esperanza Irrigation Zone



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Mr. José Joaquín Crespo M.
President, Molinos de Arroz Cibao
Peñuela, Esperanza

Ing. Felix Muñoz
Chief, Santiago Irrigation Zone
Alto Yaque del Norte Irrigation District

Water User Committee Members
Santiago Irrigation Zone

Ing. Rafael Castellanos
Professor of Irrigation
Instituto Superior de Agricoltura (ISA)

Ing. Andrés Fernandez
Professor of Irrigation
ISA

Mr. Brian Barnett
ISA

Mr. Carlos Escobar
ISA

Mr. Teofilo Gomez
ISA



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ANNEX 2
Dominican Republic

A. Background

1. Economic background

a. Macroeconomic conditions and policy

The general progress of economic growth in the Dominican Republic (DR) during the 1960s and 1970s was very good. In some years real growth in Gross Domestic Product (GDP) reached 13 percent. (See Tables 2-1 and 2-2 for GDP estimates since 1970.) But all of this began to slow with the steep rise of petroleum import prices in 1978 and came to an end with the precipitous drop in world prices for important Dominican Republic export commodities, especially sugar and ferronickel. Earnings from these two items alone fell from US$ 670 M in 1981 to US$ 350 M in 1982.[1] In addition, during the past four or five years, high interest rates in world financial markets have made foreign credits scarce and expensive. GDP has grown little, if any, since 1982.[2]

A domestic economy slowdown does not necessarily result in a reduction in import demand. Indeed, import demand may rise relative to the slowdown if, as in the case of the Dominican Republic, the domestic currency becomes overvalued. Accompanying any major slowdown is a steady loss in confidence that the traditional exchange rate (1 peso [RD$] = 1 US dollar), reflects reality. However, as long as the Central Bank is willing to sell dollars at the official rate, more and more dollars will be purchased to finance more and more imports. The most immediate (but difficult political) remedy is devaluation. But devaluation is a bitter political pill so it is natural that other stratagems are tried first. These include import quotas on tariffs and restrictions on availability of foreign exchange. Black markets can also develop to relieve some of the pressure of an overvalued currency.

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[1]Inter-American Development Bank, "Dominican Republic Reformulation of Loan 570/SF-DR." Mimeo Document PR-915-Z. Memo to Board of Directors from the Secretary (Washington, D.C.: Inter-American Development Bank, 1984), p. 3.

[2]Instituto Nacional de Recursos Hidráulicos (INDRHI), "Resumen Proyecto de Presupuesto de operacion, mantenimiento y administracion para el año 1985" (Santiago: INDRHI Irrigation District Files, 1983), p. 2.



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IRRIGATION PRICING AND MANAGEMENT: DOMINICAN REPUBLIC

Table 2-1: Gross Domestic Product by Sector (1970-1982)
(Constant US$--1970 Prices)

| Sectors | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|
| Crops | 232.6 | 247.0 | 253.9 | 279.3 | 279.1 | 262.8 | 296.3 | 310.3 | 318.4 |
| Livestock | 103.1 | 107.7 | 113.7 | 116.3 | 118.8 | 125.3 | 168.2 | 179.1 | 190.6 |
| Transport | 104.5 | 116.3 | 124.7 | 140.7 | 155.0 | 161.3 | 199.6 | 210.1 | 222.1 |
| Government | 152.1 | 157.8 | 156.8 | 157.1 | 168.6 | 183.1 | 277.7 | 274.7 | 281.7 |
| Manufacturing | 275.4 | 311.0 | 336.5 | 361.3 | 399.4 | 428.5 | 530.2 | 546.1 | 563.9 |
| Construction | 72.7 | 103.3 | 112.7 | 137.5 | 141.0 | 152.6 | 130.9 | 132.6 | 134.7 |
| Commerce | 237.6 | 269.9 | 308.9 | 340.3 | 369.0 | 385.6 | 475.6 | 491.6 | 506.6 |
| All Other | 307.3 | 334.1 | 411.1 | 519.6 | 549.0 | 589.6 | 655.1 | 692.9 | 670.8 |
| TOTAL | 1485.5 | 1647.1 | 1818.3 | 2052.6 | 2174.9 | 2288.8 | 2733.6 | 2837.4 | 2888.0 |

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, p. 8.



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IRRIGATION PRICING AND MANAGEMENT: DOMINICAN REPUBLIC

Table 2-2: Percent of Gross Domestic Product by Sector of Origin (1970-1982)

| Sectors | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|
| Crops | 15.7 | 15.0 | 14.0 | 13.6 | 12.8 | 11.5 | 10.2 | 10.3 | 10.4 |
| Livestock | 6.9 | 6.5 | 6.3 | 5.8 | 5.4 | 5.5 | 5.9 | 6.0 | 6.5 |
| Transport | 7.0 | 7.1 | 6.9 | 7.2 | 7.1 | 7.1 | 6.9 | 7.0 | 7.3 |
| Government | 10.3 | 9.6 | 8.6 | 8.9 | 9.0 | 9.0 | 9.6 | 9.2 | 9.2 |
| Manufacturing | 18.5 | 18.9 | 18.6 | 18.3 | 18.7 | 18.7 | 18.3 | 18.2 | 18.5 |
| Construction | 4.9 | 6.3 | 6.2 | 6.7 | 6.5 | 6.7 | 6.8 | 6.6 | 6.4 |
| Commerce | 16.0 | 16.4 | 17.0 | 17.0 | 16.9 | 16.9 | 16.3 | 16.4 | 16.7 |
| All Other | 20.7 | 20.2 | 22.4 | 22.5 | 23.6 | 24.6 | 25.1 | 26.3 | 25.0 |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, p. 9.

Beginning in 1978, the Dominican Republic balance of payments suffered larger and larger annual deficits. Between 1978-83, the total deficit reached US$ 850 million, compared to a small surplus during 1973-77. The deficits have been financed by ever increasing external debt, a large part of which is short-term, high cost, commercial bank loans. Some of these debts were rescheduled in 1982-83 but the debt service ratio is now about 30 percent of GDP, up from 11 percent in 1980.

To some degree, the Dominican Government has utilized several strategies, but in general, imports (and US dollar hoarding) have been allowed if currency purchases have been made in the officially sanctioned "parallel market." Foreign exchange rationing is not new; the premium on the US dollar averaged 8 to 10 percent throughout the 1960s and was 25 percent by the end of the 1970s. The premium in the parallel market reached 200-250 percent in 1984. Consumer prices rose 40 to 50 percent on average, thereby materially reducing real incomes. Aggregate consumption, investment and imports have had to adjust.

Ordinarily, the Dominican Republic public sector is responsible for positive savings of 2 or 3 percent of Gross National Product (GNP). Now the rate is negative. On the one hand, public sector wages and employment rapidly increased at the end of the 1970s and further increases in current expenditures that were built in reached 25 percent per year by 1980. At the same time, receipts barely kept pace with inflation as operating costs of government entities rose to pay for petroleum and food imports which are largely exempt from duties.

Beginning in 1982, the new Jorge Blanco administration introduced emergency measures to reduce imports and public sector expenditures, and to increase revenues. Special drawing rights of US$ 371.25 million Extended Fund Facility (EFF) were negotiated. The EFF permitted restoration of orderly external payments and focused on reduction of the public sector deficit, forcing more and more imports onto the parallel market. Eighty-five million dollars of official imports were shifted to the parallel market, credit expansion of the Central Bank and the Reserve Bank was restricted and Central Bank external payment arrearages were reduced by US$ 100 million.

It has been less easy to satisfy second stage International Monetary Fund (IMF) conditions. The IMF wanted <u>all</u> official imports shifted to the parallel market, further reduction in public sector budget deficits and an overall balance of payments surplus for 1984. The push to the parallel market had a tremendous impact upon Instituto de Establizacion de Precios (INESPRE), which imports rice, the nation's most important food grain. Medicine, baby food, news print, overseas travel, fertilizer and some essential manufacturing raw materials are examples of imports denied access to foreign exchange at the official



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rate. But the Government balked at including petroleum. As mentioned, consumer prices rose 40 to 50 percent immediately (some as much as 200 percent). Protests against the inflation erupted in street violence.[3]

A few months ago, the Government of the Dominican Republic (GDR) moved the official exchange rate to the parallel market level, thereby making the de facto devaluation official. A parallel (now officially illegal) market still exists but the premium appears to hover within a few percent of the daily bank rate.

b. The rural and agricultural sector

During the overall growth and industrialization of the Dominican economy in the 1960s and 1970s, the share of the agricultural sector in the GDP decreased from 22.5 percent in 1970 to 16 percent in 1980. (See Table 2-2.) This pattern of a declining agricultural sector is a typical one in development. Ultimately, the sector may contribute 12 or 10 percent. At 16 percent, agriculture remains the third most important sector in Dominican Repubic national income statistics and is an important source of employment (60 percent of the labor force) and food supplies. According to the 1981 census, about 48 percent of the population of 5.65 million live in rural areas and there are about 340,000 farms.

Although some of this relative downward shift is natural and normal, the pace has been accelerated by difficult times for the sector during much of the 1970s and its stagnation since 1980.[4] Exports of sugar, coffee, tobacco and cacao can account for nearly 60 percent of annual foreign exchange earnings, but production of sugar and cacao has been falling since the early 1970s.[5] Sugar plays a key role in the economy not only in terms of foreign exchange generation but also because of the land area devoted to cane, the employment generated and taxes to the government. (In 1974, these taxes represented 21 percent of the central government's current revenue.)[6] Larson has recently calculated that, through 1982, the real prices of six of 14 main crops and animal products had been falling for a number of years. (See Table 2-3.) It will be noted that rice is among the group. But this is a situation that cannot continue for very long unless real costs are falling even faster. Table 2-3 shows that rates of productivity growth (which affect costs) have been good for many crops. At the same time, in real terms, farm gate prices grew very

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[3]INDRHI, "Presupuesto," p. 3.

[4]INDRHI, "Presupuesto," p. 4.

[5]Ibid., p. 4.

[6]D.W. Larson, "The Effect of Price and Credit Policies on Dominican Republic Agriculture." Consultant Report (Mimeo) (Santo Domingo: US Agency for International Development, September 1984).



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Table 2-3: Rate of Increase in Production and Real Farm Gate Prices for Selected Crop and Livestock Products (1971-1981)
(percent)

| Product | Production | Farm Prices | Wholesale Prices |
|---|---|---|---|
| Milk | 2.72 | -1.29 | |
| Chicken | 9.54 | 1.38 | |
| Eggs | 5.54 | -3.39 | |
| Rice | 8.99 | -1.94 | |
| Maize | 4.67 | 2.64 | 0.55 |
| Sorghum | 18.36 | -0.87[a] | |
| Red Beans | 7.60 | 8.81 | 2.97 |
| Check Peas | 2.14 | -0.36 | |
| Coffee | 5.51 | 18.56 | |
| Plantains | -0.05 | 29.88 | 12.3 |
| Cocoa | -0.99 | 23.45 | |
| Tobacco | 12.02 | -0.03 | |
| Beef | 5.15 | 1.5 | |
| Sugar | -0.10 | 0.7 | |

[a]Rate of real price increase for the years 1973-1980.

Source: D.W. Larson, "The Effect of Price and Credit Policies on Dominican Republic Agriculture," Consultant Report to USAID/DR, Santo Domingo, August 15-September 15, 1984, Table 6. (Mimeographed.)

rapidly for some crops through 1981. Information on prices at the wholesale level is limited, but the rates of price growth shown are lower than comparable ones at the farm gate.

In the past, exports such as sugar and ferronickel could be relied upon to finance imports of raw and processed food products not otherwise available in the DR, principally wheat and edible oils. But, as hinted above, the world terms of trade have deteriorated from the DR point of view and the entire economy is under stress while major structural adjustments work themselves out. It appears that the longer run effect of economic policies now being pursued will tend to raise food costs for urban consumers and turn the domestic terms of trade in favor of the agriculture sector in general.

Even if the GDR continues a price stabilization policy on some adjusted basis relative to the past, the mere fact that INESPRE and the country's flour mills now have to pay world prices for grain imports should have the impact of increasing domestic farmgate prices, for rice, maize and other staples. In addition, considerable efforts are being made to lower production cost through education, research and development, and technology transfer[7], especially in the case of irrigated crop production. It seems, therefore, that the economic situation for non-export (and possibly some export) crop producers should improve.

The GDR has a history of heavy intervention in agriculture product and factor markets, mainly to stabilize prices, that tended to achieve that particular goal. Now these policies do not blend with unstable and deteriorating terms of trade for imported inputs and product exports. In the view of USAID representatives in the Dominican Republic, "Public actions on exchange rates and interest rates have discouraged private initiative. As a result, the balance of trade, fiscal revenues, agricultural incomes, rural employment and the nutrition of the poor are all lower than they would have been if a more neutral <u>structure of incentives</u> had existed".[8]

The key government agency for marketing, pricing and trading of agriculture commodities is INESPRE. Authority to control retail food prices is held by Direction General de Control de Precios. Normal commercial wheat imports are handled by Molinos Dominicanos, which is majority-owned by the Government and accounts for 90 percent of domestic flour production.

In addition to price stabilization for basic commodities, there has been a desire to provide food security, especially where rice is concerned. The Secretary of State for Agriculture (SEA) has made increasing rice production at a 6 percent annual rate an explicit

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[7]INDRHI, "Presupuesto," pp. 4-5.

[8]INDRHI, "Presupuesto," p. 6.



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policy objective in order to achieve a national goal of self-sufficiency. Other agricultural goals are to raise the nutritional level of poor people, to increase the level and even the distribution of income in rural areas, and to reduce agricultural imports, especially wheat.[9]

Similar goals are often pursued by other developing countries. They require compromise between forces that argue for domestic self-sufficiency and incentive producer prices and forces that argue for low consumer prices to stimulate industrial processing of raw materials and, more especially, to provide low cost food for urban consumers. In practice, the pressures for low urban prices often win out, and farmgate prices do not provide the incentive necessary to achieve the goal of self-sufficiency. In a small, open economy such as exists in the Dominican Republic, there is a direct connection between domestic price policies and trade policy. Any time the domestic currency becomes over-valued there is an automatic tendency to import basic foodstuffs, especially grains. This is what has been happening in the Dominican Republic. The steady, unintended, increasing discrimination against the agricultural sector has been the focus of several recent studies of Dominican Republic pricing policies.[10]

The crop most affected has been rice, which is grown on about 55 percent of all irrigated land in the country. The Dominican Republic has consistently encouraged rice production through programs of credit, agrarian reform, improved technical assistance and ever more access to irrigation water. Although production has responded quite well, the overall goal of self-sufficiency still has not been achieved.

INESPRE effectively has been the monopsony purchaser of domestic production and monopoly supplier of rice consumed. Until very recently, the agency was able to obtain all or part of its foreign exchange needs at the official exchange rate. Sensuar et al, have shown that if the overvaluation of the domestic currency is taken into

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[9]B. Sensuar, T. Roe and D. Green, "An Analysis of Foodgrain and Nature Policy in the Dominican Republic." Report under University of Minnesota/USDA, Office of International Crops and Development Research Agreement F. 58-319R-1-220 (Mimeo) (Santo Domingo: University of Minnesota/USDA, October 1982).

[10]Larson, "Price and Credit Policies"; A. Ortiz, Incentives and Comparative Advantages to the Dominican Republic Dairy Industry. Published MS Thesis (Columbus, Ohio: Ohio State University, 1983); M. Kosters, Price Control Policy in the Dominican Republic. (Santo Domingo: US Agency for International Development, 1984); and Sensuar, Roe and Greene, "Food Grain and Nature Policy."



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account, for almost the entire period since 1970, INESPRE has paid more for imported rice in terms of its true cost to the economy than it has been willing to pay for rice from domestic producers.[11]

Export promotion is the cornerstone of the current Government's development strategy.[12] In order to rationalize conflicting agricultural policies and assess the consequences of the more liberalized and market oriented agriculture sector policies being put into place, the National Agricultural Council (CNA) has been revitalized and provided with a policy analysis unit.

Whether these very recent steps will materially affect irrigated agriculture is difficult to say. It has already been implied that INESPRE's new operating environment ought to begin to work to the advantage of domestic rice producers--and rice is the dominant irrigated crop. But traditional export crops other than tobacco have been rainfed, not irrigated. And for most of these crops, Dominican Republic policy makers cannot control international prices for what the country sells or the generally high price of money to finance inputs. Any substantial impact of irrigated production upon exports will, therefore, have to come from "nontraditional" crop sales. By substantial, we mean on the order of US$ 100 to 200 million per year.

In order for numbers of this magnitude to materialize, the country's agriculture must be competitive in world terms. Thus, whether traditional or nontraditional exports are under consideration, the most needed progress in Dominican Republic agriculture is to <u>increase yields and reduce unit costs</u> of production. (This would be the best thing that could happen for domestic production as well, assuming farmgate prices are reasonable).

2. <u>Irrigation development</u>

a. <u>Description of irrigation systems</u>

Much of the arable land in the Dominican Republic is suitable for rainfed agriculture, and most of the balance is near potential sources of irrigation water. With good management of available resources, the country could greatly increase output of crop and livestock products. Much infrastructure is already in place or is scheduled. Thus, <u>technical</u> constraints to agriculture sector development do not seem to be serious at the present time.

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[11]Sensuar, Roe and Greene, "Food Grain and Nature Policy," p. 17.

[12]INDRHI, "Presupuesto," p. 5.



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An Organization of American States (OAS) survey of Dominican Republic natural resources identified 14 distinct hydrographic zones in which a striking diversity of conditions was found (Table 2-4). Rainfall in the zones ranges from 510 to 2,700 mm per annum, with total annual stream flow (all zones) exceeding 19 billion $m^3$. (Also see Figure 2-1.)

Approximately 1.2 million ha, one-fourth of the land area of the Dominican Republic, is suited for cultivated agriculture and a little more than one-half of the latter (710,000 ha) is adapted to irrigation.[13] At present, an estimated 202,000 ha are served by irrigation developments. These lands are found within five main river basins draining 48 percent of the surface area.

These basins and smaller watersheds are drained by 23 rivers, 17 of which flow at average rates above 5 $m^3$ per second. In total, their estimated discharge exceeds 11,266,520 $mm^3$, the majority of which ends up in five major river systems: Yaque del Norte, San Juan, Yuna-Camú, Ozama-Nizao, and Yaque del Sur. These data are shown in Table 2-5.

Significant subterranean water resources also exist and are currently exploited as shown in Table 2-6. As may be imagined, the pumping in the various drainages represents one aspect of private development of irrigation.

At present the water demand by various sectors within the five basins has been estimated as shown in Table 2-7. It is clear that actual (and potential) demand is well below the amounts that are reasonably controllable in the five major basins.

Each basin listed in Tables 2-6 and 2-7 contains at least one dam classified as major by the Instituto Nacional de Recursos Hidraulicos (INDRHI), the national agency charged with managing and developing water resources. (See Table 2-5.) Planning for these major dams accelerated during the mid 1950s and construction has been more or less continuous since 1965-68. By 1984, controlled storage had reached about 2,600 $mm^3$ in five main dams. As yet, the river Yuna has no storage except on one of its tributaries.

The principal irrigated and rainfed crops, the areas they occupy, and their relative values as of 1982 are shown in Table 2-8. These crops occupy about 600,000 ha out of a total of slightly over 1,000,000 ha cultivated. About 300,000 ha are idle at any given time.

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[13] M. Pazos and G. Reynoso. "Situacion del Riego en Republica Dominicana." Documents B-5 presented at VII Seminario Latinoamericano de Irrigacion (Santiago, Chile: 1983), Table 1.



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Table 2-4: Surface Water Resources by Hydrographic Zone

| Zone | Area (ha) | Annual Rainfall (mm) | Annual Stream Flow (billion m3) |
|---|---|---|---|
| Sierra de Bahoruco | 281,400 | 750-2,000 | 320 |
| Azua, Bani, San Cristobal | 446,000 | 750-2,250 | 1,516 |
| Ozama River Basin | 270,600 | 1,400-2,250 | 1,586 |
| San Pedro de Macoris and La Romana | 462,900 | 1,000-2,250 | 2,444 |
| Higuey | 220,700 | 1,000-1,750 | 609 |
| Miches and Sabana del Mar | 226,500 | 2,000-2,700 | 1,284 |
| Samana Peninsula | | n/a | |
| Northern Coastal Zone | 426,600 | 1,000-2,300 | 3,870 |
| Yuna River Basin | 563,000 | 1,170-2,250 | 2,375 |
| Yaque del Norte River Basin | 705,300 | 500-2,000 | 2,017 |
| Dajabon River Basin | 85,800 | 750-2,000 | 370 |
| Yaque del Sur River Basin | 534,500 | 700-1,150 | 1,181 |
| Lake Enriquillo Basin | 304,800 | 600-1,200 | 312 |
| Artibonito River Basin | 265,300 | 1,200-2,000 | 1,190 |
| TOTAL | 4,793,400 | | 19,074 |

Source: The World Bank, Dominican Republic: It's Main Economic Development Problems (Washington, D.C.: The World Bank, Latin American and the Caribbean Regional Office, December 1978), Table 14.



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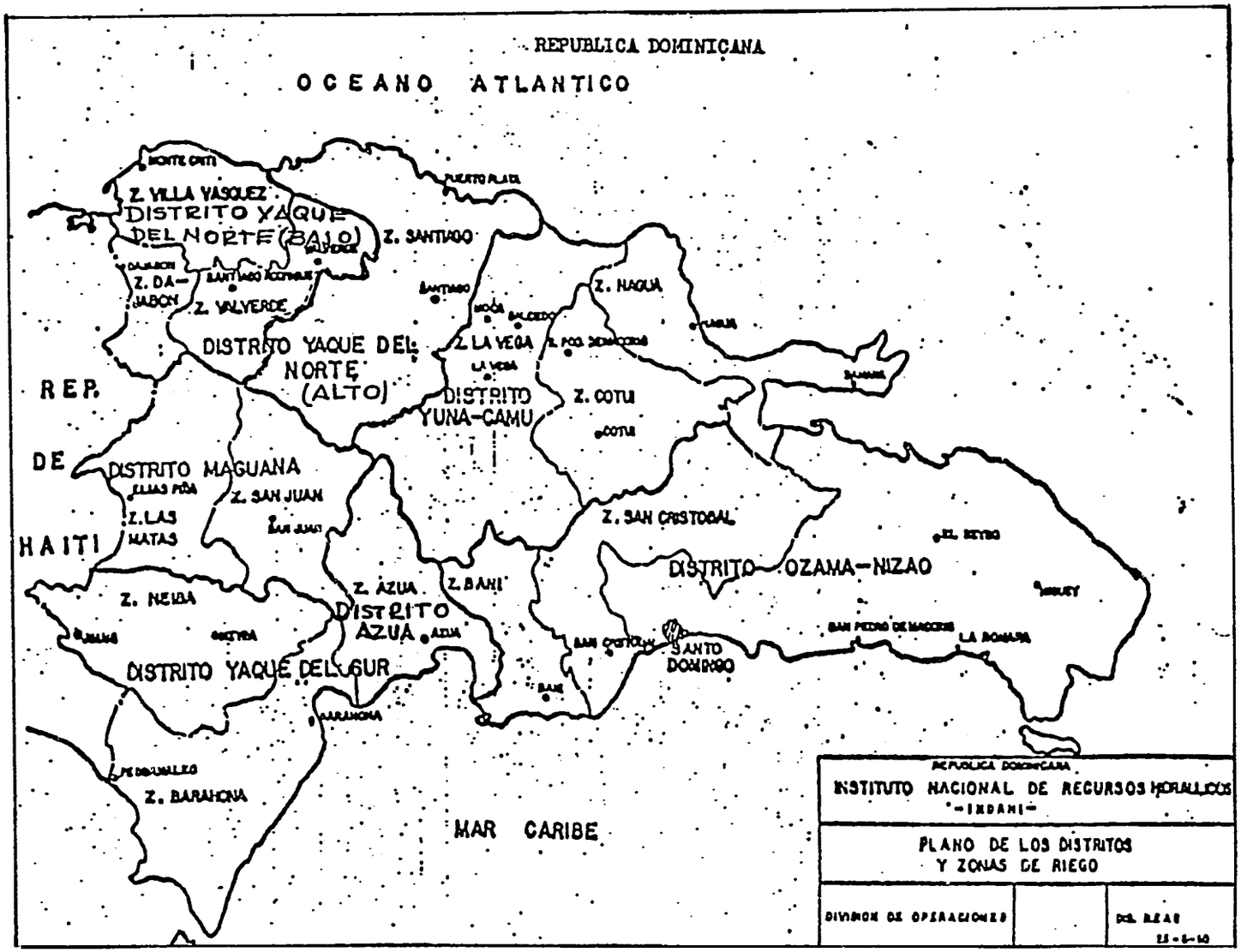


IRRIGATION PRICING AND MANAGEMENT: DOMINICAN REPUBLIC

Figure 2-1: Map of Dominican Republic

Table 2-5: Important Rivers and Dams, Volume, Average Annual Releases and Dam Characteristics

| River | Basins | Annual Discharge ($mm^3$)[a] | Average Releases ($m^3$/Sec)[b] | Dams | Total Storage Capacity ($mm^3$) | Available Storage ($mm^3$) | Spillway Capacity ($m^3$/Sec)[b] |
|---|---|---|---|---|---|---|---|
| Macasías | Artibonito/Macasías | 180.07056 | 5.71 | | | | |
| Joca | Artibonito Joca | 168.08688 | 5.33 | | | | |
| Nizao | Río Nizao | 532.01232 | 16.87 | Valdesia | 186.07 | 128.00 | 7,200 |
| Artibonito | Río Artibonito | 485.33904 | 15.93 | | | | |
| Yaque del Sir | Río Yaque del Sur | 697.26096 | 22.11 | Sabana | 401.00 | 386.00 | |
| San Juan | Río del Sur/San Juan | 294.54624 | 10.44 | Sabaneta | 78.00 | 68.00 | 4,000 |
| Mijo | Río Y. del Sur/Mijo | 168.40224 | 5.34 | | | | |
| Yaque del Norte | Río Yaque del Norte | 1457.2786 | 46.21 | Tavera | 417.00 | 251.00 | 6,000 |
| Mao | Río Y. del Norte/Mao | 654.05664 | 20.74 | | | | |
| Amina | Río Y. del Norte/Amina | 303.06096 | 9.61 | | | | |
| Bao | Río Y. del Norte/Bao | 622.836 | 19.75 | Bao | (in conjunction with Tavera) | | |
| Yuna | Río Yuna | 1195.2144 | 37.90 | | | | |
| Payabo | Río Yuna/Payabo | 210.34512 | 6.67 | | | | |
| Jima | Río Yuna/Jima | 334.59696 | 10.61 | Rincón | 75.5 | 60.5 | 390 |
| Chavón | Río Chavón | 172.81728 | 5.48 | | | | |
| Nizaito | Río Nazao | 134.974080 | 4.28 | | | | |
| Jura | Río Jura | 39.42 | 1.25 | | | | |
| Ocoa | Río Ocoa | 109.74528 | 3.48 | | | | |
| Haina | Río Haina | 154.21104 | 4.89 | | | | |
| Soco | Río Soco | 317.25216 | 10.06 | | | | |
| Duey | Río Duey | 123.62112 | 3.92 | | | | |
| Cenoví | Río Yuna/Cenón | 42.88896 | 1.36 | | | | |
| Jaya | Jaya | 34.65891 | 1.06 | | | | |
| TOTAL | | 11,266.521 | | | | | |

[a]mm3 = billion cubic meters
[b]sec = second

Source: I. Pazos and G. Reynoso, "Situation del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, Tables 3 and 6.

Table 2-6: Summary of Exploitable Ground Water Potentials
(mm3)a

| Basin | Total | Presently Exploited | Additional Potential |
|---|---|---|---|
| Yaque del Norte | 45 | 13 | 32 |
| San Juan | 50 | 2 | 48 |
| Yaque del Sur | 540 | 40 | 500 |
| Yuna-Camu´ | 225 | 20 | 205 |
| Ozama-Nizao | 550 | 170 | 380 |
| TOTAL | 1,510 | 245 | 1,265 |

[a] mm3 = billion cubic meters

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, Table 4.

Table 2-7: River Basin Water Demand by Sector
($mm^3$/year)[a]

| Basins | Urban | Agricultural | Industrial | Total |
|---|---|---|---|---|
| Yaque del Norte | 39.6 | 820 | 11 | 870.6 |
| San Juan | 8.4 | 148 | 0.3 | 156.7 |
| Yaque del Sur | 15.8 | 543 | 3.9 | 532.7 |
| Yuna | 32.7 | 533 | 4.4 | 570.1 |
| Ozama-Nizao | 190.8 | 79 | 62.3 | 332.1 |
| TOTAL | 287.0 | 2,123 | 82.0 | 2,492.0 |

[a] $mm^3$ = billion cubic meters

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigation, Santiago de Chile, 28 November-2 December, 1983, Table 5.

Table 2-8: Main Crops and Features of Cultivation (1981)

| Crops | Areas (ha) | Yield (ton/ha) | Percent of Cultivated (ha) | Value of Prod. (US$) | Percent of Area Cultivated | Av. Water Requirement ($m^3$/ha) |
|---|---|---|---|---|---|---|
| Rainfed | 425,871 | | | | | |
| Café | 229,063 | 1.44 | 17.58 | 96,073,000 | | |
| Cocoa | 119,690 | 0.28 | 9.13 | 61,830,000 | | |
| Sugar | 77,119 | 6.40 | 7.71 | 335,223,000 | | |
| Irrigated | 188,169 | | | | | |
| Rice | 94,859 | 3.004 | 9.46 | | 50.4 | 30,000 |
| Sugar | 16,432 | ? | 1.64 | | 8.73 | 20,000 |
| Plantains | 12,622 | 48[a] | 1.26 | | 6.7 | 14,800 |
| Pastures | 12,386 | - | 1.23 | | 6.58 | 16,000 |
| Tomatoes | 4,346 | 1.3 | 0.4 | | 2.3 | 6,200 |

[a]Measured in hands/ha.

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, Tables 10 and 11.

The areas irrigated within the country have been surveyed by the Food and Agriculture Organization (FAO) teams, utilizing the methodology described in Resultados y Recomendaciones and Frias Informe Technico #1.[14] Their estimate of the area commanded by irrigation works is 206,518 ha as of 1981. However, part of this area is not actually irrigated for various reasons such as salt build-up in soils, water logging, fallow periods, water shortages, and so on. The number of water users estimated in the FAO studies (43,310) may be compared to the total rural population of 2,712,117 in 1981 (500,000 to 543,000 families). In other words, fewer than 10 percent of rural families benefit from state water.

The number of water users may also be compared with the total number of "exploitations" enumerated in the 1981 census of agriculture (385,060). An exploitation is not necessarily an entire farm; a given family might have several. These statistics suggest that many families classified as living in rural areas do not own land and must earn their living as farm laborers or in ways other than by farming. Some unknown but significant amount of irrigation is carried on without benefit of state water, i.e., water subject to tariff. Thus, irrigators probably account for about 30 percent of all active farmers.

The estimates shown in Table 2-9 have been developed by utilizing the percentages of actual land irrigated and planted, encountered in the FAO surveys of 73 systems.[15] These ratios suggest that the INDRHI estimates (see Table 2-8) of acres irrigated may not include some private developments and probably refer to areas commanded by conveyance features, even some features not in use.

b. Current status of irrigation development

After three years of study with the United Nations Development Programme (UNDP) funding, a recent FAO report recommended ways to improve existing irrigation systems in the Dominican Republic. All systems were studied to some degree and special surveys were

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[14] Food and Agriculture Council (FAO) and United Nations Development Program (UNDP). Estudio para el mejoramiento de los Sistemas de Riego Existentes: Republica Dominicana: Resultados y Recommendaciones del proyecto. Informe Tecnico. AG:DP/ODM/81/012. Preparado para el Gobierno de la Republica Dominicana (Rome: FAO and UNDP, 1984); and M.C. Frias, Metodologia EMESIRE. Informe Tecnico No. 1, preparado para el Gobierno de la Republica Dominicana: AG:DR/DOM/81/012 Rome: FAO and UNDP, 1984.

[15] Estudio para el mejoramiento de los Sistemas de Riego Existentes: Republico Dominicana.



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Table 2-9: Estimates of Actual Land Irrigated Within the Seven Irrigation Districts Served by State Water Developments

| Irrigation District | Est. Area Served (ha) | Est. Area Being Irrigated (ha) | Est. Area Planted (ha) | Total No. Water Users | Coefficient Use of Actual Irrigated Area |
|---|---|---|---|---|---|
| Yaque del Norte | 59,731 | 31,589 | 41,279 | 6,780 | 1.31 |
| Yuna-Camu´ | 45,758 | 23,092 | 44,766 | 8,169 | 1.94 |
| Ozama-Nizao | 29,738 | 14,365 | 18,046 | 5,773 | 1.26 |
| Valle de Azua | 12,615 | 7,986 | 15,019 | 6,261 | 1.88 |
| Yaque del Sur | 36,178 | 15,802 | 21,862 | 8,077 | 1.38 |
| Valle de San Juan | 22,498 | 13,730 | 25,127 | 8,250 | 1.83 |
| TOTAL | 206,518 | 106,564 | 166,099 | 43,310 | 1.57 |

Source: Food and Agriculture Organization (FAO) and United Nations Development Program (UNDP), Estudio para el pejoramiento de los Sistemas de Riego Existentes: Republica Dominicana: Resultados y Recommendaciones de proyecto Informe Ag: DP/DOM/81/012, prepared for Gavinno de la Republica Dominicana (Rome: FAO and UNDP, 1984), Tables 1 and 5.

conducted in 73 of them. The experts' diagnosis of the current status of Dominican Republic irrigation development may be summarized as follows:[16]

- There is an incomplete understanding of the possibilities that could be obtained from existing irrigation works. The existing systems have certain infrastructure limitations (and to a lesser degree this applies to rural access roads). An "almost total lack" of drainage in some areas has become critical, causing the build-up of soil salinity;

- The limited availability of human and financial resources causes INDRHI to plan its goals in short-run terms. Operation and maintenance of irrigation systems is deficient and in places does not exist. Institutional coordination between the SEA, BANCO AGRICOLA (BAGRICOLA), and INDRHI appears confused and undefined. The water tariffs do not begin to cover operating costs of the Irrigation Districts;

- The rivalry between irrigated water demands and power generation has a negative impact on irrigated agriculture;

- With few exceptions, the technological level of irrigated agriculture is low or medium. There is minimal technical assistance to farmers in managing water and soils; and

- The hydrologic information necessary to manage systems is of dubious precision.

Similar comments can be found in the Country Environmental Profile[17] and in other sources.[18] It has been noted that at least 16 government agencies are involved in some way with water development and management.[19] Some policies and procedures lack clarity and definition. For example, there may be uncertainty about ditch

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[16]Ibid., pp. 20-21.

[17]G. Hartshorn, et al. Dominican Republic Country Environmental Profile. AID Contract AID/SOD/PDC-C-0247 (McLean, VA: JRB Associates, 1981).

[18]B. Anderson, et al. Project Paper: On-Farm Water Management Project. Draft. Prepared for USAID/DR with support of Science and Technology Bureau sponsored WMSII Project. (Sando Domingo: US Agency for International Development, 1983).

[19]Ibid., p. 9.



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maintenance on agrarian reform lands within irrigation project perimeters. Clear-cut lines of authority have not been developed covering priorities of water use.[20]

The commitment of GDR to support agricultural sector development is illustrated by a steadily increasing allotment of funds to institutions such as INDRHI. In recent years, the government has invested over RD$ 500 million in the construction of dams and canals. Programs to settle farmers on irrigated lands owned by the Agrarian Reform Institute have been undertaken and, as mentioned earlier, special efforts have been made to increase rice production.

A result of all this effort has been a steady increase in irrigated area. Table 2-10 gives an indication of the rate of progress in state projects since 1978. At least 100,000 to 125,000 ha have been brought into more systematized networks backed by water storage structures and more regulated conveyances.[21]

There is a need for better management of existing systems and, more especially, better on-farm water management. Output from many irrigated lands is far below potential. According to one claim, it can be doubled.[22]

c. Future irrigation development plans

Between 1978 and 1982, about 6 percent of annual total public investment was applied to irrigation and drainage works.[23]

Currently, six projects are in various stages of execution at a cost of about US$ 150 million by the end of 1985. Of this, US$ 61.59 million has been externally financed.[24] These projects are designed to influence a gross area of 51,050 ha (45,416 net) and supplement current water deliveries by 85 $m^3$ per second through an additional 420 ha of canals and 73 km of drains. The number of agricultural properties expected to benefit from the new or supplemental water is 20,420 (17,116 users).

In addition, four new projects have been prepared at the feasibility level and are being considered for public financing. If constructed, they would add another 18,480 ha serving 8,700 users at a cost of about US$ 75 million.

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[20]Ibid.

[21]Anderson, PP: On-Farm Water Management, p. 1.

[22]Ibid., p. 11.

[23]Payos and Reynoso, "Situación del Riego," p. 16.

[24]Ibid.



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Table 2-10: Trends in Areas Commanded by State Irrigation Systems (ha)

| Regions | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|
| Yaque del Norte | 38,100 | 38,100 | 41,764 | 41,764 | 44,683 |
| Yaque del Sur | 35,906 | 35,906 | 40,419 | 40,419 | 49,184 |
| Yuna-Camú | 40,230 | 43,013 | 43,013 | 43,926 | 43,973 |
| Ozama-Nizao | 15,051 | 15,051 | 15,910 | 15,935 | 20,925 |
| Valle San Juan | 24,696 | 24,696 | 25,375 | 27,814 | 28,195 |
| TOTAL | 153,980 | 156,763 | 166,480 | 169,856 | 189,659 |

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, Table 12.



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Finally, another five irrigation and drainage projects are being studied which would incorporate a further 29,000 ha (net), affect 11,600 users and raise the incremental value of agricultural production by US$ 82 million.

According to Pazos and Reynoso, the overall respective goals for irrigation are to reach 234,350 ha (net) irrigated hectares by the year 1990 and 319,302 ha (net) irrigated hectares by the year 2000--targets that involve only irrigated areas within projects, or within irrigation or drainage districts, which are publicly constructed and managed.[25]

The expected total cost of all this possible construction is not reported by Pazos and Reynoso. However, Anderson et al[26] suggest that as much as has already been spent (i.e., US$ 500 million) could be spent again by early 1990s.

## B. National Irrigation Administration and Policy

### 1. Organization of Irrigation Administration

#### a. Organizational structure

In terms of overall management of water resources, INDRHI and Cooperacion Dominicana de Electricidad (CDE) are the two most important and interconnected government agencies. INDRHI has statutory authority to manage stream flows from the watershed to the point of delivery on the farm (excepting hydraulic development for urban water supplies); CDE operates the dams that generate electric power. In terms of irrigation water users, SEA and Instituto Agrario Dominicano (IAD) are very important complements to INDRHI. BAGRICOLA and local rural development authorities such as Oficina para el Desarrollo Integral Agropecurio del Valle de Azua (ODESIA) and Instituto para el Desarrollo del Suroeste (INDESUR) also have a greater or lesser impact.

The chief executive of INDRHI must be a trained civil engineer, emphasizing either hydrology or hydroelectricity. Project planning, construction and operation dominate INDRHI's organizational arrangements.

INDRHI tends to centralize power over budget, supplies, and personnel as well as for programs in Santo Domingo. The agency's Planning Office sets policy and it is staffed mainly by civil engineers "who are oriented toward construction."[27] The Department of Irrigation

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[25]Ibid., pp. 17-18.

[26]Anderson, PP: On-Farm Water Management, p. 10.

[27]Ibid., pp. 116-117.

is a relatively new organizational unit.[28] It contains subdivisions for conservation and improvement; operations; and irrigation and drainage.

Irrigation Districts have been established to deliver water through the various systems. Individual farmers or water user groups interact with INDRHI mainly at the district or zone level. According to Anderson, et al, until recently, few of the INDRHI technicians have had formal training in irrigation water management.[29] Only recently have irrigation specialists and agronomists been placed in positions of authority, even for irrigation management functions. In order to obtain some expertise in effective water management at the district level, INDRHI fills many positions with people on interagency agreement with SEA.[30]

SEA is the lead agency for developing the agriculture sector in the Dominican Republic. In addition to having responsibility for coordinating the various activities of all the institutions dealing with the country's agriculture sector, the Secretariat monitors distribution of production inputs and outputs, manages the use of renewable natural resources and promotes production of animal products as well as crops. Other areas of responsibility include research, extension and training.

Although some of these responsibilities relate to water management, the agricultural use of irrigation water has been a secondary concern for SEA.[31]

IAD is responsible for agrarian reform activities. It is a semi-autonomous agency under SEA charged with redistributing land and improving the standard of living of the rural poor. Since its inception in 1962, IAD has had to reorient its operations several times in response to changing national politics and economic problems. A recent orientation has been toward collective asentamientos or farms.[32]

IAD staff have little expertise in on-farm water management and are unable to train, on their own, individual farmers in water management. In fact, many of the decisions on asentamientos are made by encargados (managers) hired by IAD. These specially appointed

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[28]Ibid., p. 117.

[29]Ibid., p. 118.

[30]Ibid.

[31]Ibid., p. 121.

[32]Ibid., p. 127.

people arrange credit, marketing of products, and other technical assistance. This span of duties excludes particular concentration upon water management.

CDE was established in 1955 and has responsibility for nationwide electrification. The agency's autonomous status and financial independence allow it to plan on a longer term, more stable basis than is the case for INDRHI.[33]

Most CDE hydroelectric projects are contracted to foreign or private sector consultants for feasibility and design studies. CDE forms a specific corporation to construct the selected dams. Upon completion of the project, the corporation is dissolved.

b. Responsibilities and functioning of irrigation agencies

For administrative purposes, INDRHI has divided the country into seven irrigation districts which include 17 irrigation zones and sub-zones. These divisions do not exactly coincide with those adopted by the SEA, which is based on eight regional districts covering 27 zones.

Unidades Regionales de Planificacion Economica (URPE) have been established in each of the eight SEA regions. These units are supposed to help increase the rate of agricultural growth, and to collect statistics at the zonal level. Regional or zonal offices of INDRHI tend to carry out such functions within the perimeters of the irrigation projects. IAD usually has some lands and colonists located inside the projects.

Other institutions including INESPRE, BAGRICOLA, ODC also maintain regional offices to help pursue agricultural goals and policies of the nation.

Of all its several legal functions, INDRHI has taken most seriously the planning and construction of dams and diversion works for irrigation purposes. In general, INDRHI acts to oversee the actual construction by engineering firms and only steps into the project after the main works have been fully or partially completed. In short, its bread and butter function is to operate the systems. But personnel of the agency have considerably more skill in engineering than in water management for agriculture. Directors of irrigation districts may be civil engineers without agronomic experience.[34]

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[33]Ibid., p. 128.

[34]Hartshorn, Environmental Profile, p. 42.



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Writing in 1983, Anderson, et al saw the role of the ditch rider (cabo de agua) as a reflection of "the low priority placed upon water management by INDRHI."[35] Although such individuals stand at the interface between the agency and water users, they are poorly paid, corruptible (according to Anderson, et al) and lack technical irrigation skills and ability to relate to farmers.[36] Until recently, INDRHI did not push the idea of water user organizations although it has had authority to form such groups for some time. This is further evidence of lack of concern for water management.

Although INDRHI, in 1985, is forming water user groups, agency officials resist the idea of giving the groups power to collect water user fees or pay part of the salaries of the cabos de aguas. However, as Anderson indicates, "Unless user associations have some such authority, they are not likely to be effective."[37]

Various SEA functions or sub-secretariates get involved in irrigation activities although, as mentioned, SEA does not focus high level attention upon water management per se. Some of SEA's research centers study irrigated crops and one of the four centers concentrates solely upon rice. There is a small group of irrigation specialists which trains farmers living at higher elevations in methods of using small irrigation systems. There also are over 600 extension agents working throughout the country, and many are stationed in irrigation projects. These agents have little or no background training in irrigation techniques or water management to pass on to farmers. In early 1981, INDRHI agreed to begin to train some of SEA's extension agents in correct and modern irrigation practices. However, there are few people in INDRHI who could conduct such training and as yet the program has not been implemented.[38]

Inside the SEA's sub-secretariat for Research, Extension and Training is the Department of Rural Organization (DRO). Personnel of this department have been engaged in performing socioeconomic analysis in various irrigation districts for INDRHI. Their skills are available for organizing user groups. However, INDRHI may or may not want the development of rural associations to achieve effective participation and representation of members' interests to become the focus of DRO.

Some of IAD's functions within irrigation districts have already been described. A further point of interest, however, is that women, who do much of the work on farms, have poor access to training. Apparently this is due partly to the fact that few women are parceleras

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[35]Anderson, PP: On-Farm Water Management, p. 118.

[36]Ibid.

[37]Ibid., p. 119.

[38]Ibid., p. 112.



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(female small farm operators) or actual members of the asentamientos with rights of representation. They are only connected via their husbands and families.[39]

The separate corporations created by CDE for each dam constructed are relatively short lived so they tend to ignore the condition of watersheds or fail to take any interest in watershed management. Money is not allocated for such purposes.

Lack of communication and even friction between INDRHI and CDE were sensed by Anderson, et al in 1983. Examples cited were lack of knowledge and indifference at the technical level as to the activities that each institution is involved in and the fact that maps locating future dams for one institution do not show the projected dams of the other.[40]

Some conflict exists concerning water releases from storage reservoirs. Normally, hydro-power production requires only 15 percent of water capacity, but extra water is released to meet peak demands or to replace power outages when other plants are off-line. Less storage is available for irrigation when needed. Since INDRHI does not have good control over its water management functions, its engineers do not know how much water is being put into the irrigation systems, or how much more or less is needed at a given moment. CDE's data on energy needs and supplies are much more exact. This situation puts INDRHI at a disadvantage in negotiations with CDE.[41]

2. Irrigation policies

a. Policy framework for irrigation development

(1) General

All water within the Dominican Republic belongs to the State. Only those uses may be made of the resource as are permitted by agencies having the authority to approve or disapprove, other than in instances expressly provided for by law or regulation prescribed by law. The priority accorded to utilization of public waters in descending order is as follows:

- To satisfy human drinking, washing, and other municipal requirements;
- To satisfy animal and poultry needs;

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[39] Ibid., p. 128.

[40] Ibid., p. 129.

[41] Ibid., p. 130.



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- For agricultural purposes;
- For production of electricity and for industrial and mining use; and
- For other purposes.

INDRHI is the highest national authority in terms of interpreting and executing all legislation pertaining to water law and custom. No other authority exists at the national level, other than the Office of the President, to deal with water resource questions. Certain aspects of water law application require cooperation on the part of SEA and IAD in the management of water resources and improvement of water use. Within geographical regions there are instances where mechanisms must be created to accomplish interregional cooperation among agencies to deal with certain aspects of irrigation and drainage. INDRHI officials are expected to provide the necessary leadership.

INDRHI was created in September 1965 to implement various existing laws concerning management and development of the nation's water resources. Since then, various refinements and regulatory changes have been introduced to delineate and clarify INDRHI's power and authority. Regarding irrigation system operation, INDRHI has the responsibility to propose tariffs and rates, rents and costs, for approval by the highest executive authority. The agency can suspend water service for failure of users to pay their quotas and the agency can dictate the regulations necessary to carry out its defined tasks.

(2) Specific laws (customs) related to water rights

In order to make private use of public water, it is necessary to obtain in advance a right or concession describing the approved (effective) use of the water, in accordance with underlying law.

Persons who rent land can obtain a concession if they have permission of the land owner who is entitled to the basic concession. Any rights granted the renter involve the land itself, they are not conferred upon the renter.

Water use concessions or rights are an inalienable part of the corresponding land parcel. Use is permitted for the purposes indicated in the actual concession (titulo). Each year, there is an obligation to explain in advance how the water is proposed to be used and to obtain approval (i.e., to switch from rice production to other crops).

However, INDRHI has the power to authorize transfers of water use rights between parcels of land if the shift is justified from a practical and technical standpoint. In all such cases, the transferred right becomes attached to the new parcel.

The water made available for a particular development cannot be used for something else without renegotiating a formal concession. Nevertheless, the water appropriated for irrigation can also be applied to industrial preparation or transformation of the products produced on the same irrigated parcel provided there is no attempt to increase the water volume permitted in the original allocation and that the water used as a prime transporter in the process is returned to the source.

Any concessions for use of water will not be effective if the conditions and deadlines are not met.

In order to construct ditches, or create storage for nurseries or make fish ponds, or for any effective use of water, the persons who hold the original rights (land owners) need INDRHI's approval. Requests for water utilization can also be made by users or renters of any parcel, as long as the parcels have established water concessions.

With respect to irrigation societies, the law makes provision for collective utilization of water. For public water to be used for irrigation, individual members must obey the rules and orders of their society or community dealing with such use. An association must be formed: a) when the number of co-irrigators is greater than ten and when the number of irrigable hectares is at least 200; and b) when the local agricultural situation demands a formal group. Outside of these cases, it is possible to form an irrigation society if a majority of the members of a community wish it.

The irrigation societies should have, as their goal, the common construction of canals, to achieve better distribution of water from the public source to the fixed points within the community's area where the water will be available for individual members' lands.

b. Functioning of current policies

Whether or not a particular plot of land receives the water to which it is entitled depends upon the specific situation governing the system serving it. If there is ample water or good user cooperation, tailenders get service, but nothing is guaranteed. New or revised conveyance systems may change established patterns with some farmers getting more than before, and others less. Equity issues are resolved at the zone or sector level, and there is no centralized or formalized way to force or require delivery.

One frequent complaint about the current status of irrigation administration has been that water tariffs have not been set at levels high enough to cover annual Operations and Maintenance (O and M). A related complaint is that many users do not pay.[42] Table 2-11 shows

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[42]The World Bank. Dominican Republic: It's Main Economic Development Problems (Washington, D.C.: The World Bank, 1978). Latin American and the Caribbean Regional Office.

Table 2-11: Trend in Water Tariff Receipts at National Level (1966-1984)

| Year | Amount (DR$) | Area (ha) | No. Users Who Paid |
|---|---|---|---|
| 1966 | 128,269.37 | a | |
| 1967 | 171,789.20 | 24,656 | |
| 1968 | 259,770.33 | 36,031 | |
| 1969 | 307,821.39 | 43,037 | |
| 1970 | 221,427.01 | 30,913 | |
| 1971 | 389,230.54 | 55,484 | |
| 1972 | 374,856.65 | 53,712 | |
| 1973 | 318,194.01 | | 9,963 |
| 1974 | 496,785.58 | 71,391 | 18,711 |
| 1975 | | | |
| 1976 | 544,372.44 | | |
| 1977 | 549,685.36 | | |
| 1978 | 541,572.76 | | |
| 1979 | 603,216.59 | | |
| 1980 | 557,126.92 | | |
| 1981 | 546,303.80 | | 24,798 |
| 1982 | 507,453.78 | | 26,116 |
| 1983 | 750,020.51 | | 29,103 |
| 1984 | 1,168,623.96 | | 35,885 |

[a]Blanks indicate data not available.

Source: Instituto Nacional de Recursos Hidráulicos (INDRHI), "Recaudaciones por Concepto de Usuarios en el Periodo 1966-1984," Santo Domingo, INDRHI Central Files, 1985.

that collections were quite low in the 1960s, but have risen both in quantity and in percent of payees, year by year. By 1984, for example, RD$ 1,168,624 was collected from 35,885 users. This represents an overall compliance rate of about 78 percent. The final report of the FAO irrigation survey reports a 1981 compliance rate of 100 percent in several of the 17 zones.[43]

By recent law and regulation, personnel of each irrigation district have begun to set water tariffs in relation to estimated upcoming operation and maintenance expenses. The 1984-85 tariffs were calculated in the late Fall of 1984 and are now being collected. The program is being phased in gradually. Fifty percent of the assessed tariff will be collected in 1985, and the remainder of the District budget will come from INDRHI. The percentage will be increased by stages until 100 percent is collected by the end of the decade. As the budgets are fixed annually, they are expected to increase with inflation and will reflect changes in the annual work program.

The question at this point is: How well will the rate of collection hold up? Although the old water rates were notoriously low, the 1985 levels are about seven to 15 times as high as in the past. The reason for the range is that a distinction is made in the fee charged according to whether rice is grown and whether the parcel is larger than ten hectares. Thus, a rice grower cultivating greater than ten hectares will pay a fee four times the base rate.

The new fees, when fully implemented, will equal RD$ 25/hectares in many cases. According to Poza and Reynoso the average cost for O and M per two hectares is running at RD$ 17 per hectare. At current price levels, RD$ 25 would easily cover current costs. However, it is possible, even likely, that the average of RD$ 17 represents a sub-optimal expenditure on O and M.

In Table 2-12, some information about past relationships between water tariff billings, collection and O and M expenditures is given. The available data permit only sketchy comparisons, but water fee collections as a share of budgeted O and M expenditures is not a very meaningful ratio unless it is based on amounts that are averages over periods of several years, or it can be assumed that O and M activities are normally at a good, adequate standard. In the two irrigation districts for which data are available, the ratio fell between 1981 and 1984, not because collections were low (indeed they rose) but because there was a dramatic increase in expenditures.

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[43] Estudio para el mejormineto de los sistemas de riego existentes, Table 4.



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Table 2-12: Recent O & M Expenditures as Related to Water Fee Assessments and Collections

| Yaque Irrigation District | Debited to Users 1985 | Debited to Users 1979/84 | Receipts from users 1984 | Receipts from users % of Total in 1984 | Receipts from users 1981 | Budgeted O&M Expenditures 1985 Budget | % 1985 Budget for: Admin | % 1985 Budget for: Oper | % 1985 Budget for: Maint | 1984 Budget | 1984 Receipts as a Share | 1981 Budget | 1981 Receipts as a Share |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bajo Yaque del Norte | 429,423 | 536,251 | 138,069 | 17.1 | 135,858 | 1,248,006 | 17 | 15 | 68 | 1,857,797 | 7.4 | 1,164,161 | 12.2 |
| Alto Yaque del Norte | 619,090 | 495,527 | 199,091 | 11.8 | 38,838 | 1,239,802 | 18 | 22 | 60 | 1,727,909 | 11.5 | 175,670 | 22.1 |
| Yuna-Camú | 1,514,261 | 1,604,732 | 408,786 | 34.9 | 197,260 | 2,672,122 | 10 | 17 | 73 | | | 528,180 | 37.3 |
| Ozama-Nizao | 379,714 | 389,989 | 106,593 | 9.2 | 41,957 | 939,765 | 15 | 35 | 50 | | | 311,897 | 13.5 |
| Valle de Azua | 230,188 | 380,056 | 77,346 | 6.6 | 23,436 | 477,179 | 16 | 35 | 49 | | | 252,000 | 9.3 |
| Yaque del Sur | 323,273 | 984,832 | 44,318 | 3.8 | 13,991 | 1,196,988 | 8 | 43 | 49 | | | 1,145,090 | 1.2 |
| Valle de San Juan | 372,606 | 376,562 | 194,420 | 16.6 | 37,569 | 1,007,065 | 14 | 35 | 51 | | | 308,186 | 12.2 |
| TOTAL | 3,868,555 | 4,767,949 | 1,168,624 | 100.0 | | 8,780,929 | | | | | | | |

Sources: All 1981 figures from Food and Agriculture Organization (FAO) and United Nations Development Program (UNDP), Estudio para el mejoramiento de los Sistemas de Riego Existentes: Republica Dominicana: Resultados y Recomendaciones de proyecto informe Técnico AG:DP/DOM/81/012, prepared for the Government of the Dominican Republic (Rome: FAO and UNDP, 1984), Tables 1, 1a & 4; 1984 Receipts from Instituto Nacional de Recursos Hidráulicos (INDRHI), "Recaudaciones por Concepto de Tarifas de Aguas Recibidas por los de Riego en al año 1984," Santo Domingo, INDRHI Central Files, 1985; Debited fees from INDRHI, "Relacion de los Deudos de los Usuarios de los Distritos y Zonas de Riego por Concepto del Uso de las Aguas Publicas," Santo Domingo, INDRHI Central Files, 1985; 1985 Budgeted O and M from INDRHI, "Determinacion de factor de Pago por zona para Usuarios," Santo Domingo, INDRHI Central Files, 1985; and 1984 Budgeted O and M, from INDRHI, "Resumen Proyecto de Presupuesto de operacion, mantenimiento y administracion para el año 1985," Santiago, INDRHI Irrigation District Files, 1983.



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O and M budgets are clearly rising in a general way, although emphasis shifts from district to district according to the greatest need at any moment in time. One of the interesting aspects of the 1985 O and M breakdown shown in Table 2-12 is the relatively small share allocated to central administration in each district.

c. Planned policy changes

The new program of higher irrigation water charges and stricter collection mechanisms has been described. No changes in this policy are contemplated other than a staged implementation of all aspects of the program. A steady increase in the percentage collected of each year's calculated fee per hectare is planned. More important, starting in 1986, the money will be retained in the irrigation districts to be spent for the O and M planned for the year. Larger renovations proposed by a District's management will continue to be dealt with in separate budget requests.

To reiterate, the sum of planned physical maintenance expenses plus expected administrative costs for the upcoming year are utilized to calculate the actual tariff levels, by district. These levels will vary from year-to-year and from district-to-district. The next year's levels are announced in the Fall and are collected throughout the production year as plantings and harvests occur. Eventually, 100 percent of the annual calculations will be assessed and that share over and above certain administrative costs will be held in the separate districts to pay for the programmed maintenance.

At the present time, the Irrigation District Directors are not allowed to keep the water fees collected in their districts. Nevertheless, the Director in Yaque del Norte pointed out to the team that there is incentive to get behind the stiffer enforcement program: a) eventually the district offices will need accurate water delivery and parcel size records for all the land areas serviced; and b) it is an advantage to get all farmers used to paying the fees so that future collections can be processed smoothly.

C. Irrigation Projects

1. Yaque del Norte

a. Background

Development of the Rio Yaque del Norte in the area around Santiago began about 1936 with an "old" project finished in 1956. Along with the other areas of the Dominican Republic, an expansion and renewal of this "old" system was initiated in the late 1970s. Projecto Rio Yaque del Norte (PRYN) is described in the AID project paper for On-Farm Water Management as follows:



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> This project [perimeter] encompasses a total area of 45,000 ha along the margin of the Yaque del Norte River west from Santiago de los Cabelleros. The right margin is between Rio Yaque del Norte and the Cordillera Septentrional, beginning from the head work of Santiago continuing west up to the stream Agua de Palma near Villa Elisa (Guayubin): the left margin is from the same head works to the Rio Amina in the south of Esperanza. The PRYN project is divided into two stages: Phase I completed first and covering nearly the total right margin; Phase II, now in progress, and covering all the left margin and an amplification of the right margin.[44]

(1) Description

The main features of the project include twin storage reservoirs with combined capacity of 300 million cubic meters (mcm), a hydro-electric plant, main canals which are lined, farm turnouts and farm ditches. The effective capacity of the reservoirs is considered to be double because there are two rainy seasons in this region of the Dominican Republic.

One operational problem of the system concerns the conflict between power generation and irrigation demands. Hydro-electric plants are consistently used to provide peaking power. In addition, the power division wants to produce all the power it can. Both of these conditions produce a situation not in harmony with irrigation requirements. Irrigation supplies should be nearly consistent and not subject to the wide short term fluctuations that peaking power produces. Furthermore, the power releases from the reservoir may not agree with irrigation demands. Excesses will have to be bypassed at the irrigation diversions and shortages will require releases from the storage reservoir. What this means is that a small equalizing reservoir is needed to store one or two days supply and smooth out the power release fluctuations. INDRHI is now in the process of planning this equalizing reservoir.

In the design of the new project an attempt was made to salvage most of the delivery system of the old project with the result that the linkages between the old and the new are not always at the best location. In addition, the design was reported to have been made from aerial photos with the result that the designs did not always agree with the actual field conditions. However, water was delivered for the first time under the new project this year and these shortcomings will be corrected, along with other problems that always surface in the first years of operation.

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[44]Anderson, PP: On-Farm Water Management, p. 26.

The system is planned to deliver water to "rotation blocks" of approximately 40 ha with a unit stream of 40 liters per second with sufficient flexibility to increase the stream to 75 liters per second. The water is owned and controlled by the government, which manages the distribution system.

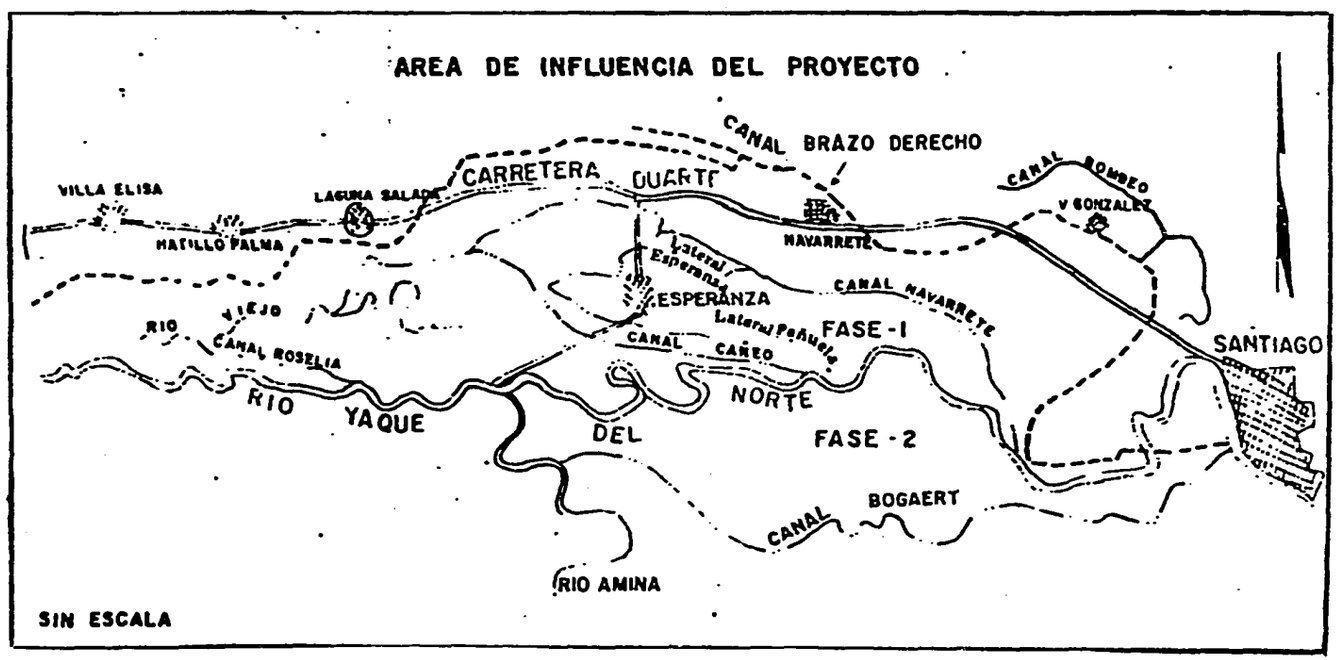
The team visited two areas of the project near Santiago to talk with farmers regarding water use: close to the diversion or upper end of the new project; and at the "tail end" of the old canal. The headend farmers disagreed among themselves as to the benefits of the new project in comparison to the old. Many farmers with small land holdings felt they were better off: water supply was more reliable and they did not suffer shortages. On the other hand, some farmers in the larger blocks said they were worse off. Their main complaint was that the new project cut off access to drainage water, a source of supplemental supply previously available to them. The farmers on the old canal feel that people upstream get more benefits than they do, and that they, the tailenders, must bear the shortages imposed by users upstream.

In response to the problem of differential water use on the old canal, a unique delivery pattern has been worked out which provides water to rice farmers at night and divides day time deliveries between sugar cane and other crops. Maintenance of the canal is a continual problem but has improved since water user groups were formed.

(2) Agriculture in project area

The PRYN project lies within the boundaries of Irrigation District Alto Yaque del Norte, and includes some new canals to irrigate additional land as well as to improve water supplies to some of the older canals (river diversions) already operated by the district. The district itself encompasses the three provinces making up the main drainage basin of the River Yaque del Norte. (See Figure 2-1.) Figure 2-2 illustrates the area influenced by PRYN. The district has been operating those parts of the project in Phase I, the right side of the river, for about two years. As mentioned, the project links in some older, existing canals, such as the Navarrete. Thus, there is a differential impact between areas that have a more established irrigation tradition and those where the practice is newer. In general, several more years will be required before full development of the system and conveyance structures will be achieved. Additional time will elapse before the ultimate pattern of multiple cropping is in place.

According to data provided by the District Director, the features of the project now can service about 22,200 ha of partially irrigated and un-irrigated lands. Allowing for the lands supplied by some other sources, FAO experts estimated a total of 27,650 ha commanded. This




IRRIGATION PRICING AND MANAGEMENT: DOMINICAN REPUBLIC

Figure 2-2: Area of Influence of the Proyecto de Riego Yaque del Norte (Phases 1 and 2)



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total is scattered in three management zones: Santiago, Mao, and Esperanza. Of this latter sum, about 20,600 ha were actually irrigated in 1981. An estimated 22,790 ha were actually planted at the time.

For the Yaque del Norte irrigation district as a whole, the estimate of farm families using state (project) water is 3,401. About 50 percent of this number live in the Esperanza zone in an area that is served by the lower reaches of the Navarrete canal. Average landholdings in this zone are nine ha. In the Mao zone, which has about 1,000 irrigators using state water, holdings average six ha. Santiago zone irrigators (720) have average holdings of 19 ha.[45]

Nineteen ha is a high average relative to state irrigation systems in other regions of the country. When allowance is made for the fact that a substantial share of farmers actually occupy agrarian reform lands, and that the percent of holdings less than five ha in size averages almost 79 percent throughout the district, it is apparent that some of the private holdings must be relatively large. For example, the team visited one farmer who claimed to own about 500 ha, but his actual holding is estimated to be about 3,000 ha. If the Santiago zone is taken as an example of an area heavily influenced by PRYN-controlled water deliveries, we see that about 62 percent of the land is held in parcels larger than ten ha. (See Table 2-13.)

Alto (Upper) Yaque del Norte is the most important tobacco growing region of the country. The other important export crop is irrigated sugarcane. Farmers with good water supplies and suitable land location rely upon rice as a cash crop. About 3,600 ha of the irrigated area is planted equally to corn, beans and tomatoes, and another 3,000 ha is operated in the form of pastures.

As appears to be the case in other irrigation districts, a range of farming techniques is encountered: animal as well as mechanical traction; high and low inputs.[46] Rice yields of five mt per ha are a maximum, but 3.5 mt is an average. Some farms employ the retoño system with rice. This consists of obtaining a volunteer crop of much lower yield, following harvest of the initial planting. A low or medium level of inputs is involved and there is no expense for land preparation.

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[45]Estudio para el mejoramiento de los Sistemas de Riego Existentes, Table 4.

[46]Secretaria del Estado de Agropecuario, Costos de Produccion por Entrevista (Santo Domingo: Departamento de Estadisticas y Departamento de Planificacción, 1980).



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Table 2-13: Distribution of Parcel Numbers and Land Areas by Size Class in the Santiago Irrigation Zone (percent)

| | P[a] (0<2 | A[b] ha) | P (2<4 | A ha) | P (4<6 | A ha) | P (6<8 | A ha) | P (8<10 | A ha) | P (>10 | A ha) | Total P | Total A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rice | 30.0 | 6.8 | 38.5 | 20.0 | 11.5 | 9.6 | 4.9 | 5.9 | 3.3 | 5.2 | 11.8 | 52.5 | 29.0 | 28.0 |
| Other | 28.0 | 3.7 | 31.8 | 10.0 | 11.3 | 6.3 | 11.1 | 8.0 | 2.9 | 2.8 | 14.9 | 69.4 | 61.0 | 72.0 |

[a]P = Parcels.
[b]A = Area in ha.

Source: Instituto Nacional de Recursos Hidráulicos (INDRHI), "Estadisticas de Distribución de Usuarios por Zonas," Santo Domingo, INDRHI Central Files, 1985.

Some relevant farm level statistics are summarized in Table 2-14. No revenue data are available for 1979. The water source and technique data are for small samples of procedures made in 1979 by SEA teams.[47]

In order to gain some impression of the range of small farmer income potentials we have assumed a basic plot size of 2.5 ha and two ways of managing the land:

- Two high yield crops of rice per year;
- Utilizing the plot as represented by the weighted average of land use in the district.[48]

These crude calculations suggest that as of three or four years ago, rice farmers could do fairly well if the farm plot was not too small (two full rice crops per year). Under the alternate assumption that 2.5 ha of land could have been farmed as an enterprise that produced a once a year crop mix in proportion to the way the majority of the district's irrigated land is used, the net income would have been enough to buy about 375 days of labor, half as much as under the rice assumption. The level of income that amount of purchasing power suggests does not appear to be especially high, but it might represent the lower range of the possible income scale. While these results are purely indicative, they do suggest the need for multiple cropping, especially if the plot sizes are small and/or families have to depend 100 percent upon farming for their annual incomes.

As part of its study of ways and means to improve existing state irrigation systems in the Dominican Republic, FAO experts analyzed expected costs/benefits, additional land to be brought under irrigation, number of jobs to be created, investments per ha and per job created for 56 proposed projects. They concluded that the amount of additional investment necessary to bring the Yaque del Norte project up to its potential, relative to the other 55 projects studied, put it in 17th place for profitability, first place for the amount of new land and for job creation, 29th place for investment cost per ha and 17th place for cost per job created. Thus, considerable, relatively expensive investment is still necessary.[49]

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[47] Ibid.

[48] INDRHI. "Recaudaciones por zonas en 1980, 1981, 1982, 1983, 1984, and 1985" (Santiago: INDRHI Irrigation District Files, 1985).

[49] Estudio para el mejoramiento de los Sistemas de Riego Existentes, Annex III, Table 1.

Table 2-14: Estimates of Annual Economic Value of Main Crops and Enterprise Potentials, PRYN (Yaque del Norte), 1979 and 1981

| Crop | Yield[b] (qq/t) 1981 | Yield[b] (qq/t) 1979 | Total Revenue/t 1981 | Total Cost/t 1981 | Total Cost/t 1979 | Net Rev/t 1981 | (RD$; 2.5 ha) Est. of 1981 Farmer Income[a] 2 Crops Rice | Farmer Income[a] Weighted Use | Unit Cost of Production 1979 | Water Fee/t 1979 | Av. Area Seeded (t) | Water Source | Level of Tech. Inputs | Level of Tech. Land Prep | Level of Tech. Land Quality[c] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rice | 8.00 | 5.77 | 98.48 | 62.50 | 54.03 | 35.98 | 2,878 | 762.78 | 0.094 | 0.16 | 63.8 | Gravity | High | Mech | A |
| Retoño | | 4.64 | 55.68[d] | 37.04 | 32.06 | 18.64[d] | | | 0.069 | 0.08 | 27.2 | Gravity | Med | None | A |
| Tobacco | 2.5 | 126[e] | 100.00 | 62.00 | 65.00 | 38.00 | | 106.40 | 0.526 | 0 | 28.0 | Spring | Med | Mech/ Animal | A |
| Pastures | | | 16.50 | 8.00 | N.D. | 8.50 | | 57.80 | | | | | | | |
| Tomatoes | 35.00 | | 92.75 | 56.75 | N.D. | 36.00 | | 28.80 | | | | | | | |
| Beans | 1.75 | 1.73 | 61.25 | 33.75 | 21.71 | 37.50 | | 30.00 | 0.1[illegible]2 | 0 | 44.6 | Spring | Med | Mech | A |
| Maize | 4.00 | 4.03 | 32.63 | 20.00 | 11.95 | 12.63 | | 5.63 | 0.030 | 0 | 50.7 | Spring | Low | Mech | A |
| Bananas | 42.40 | | 212.00 | 77.00 | | 135.00 | | 324.00 | | | | | | | |
| Cane | 5.75 | | 80.50 | 31.75 | N.D. | 53.75 | | 193.50 | | | | | | | |

| | | |
|---|---|---|
| Total (1981 prices) RD$/Year | 2,878 | 1,503 |
| DR$/Year | 1,439 | 751 |
| DR$/Month | 119.92 | 62.60 |
| # Days Labor Net Income Could Purchase | 720 | 376 |

[a]Calculation of income from assumed 40 t (25 ha) made by Devres Team.
[b]qq = quintales (100 lbs)/t = tarea (0.63 ha).
[c]Generally "A" stands for class I, II or even III level.
[d]Estimated by team.
[e]Bunches.

Sources: B. Anderson, et al., Project Paper: On-Farm Water Management Project (Draft), prepared for USAID/DR with support of Science and Technology Bureau sponsored WMSII Project (Santo Domingo: US Agency for International Development, 1983), Table 1 for 1981; and Secretaria del Estado de Agropecuario, Costos de Producción por Entrevista (Santo Domingo: Secretaria del Estado de Agropecuario, Departamento de Estadisticas y la Departamento de Planificación, 1980), Summary for 1979.



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b. Project management

Alto Yaque del Norte District is organized according to the standard INDRHI model. It has a central office in Santiago and three zonal offices in the field, all of which report upward, eventually to the national headquarters in Santo Domingo. The district office sets programs and oversees the activities of the zones. With the advent of the new tariff regulations, maintenance budgets are developed in the zonal offices, which also collect the tariffs and supervise the irrigation field staff. The district manages a maintenance budget, but any expenditures in excess of RD$ 5,000 must be processed in Santo Domingo.

According to INDRHI policy, user groups are expected to participate in discussions which set the annual zonal work program and budget. This participation may materialize this year as District staff try to implement the policy seriously. Until now, however, INDRHI staff have prepared plans and budgets themselves, without any systematic consultation with farmers.

INDRHI is responsible for virtually all maintenance of the irrigation systems. Farmers clean field channels, but have no other maintenance obligations. Emergency maintenance is executed by the District office, utilizing special appropriations from Santo Domingo.

Water is allocated according to land area and crop, not by volume. Charges are also levied on the basis of landholding and type of crop (rice or other). The zonal office is responsible for water distribution, which is managed by the distributors in each sector. The distributors open and close the turnout gates but farmers themselves manage distribution within turnout units, which average 40 ha on the new canal. This internal distribution pattern may be informal or highly formalized, depending on the sector.

In the area where field inspections were made by the team, the field ditches and laterals were in good repair and fairly clear of water weeds and vegetation that would impede water flow. This is indicative of good maintenance considering the fact that tropical conditions usually produce abundant, fast and luxurious growth of vegetation along waterways.

c. Farmer participation

Except for the articulate large landowners who interact frequently with irrigation authorities as well as other authorities, there has been very little farmer participation in the PRYN systems in the past. Farmers were not consulted during the design or construction of the new system, and they continue to have minimal maintenance responsibilities. As in most other irrigation systems in the Dominican Republic, INDRHI paid little attention to the collection of tariffs, thus indicating that farmers could not be expected to contribute, however minimally, to the O and M of the system.

However, the situation is starting to change dramatically in PRYN, which is in the forefront of implementation of the new laws relating to tariffs and water user organizations. During the last year, the District Director has traveled throughout his territory to discuss the new laws and their implications. Meanwhile, he has instructed his zonal directors to establish water user groups in their respective zones. The group formation effort suffers from a number of weaknesses which illustrate basic conceptual problems in INDRHI's approach, as well as the limited time that inexperienced staff can devote to the task. Nonetheless, given real institutional limitations, the effort has been surprisingly effective in a short time.

The team had extended discussions with representatives of several user groups in two zones: Santiago and Esperanza. The farmers from each zone identified a broad spectrum of irrigation problems they faced, from water shortages to conflicting water demands for a wide variety of crops. In general, farmers in Esperanza have a more favorable environment now that the new canal has been completed, whereas those in Santiago are served by an old canal which is inadequate for the demands made on it.

Although the groups in the two zones ostensibly were formed for the same purpose, they each have distinct, different styles, and they will probably produce different results. More than any other factor, the personality of the zonal director accounts for differences in the quality of the two sets of groups. As this question has important implications for the outcome of the group formation effort, the groups will be described briefly below.

The group organizers employed a similar model for the group structure. The basic unit of the groups is a "nucleus," a small turnout group consisting of perhaps 15 people. These units were mentioned in meetings with the team, but it is clear that they have informal status, rather than a recognized structural role. In practice, group formation occurs at the level of the sector, and each group has direct contact with the ditch rider, or cabo de agua, INDRHI's lowest level employee. In Esperanza, the sector groups are autonomous; in Santiago, the presidents of right bank and left bank sectors belong to a confederation in their respective areas.

To create the groups, the zonal directors called meetings in each sector at which they discussed new INDRHI policies regarding tariffs and user organizations. They then invited farmers to elect a five-person executive committee consisting of a president, secretary, and three other members. From this point, the outcome in the two zones began to diverge somewhat.

Most obviously, group leaders ended up with varying definitions of their roles and their relationships between themselves, their constituents and INDRHI. The group leaders in Esperanza see themselves as local representatives of INDRHI, but without adequate power to make



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their members follow their directives. They are enforcers who feel the need to be legitimized by being recognized officially by INDRHI so that they can get their members to listen to them. In contrast, leaders in Santiago describe themselves as representatives of farmers to INDRHI. They are advocates who approach INDRHI on behalf of their constituents to articulate the problems and needs of their fellow farmers.

In the field, both sets of group leaders have attempted to improve water distribution patterns. The leaders from Esperanza have done so by substituting unofficially for the ditch riders, merging technical and traditional authority. This has met with some success, depending on the strength and forcefulness of individual leaders. In Santiago, group leaders have attempted to establish ongoing dialogues with the distributors, sometimes individually and sometimes with groups of farmers, in order to improve cooperation within the sector and between sectors. Leaders claim that ditch riders now listen more attentively to the farmers and respond to their problems more rapidly than they did before they were organized.

Farmers in both zones indicated that since becoming organized they have assumed maintenance responsibilities which previously fell between INDRHI and individual farmers, but were undertaken by neither. Both farmers and INDRHI officials in Santiago point with pride to the fact that user groups even participated in a major maintenance program on the main canal, one which was clearly INDRHI's responsibility.

Each zone has a unique situation which deserves special mention. In Santiago zone, the old canal serves a diversified area with a broad range of irrigation needs. Part of the command area is planted in sugar cane, part in rice, and part in fruits, vegetables and grains; each requires a different irrigation pattern. In addition, there are a number of private pumps which lift water from the canal to upland tracts outside of the command area; this use decreases the already inadequate supply of water to the command area. In order to balance competing water demands, the Santiago zonal office has developed a complex rotation system. Rice is irrigated at night because the water can flow from paddy to paddy without constant surveillance. Sugar cane gets the daytime water from Monday through Thursday, at which time pumps are allowed to draw water. Other crops are irrigated on Friday, Saturday and Sunday. Farmers claim that the rice area is decreasing, and the time for "other" crops is inadequate, thus it may be opportune now to review the current pattern to see if it can be fine-tuned a bit. In any case, farmers appreciate the rotation system as a visible indication of INDRHI's responsiveness to their problems. Surely this arrangement helped to establish a framework for the collaborative relationship which is becoming institutionalized between INDRHI and the new water user groups.



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The collaborative spirit evident in Santiago user groups has not yet materialized in Esperanza. However, the new canal and conveyance system were utilized for the first time this year and offer a good opportunity to foster such a spirit, to the benefit of both users and INDRHI, if INDRHI manages the shakedown period properly. Until now, the new system has been designed and introduced from the top down, in a manner reminiscent of the authoritarian nature of the new user groups in Esperanza. In order for the new system to function properly, a number of things will have to happen: structural changes will be required to get water where it is needed; new distribution patterns will have to be developed to ensure that all plots can get water as needed; and new relationships will have to be established to enable the distribution to proceed smoothly. Ultimately, it would be possible to complete this shakedown process using traditional authoritarian or technocratic approaches, but this would be neither expedient nor efficient. Rather, what is needed is a collaborative effort between technicians, farmers and administrators, one in which all groups share their knowledge and experience with the other groups, articulate their assessment of the consequences, and together choose alternative solutions to problems that emerge.

If water user groups are identified as partners in this process, and if their role is defined as that of mobilizing members to contribute actively to the creation of a new system, instead of merely executing INDRHI's directives, a new type of group may emerge, based on a stronger, more democratic foundation. This is an important opportunity in which the interests and needs of both farmers and INDRHI coincide perfectly.

To make the best of the current situation, INDRHI should prepare its staff to function in the collaborative manner indicated above. This would require a reorientation of some of the people responsible for group organizing and minimal training of other relevant staff in ways to relate to farmers in the field. Most critically, INDRHI should establish clear procedures for collaborating with user groups to set detailed, equitable water distribution patterns in each sector. This reorientation will require a new understanding of INDRHI's possible role vis-à-vis farmers and user groups, but no staffing changes. Fortunately, the District includes a very good role model, the director of Santiago zone, who should actively participate in preparing the orientation training program. Given the responsiveness of farmers, as demonstrated in the success achieved so far, this reorientation program should produce concrete benefits in a very short time with virtually no commitment of resources.

d. Cost recovery

The new, general policies for making water fee collections have already been discussed. As near as can be ascertained, Yaque del Norte Irrigation District personnel are implementing the directives.



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Implementation of the new water charge directives is forcing the District personnel and the farmers they serve to come together to create better records, especially those related to land ownership or to areas serviced by state irrigation water. For example, in the Yaque del Norte District, farmers who pay water assessments in person have started to bring in maps or drawings of their plots in order to try to reduce the actual fee to be levied upon them.

District personnel recognize a natural tendency to irrigate more land than indicated by the drawings. On the other hand, in some cases, farmers are able to argue that zone records show that past charges imply larger areas than actually held. If there is disagreement and a resolution cannot be achieved by checking against aerial photos, etc., it may be necessary to survey the plots and prepare new drawings.

The system works as described earlier: charges vary according to size of land holding and whether rice is the crop to receive water. Various methods are utilized to notify farmers of the need to pay fees. At present, there is no plan to recover investment costs of the Tavera dam, diversion and canal works. During the past few years, more and more money has been collected in the form of water charges, but none of it has been directly applied to district O and M expenditures. For the present, the district competes for operating and maintenance funds as its share of INDRHI's general budget. The only annual amount it can be certain of is the administrative costs of salaries and district and zone office management for permanent employees. (Indeed, all this is paid directly from Santo Domingo, even the district telephone bills). In the mind of the District Director, therefore, "O and M" stands for his budget needs over and above administrative/operating costs and he would be happy to have the water fees reach that level.

The levels of O and M disbursements from INDRHI headquarters during the past few years are shown in Table 2-15. The annual increases recorded there appear to be greater than the rate of inflation, although the annual totals fluctuate. In the past, receipt of budget allocations may have been sporadic but, since 1982 some money has been disbursed to the district at least by February. Listed across the bottom of the table are the totals of annual water fee collections which have been forwarded by the district to INDRHI Headquarters.

It will be noted that in 1980 more in water fees was returned than was received for O and M. When a comparison is made between receipts and the water user fees collected, it is easy to see why the current District Director is looking forward to holding the fees in the district. During the early months of 1985 the fees collected are keeping up with the budget disbursements.

Table 2-15: Pattern of Receipts of Central Budget Funds for O and M Work in the Irrigation District Alto Yaque del Norte by Month vs. Annual Water User Fees Collected and Passed to Headquarters (1980-1985)

Budget Receipts From Santo Domingo

| Months | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|
| January | -- | -- | -- | -- | 28,581.08 | 23,169.56 |
| February | -- | -- | 45,422.42 | 9,515.69 | 21,787.89 | 59,385.54 |
| March | -- | -- | 28,818.35 | 9,652.94 | 29,059.30 | 47,002.23 |
| April | 30,000.00 | 14,105.14 | 38,337.85 | 27,407.62 | 43,928.78 | 2,945.26 |
| May | -- | -- | 12,008.01 | -- | 31,602.87 | -- |
| June | -- | 13,184.96 | 42,163.52 | 36,229.35 | 31,930.02 | -- |
| July | -- | 4,202.54 | 34,368.47 | 50,696.13 | 24,814.30 | -- |
| August | -- | 25,560.05 | 36,360.67 | 68,871.77 | 34,889.25 | -- |
| September | -- | 30,000.00 | 28,349.41 | 62,507.49 | 22,957.95 | -- |
| October | 10,174.28 | 53,848.73 | 9,433.75 | 35,304.36 | 42,758.32 | -- |
| November | -- | 27,507.86 | 52,011.16 | 72,062.87 | 39,780.70 | -- |
| December | -- | 67,940.33 | 31,265.23 | 43,333.06 | 28,318.69 | -- |
| TOTAL | 40,174.28 | 236,349.61 | 358,538.84 | 415,581.28 | 380,409.15 | 132,502.59 |

Collections Forwarded to Santo Domingo

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTAL | 105,278.56 | 82,277.43 | 87,830.10 | 134,689.73 | 223,122.33 | 114,870.19[a] |

[a]Through March 1985.

Sources: Instituto Nacional de Recursos Hidráulicos (INDRHI), "Recaudaciones por zonas en 1980, 1981, 1982, 1983, 1984, and 1985," Santiago, INDRHI Irrigation District Files, 1985; and

INDRHI, "Registro Asignaciones RD al Distrito/mes-1980-1985," Santiago, INDRHI Irrigation District Files, 1983.



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Data that compare water fee collections with specific budgeted total O and M are hard to obtain. In Table 2-12 we saw the relation for 1984 for the two northern irrigation districts. The 1984 data involve collections made before the new rates went into effect, but both budgeted expenditures and collections had begun to rise. The comparisons shown for 1981 are adapted from FAO calculations.[50]

Some feeling for the on-farm economic impact of the level of water fee assessments can be obtained from further inspection of Table 2-14. Based upon 1979 cost of production data obtained by sample survey, SEA estimated that the unit cost of production of rice was RD$ 0.094 per pound. The yield per tarea would have been about 600 pounds. The water user fee per tarea at that time was RD$ 0.16 for rice. Thus about 1.7 pounds (out of 600 total) would have paid the low level fees of that era.

For 1985, the water fee per tarea for growing rice has been increased to about RD$ 1.25 as long as the total area dedicated to rice by one farmer does not exceed 159 tareas (ten ha); beyond that size the cost per tarea jumps to about RD$ 2.43. This is a fee jump in nominal terms of seven to 15 times. Continuing with the rice examples, but in the absence of any up-to-date hard cost of production data, we might suppose that the cost of rice production is RD$ 700 per ton in 1984-85. This would imply a unit cost of RD$ 0.15 per pound (say 0.20). The real cost of the new fee in terms of rice would be 6.25 pounds of rice per ton (12.5 per tarea for parcels > 10 ha). Thus, the real jump in fee may be about 3.6 times to 7.15 times.

Due to the fact that available 1979 data do not cover the same crops, or the fee was zero due to a non-state controlled water source, other examples cannot be computed with available data.[51] However, the rice case conveys an adequate feeling for the new situation imposed by the current fee formula. The new fees are still low but they are scheduled to increase by at least 100 percent in the next few years. At that 'final' level they may represent about 2 percent or more of the production cost of rice and 1 to 3 percent of the production cost of other crops.

e. Summary

Alto Yaque del Norte District is undergoing a number of major changes at the moment. The new conveyance system is just beginning to operate on approximately 5,000 ha of an ultimate command area of about 20,000 ha to be developed in stages. At the same time, the new tariff regulations are being enforced, and an effort has

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[50]Ibid., Tables 1, la and 4.

[51]Secretaria del Estado de Agropecaurio, Costos de Produccion por Entrevista, (Santo Domingo: Departamento de Estadisticas y Departamento Planificaccion, 1980), Restmen.



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been launched to organize user associations. Meanwhile, existing irrigation facilities are increasingly being put under stress with the introduction of private pumps.

Heretofore, water charges have been levied irrespective of maintenance or other budgetary demands, and the rate of collection has had no bearing on the level of maintenance funds made available to the District. Tariff collection has been low, and participation of farmers has been minimal. Starting this year, tariffs are being set on the basis of estimated O and M costs, and water users are being organized in the hope that this will complement the budgeting process and facilitate cost recovery efforts.

The new INDRHI tariff program is a very positive development. It will raise water charges high enough to make each district self-supporting. More critically, however, the funds will stay within the district. This will tie charges to budgets and tie budgets to collection, which will give district and zonal officers an incentive to enforce collection. The recovery of O and M costs in the district is feasible and reasonable.

It is doubtful that increased farmer participation will affect cost recovery if INDRHI makes a serious effort to collect funds. Cost recovery has been low in the past because of INDRHI's collection policies, not because of the inability or unwillingness of farmers to pay water charges. If INDRHI is perceived to implement its program seriously, it is likely that farmers will pay the tariff, regardless of other factors.

The team visited no systems with conditions which would enable it to relate cost recovery with water reliability or adequacy, water measurement, or different types of charges. Once INDRHI engages in a serious collection program, however, some relationships may appear.

Increased water charges are necessary for improved O and M in the Yaque del Norte District, but probably not sufficient. Other important elements in the equation are likely to be the local use of the funds that are collected, and the participation of water users in setting O and M priorities and programs. There is no reason to believe that higher charges will lead to increased application efficiency.

The recent experience in Yaque del Norte with water user group formation suggests that institutionalized participation mechanisms may contribute to the improvement of O and M. However, the contribution is likely to depend on the nature of the group, its perception of its role, the level of responsibility it assumes or is given, its legacy of past activities and their impact, and its rapport with officials. The experience has been too brief to draw conclusions yet, and it remains to be seen whether the groups being formed will ultimately become viable entities or merely remain "official" groups. The result so far suggests that an important factor in early stages of group formation is the attitude of people who interact with the groups. In one zone,



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groups are authoritarian and mechanistic, little more than extensions of the INDRHI bureaucracy. In the other zone, the groups sense their strength in solidarity, and see themselves as partners with INDRHI staff. The two sets of attitudes are clear reflections of the attitudes and personalities of the INDRHI staff who organized the respective groups. As might be expected, the groups which emphasize collaboration and solidarity have taken a much more active role in O and M than the others.

2. Valle De Azua

a. Background

(1) Description

During the 1950-1960 period, agricultural activity in the Azua Valley was dominated by two large agricultural companies, the Dominican Sisal, C. por A. and the Dominican Fruit Company, which provided most of the employment for the people of the area. In the early 1960s these two companies ceased their activities. By the end of 1960, some vegetable production began to be developed, initiated by an Israeli group. By mid-1970, the Dominican government identified the lack of irrigation water as the major constraint to agricultural development and started work on the Yaque del Sur-Azua (YSURA) project.

The main features of the project include the following: the Sabana Yegua storage dam on the Rio Yaque del Sur with a capacity of 401 mcm and usable capacity of 368 mcm; a diversion dam at Villapando to a feeder canal linking to the Rio Tábara; and a diversion dam at Tábara to a concrete lined main canal which supplies water to the project. Six concrete lined laterals take off from the main canal and provide water to approximately 11,000 ha under the project. The capacity and area to be served by each lateral is shown in Table 2-16.

Each lateral is equipped with a control gate at the turnout from the main canal to regulate the flow. Below the gate is a Parshall measuring flume so that the flow to the lateral can be accurately metered. Turnouts from the lateral to the farm ditch consist of constant head double orifice control gates following the design of the US Bureau of Reclamation. These gates not only maintain a near constant flow to the farm ditch but also provide for water measurement and control. The farm ditches below the turnout are unlined but fairly well maintained.

Although storage is provided above the feeder canal, the fluctuating flow of the Río Tábara makes the water supply to the canal more or less like a "run of the river" system. At this stage of development only 7,038 ha, 64 percent of the command area, is being cropped. There is more than ample water, as evidenced by the fact that farmers do not irrigate at night. At the end of the day the ditch turnout is closed and the water is left in the lateral or main canal. At this stage of the project's evolution farmers can have water



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Table 2-16: Capacity and Area Served by Laterals of the Yaque del Sur Project - Azua

| Lateral | Capacity ($m^3$ sec) | Area (ha) |
|---|---|---|
| 1 | 3.77 | 2,500 |
| 2 | 2.34 | 1,000 |
| 3 | 0.75 | 200 |
| 4 | 2.96 | 1,300 |
| 5 | 1.50 | 2,000 |
| 6 | 6.20 | 4,000 |
| TOTAL | 17.52 | 11,000 |

Source: Azua Project Office.

essentially when they want it and the YSURA project virtually functions as a demand system. Except during shortages, water is rotated within laterals during the daytime. The six laterals are each divided into smaller units, called sectors. A ditch rider located in each sector manages allocations within his sector. The rotation period varies by crop, but farmers can request water as needed. The rotation for sorghum is 15 days; maize is about 12 days; tomatoes, four to seven days; and peppers and melons are watered more frequently. Outside of the regular schedule, a farmer must request water from the ditch rider about two or three days before it is needed.

The team visited with farmers on both the head end and tail end of lateral number two in order to determine whether or not water is distributed equitably. It was found that inequity is not a problem because capacity and supply are more than adequate for the area now developed. As the development expands from the present 7,000 ha to the expected maximum of 11,000 ha, more stress will be put on the system, probably requiring round the clock operation and more rigid scheduling. At present, farmers seem to be doing a fairly good job of water management on their farms. The excesses, however, due to non-use of water at night and the luxurious use of the available supply are causing serious drainage problems in the lower parts of the valley. The project was put in service in 1978 and by 1982 drainage problems were already becoming serious, with more than 900 ha having a water table at less than 0.50 meter and an additional 4,000 ha with the water table at between 0.50 and 1.00 meter. The original project design did not include an adequate drainage network, but work is now underway to build drains which will carry excess water out of the valley.

(2) Agriculture in project area

Irrigated lands lying within the Azua District are concentrated in the Valle de Azua which is a relatively small area lying between the city of Azua and the sea. Some small water sources have been developed for irrigation for some time, but pumping the local aquifer formed the real basis for agricultural development during the 1960s and 1970s. This development was based on a concentration of production of vegetable crops. Beginning in 1978, about 4,500 ha began to receive water from the Sabana Yegua dam as part of the planned 12,000 ha YSURA (Phase I) project. As of 1984, about 7,300 project ha receive water. The remaining 10,000 plus ha in the valley continue to be irrigated on a catch-as-catch-can basis.

The most up-to-date estimate of farm families receiving State (project) water is 6,261. About 400 of them occupy lands in a sub-zone outside of the project. For the project as a whole, the average irrigated holding is two ha, but this varies somewhat according to whether a plot holder is settled in Instituto Agrario Dominicano lands that lie inside the project perimeter. IAD plots appear to average no more than 1 to 1.5 ha per family. Remaining project lands



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which are classified as "private" average 2.5 ha in size. Slightly over 27 percent of the project area is divided into private holding of greater than five ha.[52] (See Table 2-17.)

According to parcel size distribution data shown in Table 2-17, project YSURA has far, far fewer large holdings than anywhere else in the entire country. About 67-68 percent of all farm plots within the project are less than two ha in size. (Although the data are identified by the valley as a whole, it is possible that the percentages refer mainly to the project YSURA. Some larger holdings (over 100 ha) exist outside the project perimeter.)

A wide range of crops are grown in the Valle de Azua: tomatoes, beans, maize, sorghum, peanuts, rice, cantaloupe, cassava and others. The most important cash crop is tomato. In a given year, 8,900 ha in the project will be seeded in relation to 7,580 ha actually receiving water. This suggests overall land use efficiency of 1.17.[53] One estimate is that about 30 percent of the seeded area would be in tomatoes. The next largest percentage (15) is for red beans.[54]

Some unknown percentage of small farmers manage three harvests per year. A typical rotation might be maize-beans-tomatoes. Farmers arrange in advance to sell the output of one trimester harvest--melons, peppers or tomatoes--to "The Company". Thus, they are assured of a cash market and can sell or consume the small grains they produce during the other seasons. "The Company" provides seed, credit and some degree of supervision of the specialty crop production process.[55]

According to FAO experts, the level of technique employed in the YSURA project could be much improved.[56] However, relative to the rest of the Dominican Republic, the level of inputs used plus reliance upon mechanical land preparation and on good soils, represents good technique. By national standards, income per tarea is high, and the

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[52] Estudio para el mejoramiento de los Sistemas de Riego Existentes, Table 4.

[53] Ibid., Table 5a.

[54] INDRHI, Recaudaciones por Zona.

[55] A. Espaillat, L.S. and H.H. Melo A., "Funcion de Producción del Agua en Interaccion con Nitrogeno en el Cultivo del Tomate Industrial, Lycopersicon esculentum" (Azua, Republic Dominica: Facultad de Ciencias Agronomicas y Veterinaries, Universidad Autonoma de Santo Domingo, 1984), p. 21.

[56] Estudio para el mejoramiento de los sistemas de riego existentes, Azua Section.

Table 2-17: Distribution of Parcel Numbers and Land Areas by Size Class in the Valle de Azua Irrigation Zone (percent)

| | P[a] (0<2 ha) | A[b] (0<2 ha) | P (2<4 ha) | A (2<4 ha) | P (4<6 ha) | A (4<6 ha) | P (6<8 ha) | A (6<8 ha) | P (8<10 ha) | A (8<10 ha) | P (>10 ha) | A (>10 ha) | Total P | Total A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rice | 88.6 | 67.4 | 9.4 | 21.4 | 0.8 | 3.3 | 0.8 | 4.6 | - | - | 0.3 | 3.3 | 5.7 | 2.3 |
| Others | 63.3 | 26.3 | 20.8 | 24.1 | 12.4 | 21.1 | 1.6 | 4.3 | 0.5 | 2.0 | 1.3 | 22.2 | 94.3 | 97.1 |

[a]P = Parcels.
[b]A = Area in ha.

Source: Instituto Nacional de Recursos Hidráulicos (INDRHI), "Estadisticas de Distribución de Usuarios por Zonas," Santo Domingo, INDRHI Central Files, 1985.



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amounts of land worked on average, keeps a single farmer busy. Hired labor would be required if average land holdings increased very much (and were cropped three times per year).

Table 2-18 suggests a range of income possibilities. These estimates are based upon the assumption of 25 tareas (1.57 ha) as the enterprise base and two different ways of working the land:

- o Three crop annual rotation: corn-beans-tomatoes; and
- o Cropping according to the weighted average of the cropping pattern for the whole project area.[57]

The apparently better income opportunities for small farmers relative to Yaque del Norte (Table 2-14) and La Vega (Table 2-20) zones show up in the assumption of 25 tareas for the Azua calculations in comparison to 40 tareas and 30 tareas in the other two; nevertheless more income can be obtained from the smaller parcel and the more valuable vegetable crops grown in Azua.

Unfortunately, the 1981 and 1979 data sources did not contain comparison estimates of all crop yields. Nevertheless, as in the Yaque del Norte example (Table 2-14), there seems to be substantial variation in yield estimates quoted from one study to another. Thus, considerable caution must be exercised when drawing conclusions from such data. The reported maize yields appear to be very low (3 qq per tarea = about 40 bushels per acre) for irrigated conditions (90 to 130 bushels per acre is not uncommon).

Table 2-19 supplies some indication of the historic economic impact of the District's water tariff. One pound of tomatoes out of a yield of 3,000 pounds (per tarea) could have paid the per tarea fee.

b. Project management

Four government entities are involved in the Valle de Azua irrigation district: INESPRE, BAGRICOLA, SEA and INDRHI. INDRHI controls the water supply, and provides the ditch riders as well as maintenance of the main conveyance features. The remaining three entities support farmers by providing technical assistance and a machinery backup. Farmers are responsible only for maintenance of channels which service their own fields. If the farmers are delinquent, they are warned by the ditch riders, who ultimately can cut off water until the work is performed.

Peak water demand occurs in December and January, and the water supply is shortest in June and July. When shortages occur, about one year in five, farmers must also irrigate during the nighttime. Given the abundant water supply, farmers seem satisfied with the irrigation

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[57]Anderson, PP: On-Farm Water Management.



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Table 2-18: Partial Estimate 1979 Economic Value of Main Crops and Enterprise Potential, La Vega

| Main Crops | Yield (qq/t)[b] 1979 | Total Revenue/t[a] 1979 | Total Cost/t 1979 | Net Rev/t 1979 | Est. of 1979 Farm Income[b] (RD$; 1.92 ha) 2 Crops Rice | Unit Cost of Production (lb) 1979 | Water Fee/t 1979 | Water Source | Level of Inputs | Technique Land Prep. | Land Quality |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rice | 3.25 | 86.63 | 58.30 | 28.33 | 849.9 | 0.071 | 0.13 | Gravity | High | Semi Mech. | A |
| | | | Retoño | 18.00 est. | 540.0 | 0.209 | 0 | Spring | Low | Animal | B |
| Beans | 0.90 | 29.70 | 18.88 | 10.82 | | 0.065 | 0 | Spring | High | Animal | B |
| Potato | 16.96 | | 67.65 | | | | 0 | Pump | High | Semi | B |
| Garlic | | | | | | | | | | | |

| TOTAL: | | |
|---|---|---|
| | Year | 1390 |
| | US$/Year | 927 |
| | US$/Month | 77 |
| | # Days Labor Net Income Could Purchase | 397 |

[a]Prices used: RD$ 10.5/qq rice; RD$ 33/qq beans.
[b]Range of farm income calculated by Devres Team.
[b]qq = quintales (100 lbs)/t = tarea (.63 ha).

Source: Secretaria del Estado de Agropecuario, Costos de Producción por Entrevista. (Santa Domingo: Secretaria del Estado de Agropecuario, Departamento de Estadist y la Departamento de Planificación, 1980).

Table 2-19: Estimates of Annual Economic Value of Main Crops and Enterprise Potential, Valle de Azua, 1979 and 1981

| Export Crops | Yield (qq/t)[a] 1981 | Yield (qq/t)[a] 1979 | Total Rev./t 1981 | Total Cost/t 1981 | Total Cost/t 1979 | Net Rev./t 1981 | Est. of 1981 Farm Income (RD$; 1.57 ha) Rotation | Est. of 1981 Farm Income (RD$; 1.57 ha) Weighted Use | Unit Cost of Production (lb) 1979 | Water Fee/t 1979 | Water Source | Level of Inputs | Land Quality |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tomato | 36.33 | 29.47 | 96.28 | 55.60 | 119.49* | 40.68 | 1,017.00 | 355.95 | 0.040 | 0.05 | Gravity | High inputs/Mech | A |
| Melons | 2.50 | — | 215.00 | 37.25 | — | 177.50 | — | 443.75 | — | — | — | — | |
| Hot Peppers | 12.28 | — | 158.41 | 90.35 | — | 68.06 | — | 85.08 | — | — | — | — | |
| Maize | 3.00 | 2.04 | 27.50 | 19.00 | 16.95 | 8.50 | 212.50 | 31.88 | 0.083 | 0.05 | Gravity | Low inputs/Semimech | A |
| Red Beans | 1.36 | — | 61.12 | 26.55 | — | 34.57 | 864.25 | 172.95 | — | — | — | — | |
| Cassava | — | 6.87 | — | — | 27.87 | — | — | — | 0.041 | — | Gravity | No inputs/Semimech | A |
| Peanuts | 2.01 | 2.28 | 40.17 | 22.00 | 25.60 | 18.17 | — | — | 0.112 | 0.130 | Gravity | Low inputs/Semimech | A |
| Rice | — | 3.12 | — | — | 47.67 | — | — | — | 0.153 | 0.160 | Gravity | Med inputs/Semimech | A |
| Sorghum | 5.50 | 4.64 | 43.50 | 17.00 | 11.37 | 16.50 | — | 61.88 | 0.025 | — | Spring | Med inputs/Mechanical | A |
| Bananas | 75[c] | — | 112.50 | 84.00 | — | 28.50 | — | — | — | — | — | — | |
| Plantains | 4,000[d] | — | 200.00 | 95.00 | — | 105.00 | — | 100.00 | — | — | — | — | |
| Other | | | | | | 40.00 est. | | | | | | | |
| TOTAL (1981 prices): RD$/Year | | | | | | | 2,093.75 | 1,296.80 | | | | | |
| US$/Year | | | | | | | 1,046.86 | 648.40 | | | | | |
| US$/Month | | | | | | | 87.25 | 54.03 | | | | | |
| # Days Labor Net Income Could Purchase | | | | | | | 465a | 288 | | | | | |

[a]qq = quintales (100 lbs)/t = tarea (.63 ha).
[b]Each.
[c]Measured in hands.
[d]Range of farm income calculated by Devres Team.

Source: Anderson, B. et al. Project Paper: On-Farm Water Management Project. (Draft), prepared for USAID/DR with support of Science and Technology Bureau sponsored WMSII Project. (Santo Domingo: US Agency for International Development, 1983), Table for 1981.

administration. The team visited the lateral which said by many to be the best in the system, but other observers have confirmed that the generally favorable situation prevails even in the less advantaged parts of the system.

Although the irrigated area in Valle de Azua project is neither large nor small by INDRHI standards, the average parcel size in the district is the smallest of all districts and many farmers are involved. As a consequence, the nominal number of INDRHI personnel stationed in the district is greater than anywhere else. The total breaks down as follows: Professional (five), mid-level technicians (five), sub-administrators and secretaries (15), special laborers and chauffeurs (four) Laborers and ditch riders (99).

SEA stations 35 professional and technical personnel in the valley. These people are responsible for extension of technical assistance and operation of tractor and equipment pools. (One person for every 182 irrigation families.) IDA handles its activities with 12 persons (one for every 522 families). The number of INESPRE employees is unknown.

BAGRICOLA spends about RD$ 5 per hectare per year and uses four vehicles. SEA provides 20 tractors and 15 vehicles and spends about RD$ 13 per hectare per year in the irrigation district. INDRHI spends at least this much again annually. Such support services may approximate 5 to 10 percent of net farm income per hectare per year.

According to the FAO technical investigations, the irrigation situation in the entire valley would require increases in both heavy earth handling and canal cleaning equipment. These experts suggest that INDRHI, SEA and BAGRICOLA personnel be reduced, and O and M expenditures be increased in the future.[58]

The YSURA project only commenced operation in 1978, and the cement lined canals and laterals are generally in good repair. Ditches leading off the laterals are unlined and must be kept free of weeds. Five to ten families appear to be served by each such ditch, so some coordination of cleaning is required. From the general appearance of the ditches seen by the team, a fairly good job of cleaning is being done.

The current operation of the system works to keep the laterals full two or three days per week. The farmers do not irrigate at night and the team noted that there was plenty of water in the laterals for all users. There was no tail end problem. Any lack of productivity is therefore due to management of other inputs.

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[58] Ibid.



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c. Farmer participation

INDRHI has not started to form water user associations in Azua, as prescribed by the new law. Land reform farmers are organized in credit groups which continue to provide a local framework for contact with land reform and irrigation officials even if they lose their credit function. As the groups frequently consist of people who operate adjacent plots, they sometimes also serve as coordinating mechanisms for water distribution and field channel maintenance. In such cases, it may be superfluous or even counterproductive to insist on creating the official organizations. Rather, the existing associations should be utilized as much as possible.

Farmers outside of the land reform areas are not organized in the same fashion. However, it was not clear to the team whether this lack of organization impedes the smooth operation of the irrigation system. If so, INDRHI should direct its efforts in such areas, rather than undertake a general, system-wide campaign to organize water users.

Overall, farmers have a limited role in the operation and maintenance of the system. Farmers and INDRHI personnel seem to have a good rapport, and information flows well between the various governmental and private entities working in the area, and the farmers. Once the remainder of the planned command area is brought into the system, however, the stress on available water supplies will require both farmers and officials to change their practices somewhat. Officials will need to establish less flexible rotation schedules and farmers will need to achieve higher levels of cooperation within turnout units and between sectors. Both ends can be served by gradually transferring responsibility for the management of sector units to the farmers themselves.

d. Cost recovery

There are a number of irrigation district zones where water fee collection rates have reached 100 percent, but they do not include the YSURA project. In 1981, the FAO survey of water system improvement possibilities found that collections were made from 55.9 percent of the users in the project zone. From the standpoint of the district, there is automatic collection of fees from those families settled on agrarian reform lands, at last to the degree that such settlers do business with BAGRICOLA (water fees are collected in the credit/repayment process). Fruit and vegetable processors or marketing companies which offer credit also include the water tariff and make certain the district gets paid. Actual fee collection is somewhat hampered because there are a relatively large number of plots and farmers inside the project perimeter.



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Farmers who do not receive credit through the bank or marketing institutions tend to ignore the tariff because paying it is a nuisance, not because they object to it in principle or because they think it is too high. Indeed, by all accounts farmers in Azua have no problem with the tariff. They can afford the current tariffs and will have no difficulty meeting future increases.

Until now, the Azua District office has limited its collection efforts to the credit-giving channels; it has not attempted to collect tariffs from individual farmers. Consequently, any deficiencies in cost recovery reflect collection problems and policies, not the recalcitrance or delinquency of farmers.

However, it may be assured that the irrigation district personnel will implement the new directives that already have been described in detail. Under the new procedures, the tariffs will be set at levels seven to eight times higher than in the past. Not much rice is grown in the project (see Table 2-17) and the plot sizes are small, so the great bulk of water users will be asked to pay the same rate per hectare. Again, nothing in the new water fee procedures suggests any intention to recover the investment cost of the Sobana Yegua dam, the two diversion structures or the conveyance works.

Little information was available showing the historic relation between amounts budgeted to the district for its cash O and M outlays and amounts collected and forwarded to INDRHI headquarters. In 1981, however, the FAO survey mentioned at several points previously, created an estimate of total INDRHI expenditures in the Valle de Azua District of RD$ 20 per hectare. The collection for the same year averaged about RD$ 1.55 per hectare. About 9 percent of the total O and M expenditures were collected from water users. (Estimates of the overall amounts for the whole project are shown in Table 2-12 for 1981.) In 1981, a 9 percent recovery was one of the lowest of any zone or district in the country.

In the future, if the new procedures are fully implemented, collections will equal programmed expenditures plus expected administrative and operating outlays. Eventually, the districts will retain the programmed expenditures.

e. Summary

At present, the Valle de Azua is a smoothly working system with abundant water supplies being used for high value crops. Moreover, it benefits from a well-articulated support structure which provides inputs, credit and technical assistance for crop production, as well as markets. The new On-Farm Water Management Project will undoubtedly benefit farmers, but it will do so by refining an already favorable situation, not by qualitatively changing the irrigation environment.



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INDRHI's cost recovery program is feasible in Azua. Farmers will be able to pay the increased water charges without difficulty. Indeed, the collection mechanism is so mechanical that most farmers will never know they have done so.

Previous cost recovery efforts were plagued by deficiencies in the collection program, more than anything else. Now that it is clear that INDRHI intends to apply its policies seriously, it should encounter no opposition from farmers. Cost recovery in Azua has been unrelated to any important element of system operation and maintenance, especially application efficiency. In the future, payment levels may begin to reflect levels of service, but that remains to be seen.

The abundant water supply determines current irrigation practices, rather than any other factor. Water charges will increase irrespective of water use, thus any changes will not affect water use. The current drainage problems are only partially related to farmers' water use, because water flows through the system whether or not it is applied to crops. The drainage situation might be relieved somewhat if water were used around the clock for agriculture, but such use does not correspond to the farmers' present needs. Increased cost recovery will not affect this problem.

Farmer participation in irrigation management is not formalized in Azua, and this does not seem to affect either cost recovery or the O and M situation to date. In the future, however, farmer participation should be encouraged, especially because farmer associations, formal and informal, can be used as mechanisms to resolve problems which will undoubtedly arise when the command area is increased and the resulting stress on water supplies becomes evident.

3. La Vega

a. Background

(1) Description

La Vega is located on the upper tributaries of the Rio Camú approximately 125 km northwest of Santo Domingo and 30 km southeast of Santiago. The irrigation of this region is some of the oldest in the Dominican Republic and problems of drainage are the most advanced. The area was originally developed as pasture land but is now devoted almost exclusively to rice, with 6,966 ha reported to be cropped. A 1984 FAO report noted that drainage problems exist on approximately 80 percent of the area, with more than 5,700 ha having a water table at less than one meter. This partially explains the predominance of rice.



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The field inspection covered both head and tail areas of the system. INDRHI is responsible for the cleaning of the main canals and laterals and machines are used. Hand cleaning of laterals and field ditches is also accomplished. The system appeared to be fairly well maintained and not overgrown with vegetation, indicating that the cleaning of canals was not neglected.

The water delivery schedule is on a 24-hour basis and the water supply was said to be short almost every year. Under normal conditions rotation is up the lateral, especially when the supply is critical. In extreme stress conditions the farmers request water and are able to obtain it. The normal period between turns is from six to eight days.

In one area, the farmers said they jointly hired a member of their credit group to distribute the water and irrigate for the group. The farmers of the group rotate the position among themselves; all pay their share amounting to RD$ 2.50 per year. The irrigator is instructed to give priority to lands needing water.

(2) Agriculture in the project area

The Irrigation District Yuna-Camú covers one of the largest areas of all seven irrigation districts and is extensively devoted to rice cultivation. This is the region where much of the private development of small systems for rice production occurred prior to 1960. Based upon INDRHI estimates, the overall land utilization ratio for the entire irrigation district is about 1.50.

The La Vega Zone, the largest of the five included in the district, was the area visited by the team. Land utilization is the most complete in this zone. According to adjusted FAO survey data, the land use efficiency ratio for lands actually receiving water is 1.90.[59] This drops to 1.39 when allowance is made for fallow, or waterlogged lands or for areas that for some reason are not serviced.

About 2,980 families receive water from state irrigation systems. The average parcel size is five ha (79.5 tareas) but 81 percent of all parcels are under five ha in size. Due to restrictions on the maximum plot size allowed to agrarian reform farmers, we may assume that at a minimum, all the larger plots (roughly 22 percent of the holdings in the area) are in private ownership. Table 2-19 illustrates the pattern of land utilization in some detail. Production is overwhelmingly centered on rice and is concentrated in larger parcel sizes. Although the team saw some irrigated pasture during its visit, this land use is not mentioned in the statistical sources available.

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[59] Ibid., Tables 1 and 5.

If a full rice crop can be grown twice a year, a single family can do fairly well even on a small plot, but many farmers do not have adequate water for a second crop. Thus, considerable reliance is placed upon the retoño practice, already described.

In the La Vega Zone, the river diversions are from the Camú, which has no storage. Thus, the bulk of the irrigation is on a run-of-the-river system. The actual water that can be diverted varies according to runoff from the watershed and annual rainfall. The risk of low water supplies during the second rice crop is the basis of the retoño system. Rice yields for the main crop average 3,500 to 4,000 kg per ha (which is not outstanding by world standards). The yield under the retoño system is about 50 to 60 percent of a regular crop.

All rice is purchased by local mills which in turn sell the polished grain to INESPRE, the state agency that controls pricing and marketing of this important product. Farmers large and small thus have a steady market for their output and will try to grow rice if they think they can be successful, rather than other small grains.

Table 2-20 contains some abbreviated production cost estimates for 1979. Unfortunately, more up-to-date price and cost data could not be located by the team. The table shows that a parcel size of 1.92 ha (30 tareas) would produce net income of RD$ 1,390 per year from one regular and one retoño rice harvest. The amount of net income under these assumptions would have been enough to hire about 400 days of ordinary labor.

Two pounds of rice out of 825 pounds per tarea could have paid the 1979 district water tariffs under the previous collection system.

b. Project management

La Vega is one of five zones in the Yuna-Camú District. The district contains over one-fourth of the total state irrigated land in the Dominican Republic, and La Vega includes about one-fourth of the district total.

On the surface, the Yuna-Camú District has an organizational structure which resembles other districts: a district administration, five zonal offices, and individual irrigation systems divided into sectors, as appropriate. The official hierarchy is also the same, going from a District Director to Zonal Directors to ditch riders on the sector level. In the field, however, one would expect to find a qualitatively different management situation than those found in Azua or Yaque del Norte. Yuna-Camú contains a number of systems of different sizes, located all over the area, drawing water from a number of different sources; thus the logistics of maintaining contact with each of the systems, let alone managing them directly, must be formidable. Moreover, a number of the systems are small, technically unsophisticated systems which serve paddy lands and do not present special scheduling problems, such as those found on the old canal in



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Table 2-20: Distribution of Parcel Numbers and Land Areas by Size Class in the La Vega Irrigation Zone in Percent

| | P[a] | A[b] | P | A | P | A | P | A | P | A | P | A | Total P | Total A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0<2 | | 2<4 | | 4<6 | | 6<8 | | 8<10 | | >10 | | |
| Rice | 32.0 | 6.4 | 45.4 | 23.3 | 7.5 | 6.0 | 4.6 | 5.3 | 1.7 | 2.5 | 8.9 | 56.5 | 95.5 | 97.8 |
| Other | 62.8 | 21.1 | 24.4 | 25.2 | 5.1 | 9.4 | 2.6 | 6.6 | 1.3 | 4.5 | 3.8 | 33.2 | 4.5 | 2.2 |

P = Parcels
A = Area in ha.

Source: INDRHI, Estadisticas de Distribucion.



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the Yaque del Norte, described above. Such systems do not need as much administrative attention as the other ones visited. In such a diffuse situation, one would therefore expect INDRHI to spread its manpower unevenly in the zone, as was stated to be the case although this point was not verified by field visits.

As regards maintenance responsibilities, tariff rates, water allocation priorities, distribution mechanisms, and so on, the zone is not unusual. Other than the fact that the Yuna-Camú District is very large and contains a hodge-podge of systems as a whole, the biggest difference between it and other districts is the high level of tariff collection, which may be less real than apparent, as indicated below.

c. Farmer participation

The number and varying size of systems within the La Vega Zone--41 systems ranging from 15 ha to 7,000 ha--suggests that the amount of farmer participation probably also varies from one system to another. It is likely, for example, that farmers participate actively in most decisions which affect the smaller systems, yet it is clear that INDRHI controls the largest system, Camú. Even in Camú, however, where INDRHI is responsible for O and M, including water distribution, farmers do distribute water to plots within the turnout units except during drought periods. There is no indication, however, that water users participate in decisions affecting system design, O and M budgets, water allocation priorities, tariff levels, or INDRHI personnel.

INDRHI staff in the La Vega Zone started to organize water user associations in late 1984, and about eight of the 41 systems in the zone now have user groups. District staff claim that the groups will be helpful in two ways. First, they will participate in zonal planning sessions to identify problems and maintenance priorities and to set INDRHI's annual work program. Second, they are expected to organize and oversee minor maintenance activities.

As in Yaque del Norte, the zonal offices are responsible for organizing the groups. The standard organizational model is used, which consists of a nucleus group at a turnout on a lateral, which may be as large as 200 has, and an association with an executive committee at the sectoral level. In forming the groups, staff have approached existing Farmers' Associations, (Asociaciones de Agricultores), inviting them to establish Irrigators' Associations (Asociaciones de Regantes. Thus the associations are sub-groups of existing groups, or re-groupings, not entirely new creations. The team visited Camú, a system which has yet to be organized, so it was not able to assess the structure, strength or impact of the official organizations. However, in Camú the team encountered one Farmer Association, and one informal group, both of which are active and viable.



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The informal group is the remnant of a land reform credit group, consisting of 15 farmers located on a 750-tarea (47 ha) land reform plot. Each year, the group appoints one of its members to manage water distribution within the plot, for which he is paid RD$ 250 per year by each of the other members. Rice is the principal crop; although farmers rarely have enough water for a second crop, they usually try to start a ratoon crop after the rice harvest until the water situation becomes clearer. This group is interesting because it illustrates two important points. First, informal water management groups exist in the system, and presumably in other systems, which should be incorporated in any organizational effort rather than ignored. Second, farmers understand the value of water so well that they are willing to pay considerably more than the prevailing water charge to have it managed properly.

The second group is a Farmers Association which was established as part of the land reform program. Essentially a cooperative, the Association operates farm machinery, provides inputs and markets some crops. There are 50 members, most of whom seem to be land reform parceleros. The members operate 9,000 tareas (563 ha), which indicates either that they obtained unusually large land reform parcels, or that the membership includes a number of large landowners. The discussion with members of the group brought out two main points. First, located at the tail of the system, they are acutely aware of the limits of the irrigation system. Their lands inevitably suffer when water shortages occur. They estimate that they lose their second rice crop in seven out of ten years, at an annual loss of about RD$ 3 million. Credit is easily available for rice, so most farmers invest in a second crop, lose it, and remain in debt. Last year, the Agricultural Bank cancelled many debts, but the cycle continues. Second, the members are aware of alternatives and want to contribute to improving the system. For example, they described a proposal which would take water from a point 8 km downstream from the existing diversion weir and lift it six or seven meters into a canal that would connect to the current distribution network. The farmers said they would gladly share the cost of such an investment with other beneficiaries.

The team was not able to discern how prevalent such groups are in Camú, or to what extent the two are typical of existing groups. In particular, it was not made clear whether non-parceleros also participate in farmer associations, formal and informal, or if they have their own groups. Additionally, it was not possible to determine the nature of the relationship between parceleros and non-parceleros in mixed areas. If, for example, non-parceleros are not well organized, or easily organizable, or if they tend to be dominant in their interactions with parceleros, rather than egalitarian, it will be difficult to establish a system-wide network of functional water user groups without investing considerably more attention to the effort than is now possible, and without calling upon organizational skills which are not currently available in INDRHI. However, if such groups are



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prevalent in the system, and if the two examples are typical, then it appears that the district has adopted a promising organizational strategy.

d. Cost recovery

As part of their survey of Dominican Republic irrigation systems, FAO teams calculated that 100 percent of the farmers in two of the five zones of the Yuna-Camú Irrigation District paid irrigation fees in 1981; the payment rate for the La Vego Zone was 87 percent that same year. These results support the opinions of INDRHI technicians who told our team that the rice regions were the most faithful in paying the water tariffs presumably because the fee is paid as part of the input credit package for rice. The volume of money collected in 1984 was about double that of any other district.

As in the case of other projects visited, the local district and zone personnel are implementing the new directives concerning water fee imposition and collection. Farmers interviewed by the team realized the fees were rising and were concerned because rice profits are being squeezed at present. However, their main interest is in increasing and stabilizing water supplies, because they know that over the long pull the domestic demand for rice will be steady and growing. One user group association is pressing INDRHI to establish a new intake in order to divert water which currently is discharging into the river below the present intake.

Although precise figures are not available, the central budget allocations for O and M have been rising in recent years, just as in other districts. In the 1985 budget, for example, the Yuna-Camú District will receive more than double the amount of any other district in the country and is the only district that allocates nearly 75 percent of its budget for maintenance (27 percent for administration and operations).

These figures suggest the importance of the district in INDRHI's overall operation. In addition, historically, it seems that the district has done far better on collections as a share of O and M. In 1981, for example, when the district O and M budget was far higher than that of any other district, the receipts from water users equalled 37.3 percent of O and M. In that same year, the next highest collection ratio was 22.1 percent. (See Table 2-12.)

If the 37.3 percent figure is related to just the part of annual budget expenditures that is actually handled in the district, as opposed to the share administered directly from Santo Domingo headquarters, it is probable that the collections represented at least 50-60 percent of the former. As the water fees rise, under the new program, covering 100 percent of the "discretionary" O and M budget should be achieved easily. The only dark spot in this picture is the price cost squeeze rice producers are in at present and the uncertainty of how long it will continue.



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e. Summary

Camú was designed to irrigate pasture lands, but is being used primarily for rice, with frequent problems of water shortage. The system seems to be maintained adequately and farmers are felt to use the water efficiently. However, the combined efforts of farmers and INDRHI staff cannot overcome real system limitations.

If farmers could be sure to receive adequate water for a second rice crop, then INDRHI's plan to recover the full cost of O and M through water charges would be perfectly feasible. However, such assurances cannot be made under current circumstances: the water supply is ultimately too short at some time during most years. When the shortages appear, some farmers always seem to get a second crop, and others virtually never do. A program which expects all farmers to share the cost burden equally will exaggerate the inequities which already exist. Although the same could be said for other systems, the impact is greater for rice than for other crops, in terms of both the yield impact of short-term drought stress, and the value and marketability of the crop. Consequently, if INDRHI intends to recover full O and M costs, it should consider revising the calculation schedule to cover each rice crop separately. A reasonable formula could be derived, using average cropping figures for the last five years as the base. When so applied, the charges would fall equitably upon beneficiaries. If the cropping base is formulated properly, the resulting levy should cover full costs during normal years and generate a surplus during good years.

The tariff payment rate in La Vega is higher than the other systems visited, but there are no indications that this is due to farmer participation, water supply, water measurement, or any other factor relating to system operation. Nor does it seem to reflect the farmers' perception of the value of the water, as INDRHI officials claim. The team noted no attitudinal or behavioral differences between La Vega farmers and farmers in the other systems. Rather, the high payment rate in La Vega is the clearest indication of the success and limitations of INDRHI's standard collection policy. That is, INDRHI tries to collect tariffs unobtrusively, through credit packages from companies and institutions, rather than directly from farmers. Credit is easily available to rice farmers. Most of them take credit, thus most of them pay their tariffs without special effort and without much choice in the matter.

Increased water charges are necessary for continued or improved O and M, as in other INDRHI systems. As in the other systems, it is unlikely that increased charges will improve application efficiency. The critical elements in Camú, as elsewhere, is scarcity. When water is short, people use it carefully, steal it, or try to ingratiate themselves to the distributor to get extra water.



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To what extent increased participation will improve O and M remains to be seen. Much of the impact of organizing farmers will depend on the organizational strategy used, as well as the ultimate role and responsibilities assigned to the user groups. In La Vega as elsewhere, INDRHI still needs to clarify this question.

D. Summary and Conclusions: Study Issues

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

In the Dominican Republic, a program is underway to raise irrigation fees and to enforce collection, to make each irrigation district self-sufficient over the next few years. There seems to be little opposition to the program, but it is clear from discussions in the field that farmers have not been informed about the whole program. They may know that irrigation rates have doubled over the last year, but they do not know what will happen next.

Fortunately for INDRHI, the rates are not seen by farmers to be high. Indeed, many farmers pay their irrigation fees essentially without knowing about it: fees are routinely included in the credit package issued by the Agricultural Bank, as well as fruit export companies, which then make payments to INDRHI. Moreover, the low cost recovery rates which have prevailed in the Dominican Republic are attributable not to the reluctance or refusal of farmers to make payments, but to the low level of the fees and INDRHI's reluctance to enforce collection. Thus, although the evidence is not complete within the above case studies, it does appear that recovery of O and M costs via direct and indirect charges is a feasible goal in the Dominican Republic.

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

INDRHI has recently begun to implement a program to organize water users and involve group leaders in planning discussions. Groups have been formed in some areas, and formal consultation may become routine this year in such areas. The program assumes that water user associations will help improve cost recovery rates and reduce maintenance costs, but the mechanisms for achieving these ends do not seem to be thought out clearly. Indeed, discussions about water user associations usually include references to mechanisms to enforce water charge payment. Thus, if the organizational effort succeeds, it will be difficult to separate the impact of the carrot (associations) from that of the stick (sanctions). Although this may not be a problem for INDRHI, it does make it difficult to predict the outcome of the change.



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3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?

a. Reliable water supply

In the Dominican Republic, as in Peru, there is a clearer link between the reliability of water charge collection and cost recovery, than between the reliability of water supply and cost recovery. In only one instance in the Dominican Republic did farmers say that they previously did not pay the fee because their water supply was irregular. If INDRHI continues to emphasize the collection of tariffs indirectly through institutional means, rather than directly from farmers, the reliability of water delivery may never become a clear issue.

b. Adequate water supply

As above, the tariff levels have been too low, and collection patterns have been too closely related to the use of institutionalized production credit to indicate a relationship between cost recovery and the adequacy of water supply. Once tariffs increase, some linking pattern may appear, or protests may increase from farmers who regularly get short supplies. Although the data available do not indicate a link until now, INDRHI should consider adopting provisions to reduce water charges for farmers who do not receive enough water, such as those at the tail end of the Camú System.

c. Water delivery and measurement technology

None of the systems we visited has measurement technology which is applied at the farm turnout level. In Azua, measurement is possible at turnouts on the main laterals, but not below. Consequently, in no system is it possible to do more than estimate the amount of water which may reach a farmer. In any case, there is no indication the level of cost recovery is affected by the presence or absence of reliable measurement devices.

4. Are increasing water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water?

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

The situation in the Dominican Republic resembles Peru to the extent that individual systems and districts are expected to become self-sufficient with respect to O and M in the near future.



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However, the Dominican Republic's low water charges and the reluctance of INDRHI to collect fees has sometimes led to less revenues being collected than expenditures being made for O and M for specific irrigation systems. As explained earlier, to date, water charge revenues from each system are not retained for O and M as O and M self-sufficiency is sought, however, increased water charges will be necessary to attain the same or improved O and M in many cases.

Such increased fees alone will not be sufficient to achieve improved O and M. However, given the low costs for irrigation administration at the system level and the beginning labor contributions of some farmers groups, adequate water charges are likely to lead directly to improved O and M, especially where meagre central budgetary allocations have constrained local official's ability to provide additional O and M effort.

The relationship between increased water charges and improved O and M will be influenced by the degree of farmer participation in both fee setting and O and M, especially where water charges need to increase substantially. At present, INDRHI officials set the tariff levels; farmers now have no say in the matter. There are plans to allow farmers to participate in the formulation of annual maintenance plans, which will in turn affect tariff levels. Presumably, the user associations will be vehicles for such input, but the situation is too new to predict how the process will be established, or what will be the ultimate impact of this policy.

The Yaque del Norte system illustrates the possible utility or irrelevance of water user groups, depending on the premises upon which they are formed. The INDRHI official who formed the groups on the old canal fostered an attitude of collaboration and cooperation by establishing a clear problem identification role for the groups, and then by attempting to resolve the problems that were identified through the groups. In contrast, the official who formed groups along the newer canals fostered a more authoritarian attitude among group leaders, who understand their role to be that of enforcing INDRHI directives. In the first instance, farmers have started to take an active part in maintenance, supplementing INDRHI's traditional role and even substituting for it. In the other, group leaders have assumed a more passive, regulatory function. Their groups have had more limited impact on O and M, and offer little promise for the future unless they are significantly reoriented.

b. <u>To what extent does efficiency of water use vary with the cost of water?</u>

The systems we visited did not constitute appropriate situations in which one could generate data to determine possible links between water prices and application efficiency. In none of the systems is water cost related to water use in such a way as to



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encourage farmers to use less water than they have available. There are any number of instances in which application efficiency is affected by water scarcity, but not by the level of water charges.

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

The Dominican Republic has not encouraged participation until recently, but the example of the old canal in Yaque del Norte indicates a possible link between participation and improved O and M. Given a proper orientation and minimal institutional encouragement and support, farmers started to take an active hand in maintenance.

Participation may be informal or highly formalized. The Dominican Republic has recently decided to establish formal participatory mechanisms, but the level of implementation varies considerably from one situation to another. Moreover, the level of nascent, informal organization also may vary. In general, the degree of formalization required for effective participation can be expected to be related to the size and complexity of the irrigation system, the magnitude of financial input necessary to carry out O and M (vs. in-kind, labor inputs), and the size and degree of centralization of the irrigation authority.

INDRHI is urged to proceed by engaging in a two-step exercise. First, it should clarify more precisely and concretely the proposed functions of the associations, and the desired outcome of the organizational effort. Second, instead of promulgating a standardized organizational model, INDRHI should allow districts and zones to establish locally specific associations, based on existing formal and informal groups wherever possible. Until the objectives and rationale are clear, the effort is not likely to succeed over the long run. Even if associations are formed, they are not likely to last long unless their existence is meaningful. Once the rationale and objectives are clear, INDRHI should not attempt to dictate organizational forms or formats.

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# IRRIGATION PRICING AND MANAGEMENT

## ANNEX 3

## Morocco

Submitted to: Ms. Joan Atherton
Social Science Analyst
U.S. Agency for
International
Development
Office of Policy
Development and Program
Review
Bureau of Program and
Policy Coordination

Submitted by: Ian D. Carruthers
N.S. Peabody, III
A.A. Bishop
A.D. LeBaron
Rekha Mehra
Ramchand Oad
Dean Peterson
Dennis H. Wood

DEVRES, INC.
2426 Ontario Road, N.W.
Washington, D.C. 20009
(202) 797-9610
Cable: DEVRES
Telex: 440184

Contract No.: OTR-0091-C-00-4466-00

September 30, 1985

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ANNEX 3

Morocco

Ian D. Carruthers, Principal Investigator
Dean F. Peterson, Irrigation Engineer
Rekha Mehra, Economist and Social/
Institutional Specialist

## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| DER | Directorate of Rural Equipment |
| DPA | Provincial Directorate of Agriculture |
| GDP | Gross Domestic Product |
| LSI | Large-scale irrigation |
| MARA | Ministry of Agriculture and Agrarian Reform |
| M | Million |
| O and M | Operations and Maintenance |
| ORMVA | Regional Office of Agricultural Development |
| ORMVAD | Regional Office for Development of Doukkoua |
| SMSI | Small and Medium Scale Irrigation |
| WUA | Water User Association |

## CURRENCY EQUIVALENTS

US$ 1.00 = DH (Moroccan Dirhams) 9.84

## WEIGHTS AND MEASURES

| | | |
|---|---|---|
| 1 hectare (ha) | = | 10,000 $m^2$ |
| | = | 2.471 acres |
| 100 hectares (ha) | = | 1 $km^2$ |
| 1 kilogram (kg) | = | 2.204 pounds |
| 1 metric ton (MT) | = | 1,000 kg |
| | = | 2,204 pounds |
| 1 kilometer (km) | = | 0.621 miles |
| 1 square kilometer ($km^2$) | = | 100 ha |
| 1 millimeter (mm) | = | 0.04 inch |
| 1 cubic meter ($m^3$) | = | 1,000 liters |
| 1 liter (l) | = | 1.066 quarts |
| 1 liter per second (l/s) | = | 1.066 quarts per second |



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## LIST OF PEOPLE INTERVIEWED

Officials

Mr. Oulad Charif
Direction de l'Equipment Rural
Ministry of Agriculture
Rabat

Mr. Guaddari
Small Scale Irrigation
Ministry of Agriculture
Rabat

Mr. Taouqi Abderrahman
Director
Regional Office de Mise en Valeur Doukkala (ORMVAD)
Doukkala

Mr. Rahale Abdelkrim
Chief of Equipment
ORVAD
Doukkala

Mr. Nassiri Hamid
Ing. de Travaux sub Equipment
ORMVAD
Zemamra

Mr. Adam Laheen
Ing. Gestin reseau d'irrigation
ORMVAD
Zemamra

Mr. Fethi Benyounes
Directeur
Provincial de l'Agriculture de Marrakech (DPA)
Ministry of Agriculture
Marrakech

Mr. Belkouch Ahmed
Ing. au Service de l'equipment de Marrakech
DPA Marrakech
Marrakech

Mr. Aït Lahouri Laheen
Ing. au Service de l'equipment Rural de Marrakech
DPA Marrakech
Marrakech

Mr. Aboutayeb Fouad
Chef de Service de l'equipment rural
DPA Marrakech

USAID

Dr. Malcolm Purvis
Agricultural Development Office

Dr. M'Hamed Hanafi
Project Officer

Mr. Andres Acedo
Program Specialist (Doukkala)

Others

Prof. Mohammed ait Kadi
Chairman, Department of Agricultural Engineering
Institute Agronomique et Veterinaire
University of Rabat

Dr. Rachid Abdellaoui
Institute Agronomique et Veterinaire
University of Rabat



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Annex 3

Morocco

## A. Background

### 1. Economic background

#### a. Macroeconomic conditions and policy

In the decade of the 1970s, Morocco pursued a dynamic growth strategy that resulted in a relatively high growth rate of 7.3 percent between 1973-77. Average annual per capita income grew at a rate of 3 percent in these years and in 1978 per capita GNP was DH 2,714 or US$ 670. The development effort of the decade saw large investments, especially in the service sector (education and training) which comprised almost half the total GDP. (See Table 3-1.) However, savings and exports did not keep pace with investment and import growth. This has resulted in a deepening financial crisis.

Table 3-2 shows the government's current account deficits as well as the large gap in the balance of payments. The overall effect has been to compel the government to resort to heavy reliance on external borrowing. Structural factors contributing to the financial disequilibrium include a sectoral development strategy that emphasized across-the-board consumer subsidies such as in education and health which were provided at all income levels. This proved to be a considerable strain on the budget. The large expenditures on modernizing the Royal Armed Forces since 1975 imposed an additional burden.[1]

Other contributing factors are the government's price policies, the effects of protectionism and over evaluation of the currency. The government intervenes in both product and factor markets through subsidies and price controls, often with conflicting objectives. The unsurprising effect of these policies is contradictory and negative results. The pricing policies pursued frequently act as disincentives to domestic production while an overvalued currency and lower world market prices for essential foodstuffs prove to be an incentive for continued high import levels.

The accelerated public investment program in the past decade was instituted in an environment in which the sudden rise in phosphate prices brought in unexpectedly huge receipts from phosphate exports. The subsequent slowdown in phosphates has negatively affected export earnings and this has not been compensated for by expansion in other export-oriented production. One of the factors responsible is the

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[1]The World Bank, Morocco: Economic and Social Development Report, (Washington, DC: The World Bank, October 1981), p. i-ii.



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Table 3-1: Sectoral Gross Domestic Product, 1978

| | 1978[a] (M DH) | Share in GDP (Percent) |
|---|---|---|
| Gross Domestic product | 50,325 | 100 |
| Agriculture | 9,104 | 18.1 |
| Industry | 16,241 | 32.3 |
| Services | 6,168 | 49.6 |
| GNP Per Capita | 2,714 | |

[a]At market prices.
[b]NFS = Non-factor services.

Source: The World Bank, Morocco: Economic and Social Development Report (Washington, DC: The World Bank, October 1981).



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Table 3-2: National Accounts Summary and Balance of Payments, 1977-82
(M DH)

| | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|
| **Government Finance** | | | | | | |
| Current Revenues | 11,669 | 10,954 | 14,820 | | | |
| Current Expenditures | 11,925 | 12,940 | 14,393 | | | |
| Current surplus/deficit | -256 | -1,966 | -427 | | | |
| **Balance of Payments** | | | | | | |
| Exports of goods and NFS[a] | 8,281 | 8,910 | 10,418 | 12,717 | 15,941 | 17,882 |
| Imports of goods and NFS | 18,292 | 16,282 | 18,282 | 20,357 | 27,465 | 31,314 |
| Resource gap | -10,011 | -7,343 | -7,864 | -7,640 | 11,524 | 13,432 |
| External Debt | 18,636 | 20,813 | NA[b] | NA | NA | NA |

[a]NFS = Non-factor services.
[b]NA = Not available.

Source: The World Bank, Morocco: Economic and Social Development Report (Washington, DC: The World Bank, October 1981).



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government's large role in investment which has dampened private sector investment.

Morocco's current financial difficulties have had their impact on irrigation development, as elsewhere. Most of the large-scale irrigation (LSI) development has taken place in the past fifteen years. During this period 65 percent of investment in the agricultural sector was applied to irrigation construction. The Investment Code of 1969 laid out a strategy for cost recovery from farmers of 40 percent of investment costs and 100 percent of operations and maintenance (O and M) expenses. In practice, the cost recovery goals have not been achieved and the government has subsidized more than its share of 60 percent of capital costs as well as O and M. However, the government's current straitened financial circumstances have given greater urgency to cost recovery issues which are now being paid more attention. This is the macroeconomic context in which the current study of irrigation pricing and management was undertaken in Morocco.

b. The rural and agricultural sector

In 1982, agriculture contributed 18 percent to Moroccan GDP at current prices, provided 40 percent of employment and a third of total exports. Although sixty percent of Morocco's population is dependent upon agriculture, the sector contributes a relatively small and declining proportion to GDP. For example, in the 1960s, agriculture contributed 25 percent to GDP growth but in the next decade its share was only three percent. However, while the share of agricultural employment in the overall labor market is declining, the absolute number of people employed in agriculture is still increasing. Furthermore, 45 percent of rural families live at or below the absolute poverty level estimated to be US$ 238 per capita in 1981. Overall GNP per capita was US$ 790 in 1979.

Total land area in Morocco amounts to 69 M ha of which only 7.7 M ha is suitable for cropping. Most of the cultivable land is located in the northern half of the country and along the Atlantic coast. Aridity increases towards the south and 20 M ha of semiarid and mountainous land are suitable only for grazing and forests. East and south of the Atlas mountains is desert. Total irrigated area amounts to 850,000 ha and this is where most industrial and forage crops, vegetables and citrus fruits are grown, as are almost 65 percent of agricultural exports.

Of the available cropping land, only 5.3 M ha are cultivated each year, the rest being under tree crops or remaining fallow (two M ha). The main crops are winter cereals (primarily hard and soft wheat, barley, and oats) which are planted on 4.3 M ha, pulses on 500,000 ha and the rest in vegetables, sugar beets, oilseeds, cotton and forage crops. Extensive livestock raising is practiced in the arid regions while intensive livestock production is becoming increasingly important in irrigated and high rainfall areas.



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There is a marked contrast between performance in the irrigated and rainfed sectors with production in the more modernized irrigated sector contributing an increasing proportion of agricultural value added. This is generated by the progress in production of high income elastic high-value commodities such as sugar, vegetables and 60 percent of milk--a trend given additional impetus by demand growth resulting from increasing urbanization. About 45 percent of total agricultural value added is contributed by production on large irrigation schemes which cover only 10 percent of the cultivated land area. Irrigated production has, however, benefitted from subsidized irrigation water, guaranteed markets, government extension services to introduce modern farming techniques and inputs and attractive prices. Consequently, sugar beet production grew by 13 percent per annum between 1967/69 to 1976/78 while milk production increased 4.3 percent per annum from 1971 to 1977 and vegetable production at eight percent per annum.[2] The prevailing patterns of protection clearly favor the irrigated sector and provide tremendous incentives for capital and energy intensive irrigated cropping.[3]

Production in the rainfed sector accounts for the major portion of the country's basic food supply and supports the majority of the rural population.[4] Thus, 85 percent of Morocco's cereals as well as its pulses, oilseeds and red meat are produced under rainfed conditions. Most rainfed areas are characterized by traditional agricultural practices. As a result of limited use of agricultural inputs and farm machinery as well as unfavorable price policies, crop yields and livestock productivity are generally low. For example, production of pulses and olives show no long run improvement (See Table 3-3), while cereal yields have increased by only 0.12 tons/ha in 18 years.[5]

Over the past 20 years, the relative importance of agriculture in Morocco's economy has declined as has its contribution to overall value added, employment and exports. The weakness of Morocco's agricultural sector performance is clearly demonstrated by the widening food gap.

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[2]Increased vegetable production was primarily due to additional area brought under irrigation. The World Bank, Morocco: Economic and Social Development Report, p. 159.

[3]The issue is of significance because the deficits in cereals, vegetable oils and meat cannot be covered except by intensified production in rainfed areas. Ibid., p. 162-63.

[4]With the expansion of agricultural imports, the food supply is generally adequate as are nutritional levels. However, nutritional deficiencies persist among poor people and approximately 45 percent of Moroccan farm families live at or below the absolute poverty level estimated at US$ 200 per capita (1979 prices).

[5]The World Bank, Morocco: Economic and Social Development Report, p. 159.

Table 3-3: Volume of Selected Agricultural Production
(000s Quintals)

| Product | 1970-71 | 1971-72 | 1972-73 | 1973-74 | 1974-75 | 1975-76 | 1976-77 | 1977-78 | 1978-79 | 1979-80 |
|---|---|---|---|---|---|---|---|---|---|---|
| Winter Grains[a] | 48,312 | 47,157 | 29,347 | 43,117 | 32,455 | 51,734 | 26,684 | 42,281 | 37,386 | 41,214 |
| Spring Grain Crops[b] | 5,138 | 4,410 | 2,890 | 4,915 | 4,746 | 5,297 | 1,890 | 4,265 | 3,349 | 3,843 |
| Pulses[c] | 3,367 | 4,143 | 3,537 | 7,048 | 4,508 | 4,963 | 1,583 | 2,749 | 3,428 | 2,310 |
| Olives | 1,160 | 5,060 | 1,950 | 2,547 | 2,009 | 3,043 | 1,630 | 3,040 | 1,630 | 4,400 |
| Oilseeds[d] | 175 | 402 | 269 | 299 | 352 | 297 | 275 | 298 | 677 | 418 |
| Sugar Beets | 15,839 | 16,770 | 12,927 | 19,436 | 17,919 | 23,616 | 14,737 | 23,954 | 21,745 | 21,890 |
| Vegetables[e] | 7,140 | 6,760 | 3,580 | 8,100 | 10,600 | 10,500 | 10,700 | NA[f] | NA | NA |
| | | | | | (000s Tons) | | | | | |
| | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
| Milk | 505 | 524 | 523 | 521 | 570 | 600 | 650 | NA | NA | NA |

[a]Includes hard wheat, soft wheat, barley, oats and others.
[b]Includes maize, sorghum, rice and others.
[c]Includes beans, chick peas, green peas, lentils and others.
[d]Includes flanseed, sunflower seed and peanuts.
[e]Includes early crops, tomatoes, potatoes and fresh vegetables.
[f]NA = Not available.

Source: The World Bank, Memorandum on Morocco's Agricultural Sector: Identification of Issues and Bank Strategy (Washington, DC: The World Bank, May 1980).



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Domestic food production has been unable to keep pace with demand which has been increasing as a consequence of high population growth (3.2 percent per annum) and rapid urbanization (4.8 percent per annum) and income growth. The result has been substantially increased food imports with Morocco becoming a net food importer in 1974. The average rate of growth in agricultural imports between 1977-81 was over 10 percent per annum amounting to US$ 600 M in 1981. Imports of agricultural commodities now comprise 25 percent of total imports, two-thirds of which are made up of soft wheat, sugar and edible oils. This increase in food imports has had a significant impact upon the agricultural trade balance which has swung from substantial surpluses in the early 1970s to major deficits in more recent years.

Factors contributing to the agricultural sector's weak performance are several successive years of drought as well as structural and policy-related causes. Of the structural constraints, the land tenure problem is most significant. Problems include unequal land distribution, extreme fragmentation (leading to inefficient holdings), lack of land titles, lack of security of land tenure and a high incidence of absentee land ownership. Table 3-4 shows the size and distribution of landholdings. Over 56 percent of the landholdings are less than 5 ha and these comprise about a quarter of the total cultivable land area. A series of reform measures have been considered by the government but, aside from the large irrigated areas, these measures have not been effectively pursued.

Other policy-related constraints include conflicting price policy objectives, protection patterns, public investment strategies, the weakness of agricultural support services including research and extension and marketing and input supply. In order simultaneously to ensure high producer prices to raise farm productivity, to keep food prices low for urban consumers and to insulate the economy from short-term international price fluctuations, the government employs a variety of price controls, subsidies, quotas, tariffs, export and import taxes, etc. The result of simultaneously pursuing such divergent goals is often contradictory.

Thus, for example, the effect of fixed producer prices and government support buying and imports of commodities such as soft wheat (for bread) is for substantially lower prices to prevail on the free market. (Producer prices for bread wheat often can be 35 percent lower than the official fixed price.) Other effects are reduced farmer incentives for production and increased imports. Additionally, subsidies for a number of food items (flour, sugar and edible oils) bring their retail prices below world market prices. (See Table 3-5.) The corresponding official domestic producer price is also lower while the subsidies impose a heavy burden on the national budget. Currency overvaluation has in the past contributed to increased imports of basic staples but the September 1983 depreciation should moderate this effect.



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Table 3-4: Land Distribution Patterns

| Size (ha) | Number of Farms | % of Total | Area (ha) | % of Total | Average Number of Parcels Per Family |
|---|---|---|---|---|---|
| < 5 | 1,090,500 | 56.5 | 1,776,200 | 24.5 | 5.5 |
| 5-10 | 220,000 | 11.4 | 1,508,000 | 20.8 | 6.8 |
| 10-20 | 113,900 | 5.9 | 1,529,700 | 21.1 | 7.7 |
| 20-50 | 44,300 | 2.3 | 1,218,000 | 16.8 | 8.8 |
| 50-100 | 7,700 | 0.4 | 514,000 | 7.1 | 8.8 |
| > 100 | 2,000 | 0.1 | 703,000 | 9.7 | 9.7 |
| Total | 1,478,000 | 100.0 | 7,250,000 | 100.0 | 6.0 |

Source: International Commission on Irrigation and Drainage (ICID), Specificities of the Moroccan Hydro-Agricultural Equipment, 30th Executive Council, May 1979.

Table 3-5: Fixed Prices for Key Agricultural Commodities Relative to World Market Prices

| Commodity | Official Producer Price (DH/t) | Official Producer Price (US$/t) | World Market Price[a] (US$/t) 1982 | World Market Price[a] (US$/t) Mobile Average 1980-1982 |
|---|---|---|---|---|
| Bread wheat | 1,400 | 204 | 167 | 164 |
| Sugarbeet | 155 | 22.6 | 15 | 20 |
| Milk | 1,590-1,790 | 232-261 | 180 | 194 |
| Paddy | 2,180 | 318 | 293 | 344 |
| Maize | 1,000 | 146 | 109 | 115 |
| Soyu | 2,270 | 331 | 245 | 265 |

[a]Prices are CIF Casablanca.

Source: The World Bank, Morocco: Agricultural Strategy Paper (Washington, DC: The World Bank, 1985).



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2. Irrigation development

a. Description of irrigation system

In Morocco, there are both large scale and small and medium scale irrigation (SMSI) systems. The LSI projects generally range from 10,000 - 20,000 ha and represent new investments in major civil works for water regulation and conveyance and have modern distribution systems. Their development is generally accompanied by land consolidation and agricultural support services that include recommended cropping patterns and improved technological methods and delivery of inputs to farmers in the service area. The large perimeters are developed and managed by well-organized regional irrigation administration and agricultural development offices. There are nine LSI perimeters in Morocco with an irrigation potential of 870,000 ha of which over 400,000 have been completed (Table 3-6).

The SMSI projects range from a few to several thousand ha (generally less than 5,000 ha) and can be divided into two subcategories. The first type are the new projects technically similar to the large modern schemes and differentiated from the latter only by size. The second type of SMSIs are traditional systems some of which have existed for centuries. They are based on simple technologies and water distribution is defined by traditional rights. There are approximately 400,000 ha under irrigation in traditional SMSIs, about 100,000 ha of which have been partially rehabilitated by the government.[6] In addition, it is estimated that there is potential for the development of 100,000 ha of rainfed areas as modern SMSI perimeters.[7]

Of the total irrigated area in Morocco, 59 percent is equipped with modern facilities, i.e., water distribution facilities to the farm level.[8] Water resources from rivers and replenishible groundwater is estimated at about 25 billion $m^3$ annually. About seven billion $m^3$ of water is undevelopable. Of the developable waters about four billion $m^3$ is in groundwater and 14 billion $m^3$ is surface water. About 50 percent of the available water resources are already developed with a growth rate of 5 percent during the last 20 years. However, with

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[6]Estimates from different sources vary. Some small and medium rehabilitations were done 30-40 years ago while others are relatively recent. Also, some of the earlier rehabilitated projects are currently under review for another rehabilitation.

[7]The World Bank, Kingdom of Morocco: Staff Appraisal Report of the Small and Medium Scale Irrigation Project (Washington, DC: The World Bank, February 10, 1983).

[8]The World Bank, Project Performance Audit Report, Morocco-Doukkala I Irrigation Project (Loan-1201-MOR), (Washington, DC: The World Bank, December 30, 1982), p. iii.



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Table 3-6: Total Area Projected for Large and Small and Medium Scale Irrigation Development in Morocco by 2000 AD

| Large Scale | Area (ha) |
|---|---|
| Area equipped by State (new or traditional perimeters assisted) | 820,000 |
| Private modern installations | 50,000 |
| Subtotal, Large Scale | 870,000 |
| **Small and Medium Scale** | |
| New equipped by State or traditional systems given assistance | 150,000 |
| Modern private installations | 30,000 |
| Traditional systems ameliorated by the State | 100,000 |
| Subtotal, Small and Medium Scale | 280,000 |
| TOTAL | 1,150,000 |

Source: International Commission on Irrigation and Drainage (ICID), Specificities of the Moroccan Hydro-Agricultural Equipment, 30th Executive Council, May 1979.



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pressure from hydroelectricity, urbanization and industrialization, increasing competition among claimants for available water is highly likely even though national policy gives priority to irrigation over hydroelectricity.[9] There are several thousand ha of privately developed high value garden irrigation serving the larger cities near the coast.[10]

Most of the irrigation lies in the four river basins draining into the Atlantic, the Loukkos, Seboo, Oued-oum-er-Rbia and Souss. The Mouloya flows into the Mediterranean from sources in the Atlas mountains and from two internally drained basins while the Tafilalet and Quarzazate are located in the southeast. All the LSI perimeters are in these basins as are a number of the SMSI perimeters. Some of the SMSI also originate in the Atlas piedmont and are scattered throughout the country. Gravity systems are the most common but there are also considerable areas under sprinklers and some tube well development, particularly in the Souss Basin[11]. Large diameter shallow dug wells provide limited sources of supplementary water in the residual soils overlying hard rock areas and the groundwater of the Atlas piedmont has been traditionally exploited by horizontal tunnels called qataras. Never a large source, qataras are being phased out because of high costs of maintenance and competition from tubewells. Surface systems range from traditional run-of-the-river without regular distribution facilities to the farm level to modern ones backed, in most LSI areas, by reservoir storage and equipped with modernized distribution facilities to farm level.

Eight major types of potential or existing SMSI perimeters can be distinguished on the basis of water source, of which five can support year round irrigation and three cannot. The first five types of SMSIs can be described as follows. First are the large perennial rivers upstream of dams where irrigation can be provided by diversions and resurgences. Approximately 124,000 ha of this type are being irrigated along the major rivers. Second are low-lying terraces downstream of existing or proposed dams which can be harnessed by pumping water released from the dam into the river. About 36,000 ha of such irrigation potential exists along the middle sections of the Seboo River. Thirdly, are the small traditional perimeters in the piedmont gravity-fed from perennial springs through concrete lined

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[9]International Commission on Irrigation and Drainage (ICID), Specificities of the Moroccan Hydro-Agricultural Equipment, 30th Executive Council, Special Session, May, 1979.

[10]This may be as much as 50,000 ha based on our discussions but no documented estimate was found.

[11]One source suggested as much as 200,000 ha is under sprinklers but this estimate could not be documented.



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channels or seguias.[12] About 100,000 ha of such perimeters can be found along the Middle and High Atlas Mountains. The team visited one such site at Chichaoua which is described in a later section. The fourth and fifth types of perennial irrigation are various types of pumped groundwater wells and tubewells in the Souss and Sub-Saharan regions comprising in total about 150,000 ha. The intermittent types of SMSI irrigation come from flood waters of Saharan streams, gravity diversions from intermittent springs and rainfall runoffs in the semiarid piedmont.

The modern SMSI perimeters have been developed mostly in rainfed areas where benefits are generally lower than in LSI projects because there are constraints to the introduction of highly profitable commercial crops. Benefits are, however, substantial enough in terms of improved farmer incomes to make these projects viable. The centuries old traditional SMSI systems are generally located in areas where farms are small (0.2-3 ha). Water losses are usually high because canals are unlined and farmer maintenance is erratic. Where some modernization was previously done, poor maintenance results in the need for rehabilitation which is being undertaken on some of these projects. The intent is to reduce water losses by 25-45 percent and to increase crop intensity or extend the area.

Irrigation development is viewed as providing the means by which Morocco will be able to meet its targets of food grain production, agricultural exports and industrial crops production (sugar, beet and cotton) as set forth by national policy. The policy and institutional arrangements are discussed in more detail in Section B. In general, large perimeters are developed and managed by nine semi-autonomous regional offices known as Offices régionales de mise en valeur (ORMVA) under the Ministry of Agriculture and Agrarian Reform, Development Directorate (Direction de l'équipment rural). There is an ORMVA for each of the drainage basins listed above, except that there are three in the Qued-oum-er-Rbia Basin. (See Table 3-7.)

Rehabilitation and construction of new small and medium perimeters is administered by the Development Directorate directly through its regional and local offices. Traditional water user organizations in some form or other exist on the traditional systems. These are being formalized by registration and adjudication of land and water holdings within perimeters as traditional systems become candidates for rehabilitation. For the large perimeters, landholdings are consolidated and regularized under a national program of land "Regrouping." This has been a significant factor in their effectiveness.

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[12] Seguias are earth canals.



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Table 3-7: Potential and Actual (1975) Irrigated Areas in ORMVA Projects

| ORMVA | River Basin | Potential (ha) | Present Equipped[a] (ha) | 1975 Irrigated (ha) |
|---|---|---|---|---|
| Moulouya | Moulouya | 61,000 | 61,000 | 38,300 |
| Loukkos | Loukkos | 36,000[b] | 36,000 | 4,400 |
| Gharb | Seboo | 230,000 | 230,000 | 65,200 |
| Haouz | Oued oum er Rbia | 140,000 | 75,000[c] | 54,000 |
| Tadla | Oued oum er Rbia | 117,000 | 87,000[c] | 90,000[d] |
| Doukkala | Oued oum er Rbia | 90,000 | 90,000 | 25,900 |
| Souss | Souss | 102,000 | 29,000 | 66,860[d] |
| Quarzazate | Quarzazate | 28,000 | 25,000 | 24,400 |
| Tafelalet | Tafelalet | 41,000 | 24,000 | 33,300[d] |
| TOTAL | | 845,000 | 657,000 | 402,300 |

[a]Area of potential ha that is currently developed with canals, gates and equipment.
[b]Of which 6,000 ha is irrigated with water from the Idris Dam.
[c]Estimate.
[d]Includes pumping.

Source: International Commission on Irrigation and Drainage (ICID), Specificities of the Moroccan Hydro-Agricultural Equipment, 30th Executive Council, May 1979 and the World Bank, Morocco: Economic and Social Development Report (Washington, DC: The World Bank, October 1981).



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b. Future irrigation development plans

According to the ICID report, Morocco's target for the year 2000 AD is to provide permanent irrigation to 1,150,000 ha.[13] The breakdown by size of system is shown in Table 3-6. In addition, 300,000 ha would receive temporary or winter irrigation.[14] About 300,000 ha would be under sprinkler.[15] Figure 3-1 shows the location of the nine ORMVAs and potential areas equipped in 1975 or intended to be equipped.

Until recently, the emphasis of Morocco's irrigation development was on the LSI perimeters, but the focus has now shifted towards SMSI projects and towards greater attention to improved O and M on both LSI and SMSI perimeters. The draft Development Plan for 1980-85 called for a large increase in per annum SMSI investment from an average of about DH 20-25 M in the previous two plan periods to an estimated DH 125 M.[16] Allocations to the SMSI sector are up from 5 to 9 percent of the rural equipment budget. It is intended that SMSI development will be accompanied by improvements in support services such as research and extension and changes in land ownership towards more rational and intensive land use.

From the point of view of policy and institutions (see Section B), emphasis is expected to be given to improving collections in LSI, formalizing user associations and collecting water charges (under a 1984 revision of the National Agricultural Development Code) on SMSI and giving greater attention to improved O and M on all systems.

B. National Irrigation Administration and Policy

1. Organization of irrigation administration

a. Organizational structure at national level

The study and exploitation of water resources in Morocco are the responsibilities of the Water Resources Directorate of

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[13]ICID, 1979 and the World Bank, Morocco: Economic and Social Development Report, p. 198.

[14]These levels agree essentially with those mentioned orally by M. Oulad Charif, Directeur de l'équipement rural, MARA and by Professor M. Ait Kadi, Head of Agricultural Engineering, University of Rabat.

[15]Conversation with Professor Ait Kadi, Mrch 25, 1985.

[16]This amount is reported to have been cut by 40 percent because of the country's financial crunch. The World Bank, Morocco: Agricultural Strategy Paper, p. 21.



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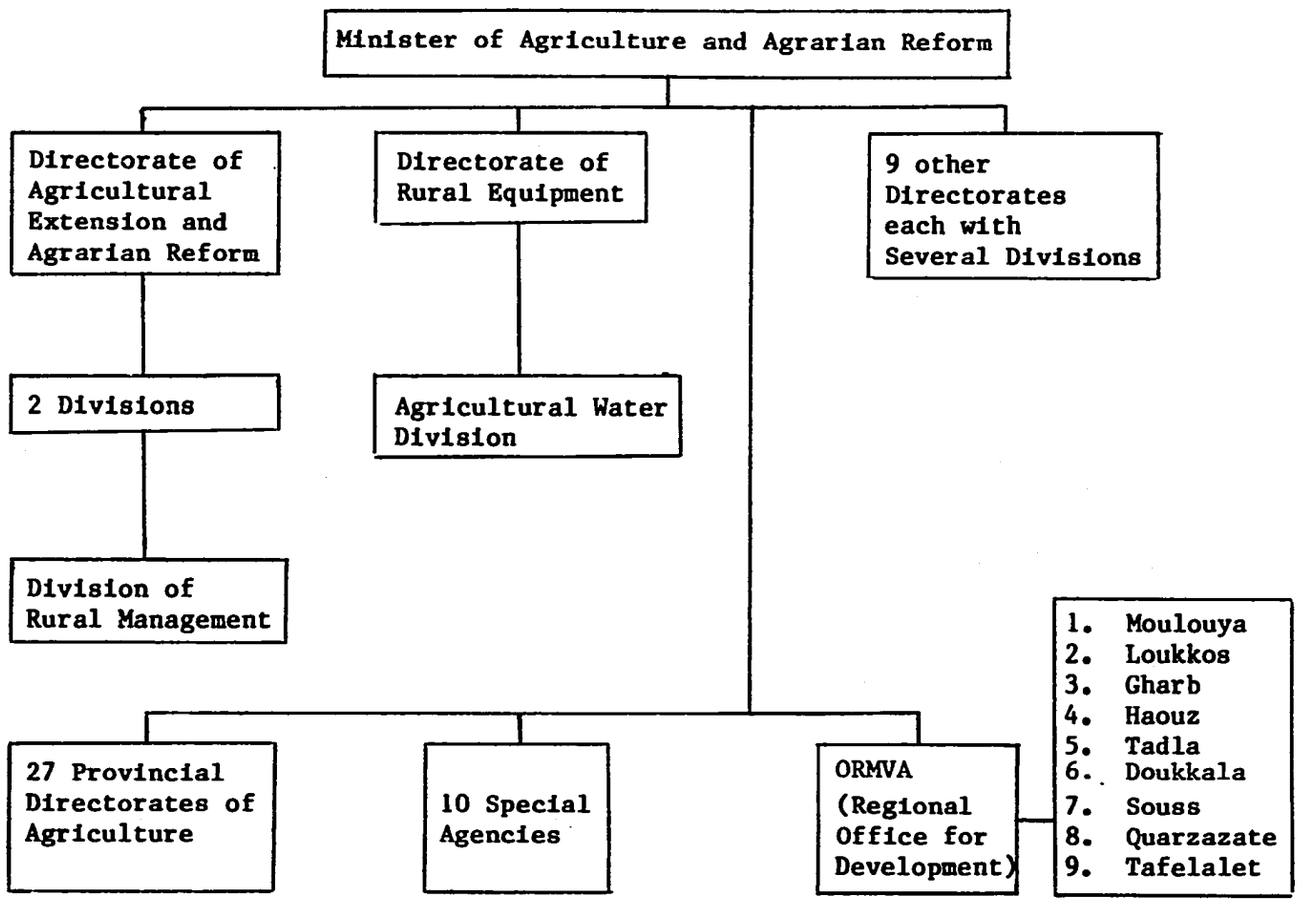


IRRIGATION PRICING AND MANAGEMENT: MOROCCO

Figure 3-1: Organization of the Irrigation Water Delivery Administration in MARA

the Ministry of Infrastructure[17] which is also responsible for maintenance and operation of most of the dams. Production and distribution are the responsibility of four ministries: Energy and Mines (hydropower); Infrastructure (drinking water), Interior (municipal authorities) and Agriculture (MARA) (irrigation water and scattered rural centers). Figure 3-1 shows the divisional organization of MARA for irrigation water administration. The Prime Minister controls capital investment through the Secretariat for Planning and the Ministry of Finance to monitor the investment program. Nine regional ORMVAs, under the Development Department of the Ministry of Agriculture have responsibility for developing and operating large-scale river-basin projects. Small scale projects are the responsibility of the Development Department.

b. ORMVAs

Beginning in 1943, the first large irrigation systems merely provided headworks and main canals serving primarily large colonial farms. After independence, from 1956-60 the Office of National Irrigation, an independent office, managed all irrigation and began to introduce specialized crops such as sugar beets. In 1965-66, this Office which became very powerful and quite centralized was dissolved in favor of a more decentralized approach, and formation of autonomous regional ORMVAs in the Ministry of Agriculture.

Each ORMVA has a separate budget within the national budget enacted each year. Separate budgets are appropriated for investment and for operations. Water charges for O and M, collected by the ORMVAs remain with the ORMVA. Loans to the Government of Morocco by international donors for development projects are processed through the Ministry of Finance and reappropriated to the ORMVAs through the annual budget.

c. Small-scale irrigation

Traditional SMSIs are administered by the local communities through the Water User Associations (WUAs) if the latter exist. At the provincial level the Provincial Directorate of Agriculture (DPA) is responsible, particularly if the government is involved in rehabilitating the project. For new SMSI project development the Directorate of Rural Equipment (DER) of MARA has the general authority for project implementation. At the provincial level the DPA is the responsible authority and overall coordination is in the hands of a Project Coordination Committee. This consists of a chairman (the Director of the DER) and members who are the Directors of Crop Production, Livestock Development, Extension and Agrarian Reform and

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[17]The World Bank, Morocco Economic and Social Development Report, p. 198.



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other agencies. Day-to-day monitoring, coordination and project implementation are done by a Central Management Unit within DER's division of rural development.

2. Irrigation policies

a. General

A variety of laws determine irrigation policy in Morocco. Small-scale traditional systems are generally governed by traditional water rights as formally recognized by a law of 1914. The Agricultural Investment Code of 1969 governs cost recovery policy on the delimited LSI perimeters.[18] The formation of WUAs is provided for by the ASAP laws of 1924. Cost recovery policy has been the subject of discussion by policy makers over the past two years leading to changes made in 1984 that are applicable on both LSI and SMSI perimeters.

b. Water rights

The water rights of individuals and communities are based on traditions many centuries old. Such rights are clearly understood although they are maintained and transmitted orally. However, a 1914 law accorded recognition to traditional rights. It declared all water to be in the public domain except rights acquired prior to the passage of the law. A procedure also exists for formal recognition of water rights for specific groups of users but it is seldom used.

Water rights operate at two different levels, namely, that of the community to withdraw a certain amount of water flow from a river and the individual's right to a share of the community water right. The individual's water rights are usually defined in terms of a specific length of time during which the water supply in the seguia is available for the user. The intervals between turns for the individual are also specified.

Within each community there are a variety of types of water rights. Individual shares of community water rights may differ greatly depending upon customs and traditions and the distribution may be inequitable. Such rights are non-transferable but they may be leased. Another type of right is tied to the land, and therefore, only jointly transferable. Water rights may be defined as well in relation to crop cultivation patterns, as they are in the modern perimeters and in some traditional areas. Finally, water rights may be privately owned separately from the land and in such cases there is often a rental market for water. The number and complexity of traditional water rights and the fact that they are not well-known outside the

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[18]The term delimited refers to consolidation of landholdings in these perimeters.



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local communities poses special problems for the irrigation administration in its attempts to modernize SMSI systems.

c. Cost recovery

(1) LSI perimeters

Three types of charges for irrigation cost recovery were established by the Investment Code of 1969 for the delimited modern perimeters where the LSI systems are located. Thus, farmers were expected to pay:

- Volumetric charges that were intended to cover 100 percent of O and M costs as well as up to 40 percent of original investment costs. MARA has the discretion to fix capital cost recovery somewhere between 0-40 percent;

- A fixed betterment levy which amounted to DH 1,500/ha. The first five ha of holdings of less than 20 ha were exempt from this charge; and

- A supplementary water charge to cover the costs of pumping, wherever applicable.

The Code also provided for the progressivity of charges during the early years of irrigation system operation, established principles for indexing and rules for the collection of water charges.

Despite the Code's comprehensive framework for cost recovery, actual collection until 1980 was well below the legally established minimum levels.[19] In practice the volumetric charges established at full system operation did not even cover O and M costs in the LSI perimeters while the rates for the supplementary charge were not specified until 1980. Recovery via the betterment levy was constrained by the vast number of landholdings (80 percent) that are less than five ha in size.

In June 1980 implementation of the Code was revised by Government decree. The volumetric water charge was to be increased 100 percent over three years, the pumping surcharge was required to be made operational to the full amount of energy cost and it was indexed to the cost of energy. These steps for the first time permitted a level of recovery that had been theoretically set up in the Code: 100 percent of O and M costs and a proportion of investment costs.

In 1982 further revisions were proposed in the form of an amendment to the Code in order to improve equity of cost recovery levels. The changes included a measure to make the volumetric charge

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[19]The World Bank, Staff Appraisal Report of the SMSI Project, p. 41.



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cover 10 percent of irrigation investment costs rather than the prevailing discretionary 0-40 percent. Simultaneously, it was proposed that the land betterment levy would be set at 30 percent of total investment costs instead of the original fixed amount. The exemptions would be maintained for the first five ha of holdings less than 20 ha. (In 1984, the betterment levy was raised to DH 8,500/ha.) A formula was also proposed for automatic indexation of the volumetric charge.

The proposals represent improvements in cost recovery policy to the extent that the revised betterment levy would shift a relatively greater degree of investment cost recovery to large farms. It would also ensure a minimum contribution to investment cost by all water users and improve prospects for long-term cost recovery levels through indexing.

(2) SMSI perimeters

Despite the existence of varieties of water charges governed by established water rights in the traditional irrigation systems and the recognition accorded them by the 1912 law, there is no comprehensive national legal framework or policy governing cost recovery in the traditional SMSI and certain undelimited modern perimeters. This proved to be a stumbling block in the World Bank's efforts to implement its project to expand and rehabilitate SMSI systems.[20] Therefore, a system was devised whereby MARA with the appropriate DPAs and ORMVAs would enter into agreements with the local water user associations at each selected sub-project location.

MARA was required to propose cost recovery charges and incorporate the agreed-upon rates into agreements with the user associations. The principles guiding rate establishment included fixing volumetric charges so that they would permit recovery of all O and M costs plus a share of investment costs (approximately in line with capital cost recovery in LSI perimeters). In addition, adjustments could be made for exemptions that would take account of the limited small farmer capacity to pay.[21]

Some of these measures were incorporated into a law in 1984 that provided for the organization of WUAs that would enter into agreements with MARA for irrigation cost recovery and management on mutually acceptable terms. It is too early to assess the effects of these changes.

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[20]Details of the SMSI project are to be found in the World Bank, Staff Appraisal Report of the SMSI Project, 1983.

[21]The World Bank, Staff Appraisal Report of the SMSI Project, p. 44.



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d. Irrigation management

The policy governing irrigation management is that O and M should be the responsibility of water users to the maximum extent possible. In practice, the establishment of WUAs that would formally undertake these duties at the LSI perimeters has been slow and is really in the initial stages. The primary responsibility for O and M, therefore, rests in effect with the project ORMVA officials.

In general, O and M has been a neglected aspect of irrigation development until quite recently. When the LSI were constructed, the O and M budget was small, emphasis was on equipping the systems in the early stages and most of the budget was devoted to that end. As a result, for a long time O and M divisions which were located in the equipment section had a low status within the irrigation administration. Staffing for O and M was inadequate and personnel were not properly trained. It was difficult to attract people because field incentives were limited and design and planning staff were more highly regarded.

Much greater attention is now being paid to O and M issues as the LSI systems are largely in place already. Further, new irrigation development as, for example, in the SMSI perimeters is being carefully planned so that WUAs are set up prior to project implementation with the clear understanding that they will be expected to assume responsibility for O and M. A new law in 1984 was designed to facilitate the process whereby the government enters into feasible agreements with individual WUAs for assuming responsibility for 100 percent of O and M cost recovery and varying percentages of capital cost recovery in these areas.

C. Irrigation Projects

1. Doukkala I

a. Background

(1) Description

The Doukkala I Project is part of an overall development effort to use water drawn from the Oum-er-Rbia River more effectively. Oum-er-Rbia provides irrigation water for Morocco's second largest agricultural area, after the Seboo Basin. The Oum-er-Rbia Basin has an estimated potential of 347,000 ha under large scale irrigation. About 252,000 ha are now developed of which 90,000 was under the ORMVAD (ORMVA Doukkala).[22] Under the new Doukkala II Project (being supported by a World Bank loan [1982]) 32,000 ha of the system will be rehabilitated.

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[22]The World Bank, Morocco Economic and Social Development Report, p. 198.



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The Doukkala I Project was intended to fully utilize all of the water diverted into an existing "low-service" canal from the Im-Fout Reservoir and was prepared within the framework of a Water Master Plan for the Oum-er-Rbia Basin prepared in 1973-74.[23] This project included installation of a sprinkler irrigation system to serve 15,400 ha in the project area, construction of farm feeder roads and improvement of major classified roads, construction of infrastructure for agricultural support services, electric power lines and telephonic communications facilities, and a land consolidation program. Estimated cost in 1976 was US$ 85 M for which the World Bank and AID provided loans of US$ 30 M and US$ 13 M respectively. Actual disbursements under the World Bank loan totalled only US$ 27,300,000;[24] and under the AID loan, US$ 12,998,000.[25] Landholdings were newly consolidated and regularized as the result of efforts under the 1962 Regrouping Law. A significant factor in the successful implementation of the project was ORMVAD's successful completion of the land consolidation in advance of construction--an effort which required four years.

Project objectives were to double wheat production, produce a sevenfold increase in maize production and to introduce and grow substantial quantities of sugar beet, cotton, vegetables and fodder. Actual crop mix and rotations have changed from those anticipated by the World Bank's 1976 project appraisal. However, yields and crop values during the first year of full development (1980), in most cases, equaled or generally exceeded those anticipated. Based on experience, ORMVAD has deleted cotton from the prescribed cropping pattern, reduced wheat area by about one-third, increased sugar beets by 11 percent, quadrupled fruits and vegetables and increased fodder crops. This is expected to increase cropping intensity from 133 to 146 percent, which with higher yield levels, is expected by the World Bank to raise the economic rate of return from the 11.5 percent forecast in the Appraisal to 20.5 percent.[26]

The main canal system at Doukkala is constructed to supply four pumping stations each serving a zone. The water surface in the feeder and main canals is held at constant level automatically by downstream controlled gates and delivered to pump stations "on demand". Pressure is maintained automatically in the pipe distribution system by the water level in elevated equalizing tanks or by pressure in the discharge pipes. Farm units are served by valved hydrants. For the portable field system, sprinkler heads are permanently mounted on quick-coupling lengths of aluminum pipe which are placed as required by

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[23]The World Bank, Project Performance Audit Report, p. iii.

[24]Ibid, p. ii.

[25]Conversation with Andres Acedo, Program Specialist, USAID, Morocco, March 25, 1985.

[26]The World Bank. Project Performance Audit Report, p. 3.



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the using farmers.[27] The intent of the project design was to charge for water on a volumetric basis. However, water meters have largely disappeared from the hydrant outlets due to undetermined cause[28] accordingly allocated on a crop area basis calculated on the total volume measured at the pumps.[29]

(2) Agriculture in project area

(a) Farm size and land holding pattern

Land consolidation resulted in 7,754 farm units representing 11,216 landholdings. With co-owners, there are some 15,600 beneficiaries in the project area. Ninety-three percent of the farm units occupy 62 percent of the land (average size, 0.92 ha); 0.5 percent of the units occupy 10 percent of the land (average size, 27.5 ha). The details of land holding size and distribution is shown in Table 3-8.

(b) Crops and cropping patterns

The land consolidation permitted the project to be laid out in blocks of approximately 16 ha. Each land holding extends the full length of the block and is provided water service by a hydrant with valves and coupling arrangement. Farm sprinkler systems consist of portable aluminum pipe with sprinkler heads attached (called "trame B" layout approach in Morocco). Crop rotation areas are delineated perpendicularly to field boundaries. This permits plowing and tillage to proceed across several holdings and would result in a uniform cropping pattern for each holding in the block if it were strictly used. But this pattern is not rigorously followed in practice.[30]

Cropping patterns are set by an ORMVAD Technical Committee consisting of agricultural agency and ORMVAD officials and farmers. They consider local conditions and national planning goals to arrive at the final cropping mix. Table 3-9 shows the cropping pattern for various crops as grown in 1980/1981 and as estimated at full development under the revised plans.[31] Cropping patterns are mandatory and, according to the ORMVAD Director, enforcement of the cropping

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[27]Ibid, pp. 24, 44; and personal observations.

[28]Many of the water meters were installed several years before settlers moved on to the land.

[29]Discussion with ORMVAD Director and staff and personal observations, March 27, 1985.

[30]Personal observation, March 27, 1985.

[31]The World Bank, Project Performance Audit Report, p. 37.



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Table 3-8: Size Distribution of Land Holdings--Doukkala I

| Size Range (ha) | Farm Units (no) | Percent | Land Area (ha) | Percent | Average Size (ha) |
|---|---|---|---|---|---|
| 0-2 | 5,815 | 75 | 5,062 | 32 | 0.90 |
| 2-5 | 1,396 | 18 | 4,746 | 30 | 3.35 |
| 5-10 | 388 | 5 | 2,848 | 18 | 6.85 |
| 10-20 | 116 | 1.5 | 1,582 | 10 | 13.35 |
| Above 20 | 39 | 0.5 | 1,582 | 10 | 31.70 |
| TOTAL | 7,754 | 100 | 15,820 | 100 | 2.05 |

Source: The World Bank, Project Performance Audit Report, Morocco--Doukkala I Irrigation Project (Loan-1201-MOR) (Washington, DC: The World Bank, December 30, 1982).



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Table 3-9: Cropping Pattern in 1980-81 and Estimated at Full Development -- Doukkala I

| Crop | 1980/81 Actual Area (ha) | 1980/81 Actual Percent[a] | 1976 Estimate at Full Development Area (ha) | 1976 Estimate at Full Development Percent[a] |
|---|---|---|---|---|
| Cereals: Wheat, Maize, Barley | 9,965 | 63.1 | 6,101 | 38.6 |
| Pulses | 505 | 3.2 | -- | -- |
| Sugar Beets | 1,203 | 7.6 | 3,266 | 20.6 |
| Vegetables | 4,066 | 25.7 | 5,688 | 36.0 |
| Forage Crops | 2,996 | 18.9 | 7,360 | 46.5 |
| Fruit Trees | 5 | -- | 772 | 4.9 |
| TOTAL | 18,740 | 119.0 | 23,187 | 146.0 |

[a]As percentage of physical area of 15,820 ha.

Source: The World Bank, Project Performance Audit Report, 1982. Morocco--Doukkala I Irrigation Project (Loan-1201-MOR) (Washington, DC: The World Bank, December 30, 1982).

pattern is not a problem because farmers find it profitable. Nor does he see ORMVAD's role as policeman. Rather the cropping patterns are accepted because the farmers like them. He estimated that compliance ranges from 70-90 percent.

(c) Yields and productivity

Yields during the first full year of project operation (1980) often exceeded yields projected by the Appraisal report.[32] According to the ORMVAD director, this trend has not fallen off.[33] Yields projected in the appraisal report, actual 1980 yields reported by the World Bank and revised projected full-development yields for principal crops are shown in Table 3-10.

Cereals production in the project area was projected at 27,600 t, actual 1978 production was 5,794 t, 1980/81 production was 63,122 t. Yields obtained from other principal crops (vegetables, sugar beets and forage) have similarly exceeded projected levels. With the proposed shift in cropping pattern, cereal production is expected to be reduced to about 50,000 t but production of sugar beet is projected to increase to 196,000 t; vegetables, to 200,000 t and fodder to 445,000 t at full development.[34]

(d) Farm income

Information on farm income is based on the World Bank models prepared at the time of appraisal and revised by the project completion report (1981). At 1981 price levels and exchange rates (US$ 1.00 = DH 5.20), net income for the one-ha model at full development was projected at US$ 2,230 or US$ 391 per capita based on 5.7 persons per farm family. For the five-ha model, this increased to US$ 9,790 with a per capita income of US$ 1,720. The Moroccan absolute poverty level is estimated at US$ 222 per capita. In this range of farm size, with the project, income increased by eight to ten times in these models: per ha net income was US$ 2,230/ha for the one-ha model, US$ 1,958/ha for the five-ha model and US$ 1,592/ha for the 25 ha model.[35]

We had no way to validate these projections in the field. Indeed, they are still in the future. Discussions with several farmers with holdings ranging from 0.5 ha to about three ha revealed that these people were extremely pleased, actually enthusiastic, about their benefits under the project. While costs have risen, prices for

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[32]Ibid., p. 37.

[33]Personal communication, March 27, 1985.

[34]The World Bank, Project Performance Audit Report, p. 62.

[35]The World Bank, Project Performance Audit Report, p. 58.



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Table 3-10: Estimated, Actual and Projected Crop Yields--Doukkala I

| Crop | Yield Estimated by Appraisal Report (t/ha) | 1980 Actual Yield (t/ha) | Revised Yield Estimate at Full Development (t/ha) |
|---|---|---|---|
| Wheat | 3.0 | 3.2 | 4.0 |
| Maize | 2.5 | 3.1 | 4.5 |
| Sugar Beet | 45.0 | 57.0 | 60.0 |
| Summer Vegetables | 40.0 | 27.0 | 40.0 |
| Alfalfa | 60.0 | 67.0 | 70.0 |
| Berseem | 25.0 | 58.0 | 60.0 |

Source: The World Bank, Project Performance Audit Report, Morocco--Doukkala I Irrigation Project (Loan-1201-MOR) (Washington, DC: The World Bank, December 30, 1982).



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farm products have also increased. The ORMVAD Director cited the rising cost of energy for pumping as a possible serious problem for the future and this would certainly be true if energy costs were to rise substantially in relation to farm prices. However, since the government sets prices for most products, the farmer is provided some protection but rising costs would, therefore, have an impact on the national treasury.

(e) Farm services

ORMVAD provides within the project area seeds, fertilizers, pesticides, water, and tillage (if needed). The cost of these services, plus a 5 percent administrative fee are charged to farmers against their sugar factory account. Extension advice is also provided by ORMVAD. While tillage service is still available, our discussions with farmers revealed that this has largely moved to the private sector (apparently with ORMVAD's blessing). Animal power is used for lighter operations and rented tractor-power equipment for the heavier ones.

(3) Functioning of irrigation in the project area

For the main system above farm hydrants, ORMVAD officials reported that maintenance problems since the project started operations seven years ago were essentially routine technical ones. Our inspections confirmed this, at least as a general impression. Feeder canals were unusually free of weed growth and bank sloughing and erosion were nominal on reaches we were able to inspect. Maintenance work on canals has not been required to date. At the Zemara I pump station visited by the team, pumps were functioning well. Except for a leaky packing on one pump the operator confirmed that maintenance had been largely routine. He said that the leak, which was a substantial one, had started earlier that day and would be repaired by the next day. The automatic drum filter was working effectively and had required no maintenance according to the operator.

Leakage at farm hydrants and in couplings of the portable system, largely because of ruptured gaskets, leaky valve packings, etc., were not particularly serious, but were greater than "normal". Since the land was not leveled (that cost was saved by installing sprinklers) considerable micro-topography was observed with low places where water collects. This is largely a nuisance although it takes some land out of cultivation, could provide mosquito breeding sites and become more serious if leakage were to increase. The design called for drainage ditches at the ends of fields but with the variance in topography these could not be very effective. Replacement or repair of sprinkler heads does not seem to be a serious problem. According to farmers, they are available in local markets and from ORMVAD.



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Both ORMVAD and the farmers themselves felt that farmer ability to maintain hydrants and portable sprinklers was technically limited. Therefore, much of this is still being done by ORMVAD. Engineers at the field level reported that farmers are learning to handle their maintenance problems and that there has been some improvement. A farmer representative who negotiates with ORMVAD is elected for each 16-ha block and local commissions and extension agents are assisting farmers to improve their capability to maintain the portable systems.

Most of the water meters have disappeared. It was not clear why this was the case. There was some feeling that farmers may have removed them because they associated them with water charges; removal or damage by children playing in the area was also mentioned. Water meters and hydrants were installed well in advance of water delivery before farmers were in control and this probably made them more vulnerable. It was reported that some farmers have requested the replacements but we were not able to confirm this. ORMVAD officials believed that water meters were not practical and our impression was that they were not interested in replacing them.

At the overall level, the Director reported that the main problem is financing. As the project develops and collections increase, he expects that revenues will become adequate and that part of the budget may be allocated to replacement of worn out or broken equipment. This conflicted with the World Bank's pessimism about future maintenance levels. The Director felt confident that maintenance would be greatly improved within five years with FAO assistance and budget increases.

Based on our observations of fields which were being cropped, water is uniformly applied. Although there are some fairly sizable ponds in depressions, soil drainage did not appear to be a problem. It should be easy enough to prevent this through proper doses and timing of sprinkler applications.

We agree with the World Bank that technical designs were, with minor exceptions, extremely satisfactory, particularly those components with high technical and low social content. The few, relatively small, components with a high social content (e.g., village infrastructure and windbreaks) proved less achievable within the project's implementation time frame.

The unique irrigation system used by Morocco warrants study by other countries for it might advantageously be introduced in situations where irregular and small landholdings are the norm or where land consolidation is desired simultaneously with development of irrigation. Sprinkler irrigation appears to be the correct tool both technically and socially for this project.



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b. Project management

(1) Structure of irrigation administration

(a) Project administrative structure

As a World Bank loan condition, a Project Coordinating Committee was formed with the Governor of El Jadida as chair and local representatives of all government agencies as members. The Committee was convened only during the first year of project implementation.

The ORMVAD, headquartered in El Jadida, is the primary executing agency. It has four field divisions: construction, operation and maintenance, agricultural development and livestock. For Doukkala I, development centers (Centre de mise en valeur [CMV]) were established in each of the four zones. With completion of Doukkala I, the construction division has turned its attention to Doukkala II. Most of the Doukkala I construction staff were transferred to O and M. The O and M division is responsible for operation and maintenance of the irrigation system except for the mobile sprinkler equipment, and for roads and drains. The O and M Division has two offices in the Doukkala I Project. Each office handles two zones. Its 1981 staff of 52 include 22 ditch riders. Ditch riders normally are responsible for water distribution to about 500 ha and are the primary farmer contact persons in ORMVAD.

The CMVs integrate extension, input supply and other services at field level. Each CMV has a manager, bookkeeper, input supply agent and several extension agents. Extension agents are responsible for determining input requirements and their distribution, monitoring sugar beet cultivation, enforcing or promulgating crop rotations and collecting agricultural statistics. They are also responsible for special programs such as distribution of windbreak plants, introducing monogerm sugar beet seed and for preparation of demonstration plots for crops such as maize and sugar beet. In 1981 each extension agent served, on the average, 278 farmers and 565 ha.[36]

Divisional O and M offices at Zemara I reported that local (division level) management committees have been formed and given the task of improving O and M. The committees consist of ORMVAD representatives, representatives of the Interior Ministry and of the District.

(b) Farm level management

Farmers are responsible for O and M of portable systems which attach to the quartenary distribution system hydrants. As stated earlier, they are still given considerable

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[36]The World Bank, Project Performance Audit Report, p. 50.

assistance by ORMVAD working through a representative elected for each block. The representatives are responsible for carrying out the specified crop rotations and for various farm operations such as tillage, weeding, irrigation and harvesting where these are not contracted for with ORMVAD. Water user organizations reportedly exist at approximately the subdivision (500 ha) level and are responsible for meeting and deciding upon irrigation schedules.[37]

(2) Functioning of administration

Scheduling of the use of mobile laterals in the blocks is organized by the farmers themselves. Conflicts are resolved by ORMVAD. Water is automatically delivered to the tertiary hydrants on a demand basis. Use of water per hectare remained relatively constant but increased gradually during the three years of implementation, from 4,100 $m^3$ to 5,100 $m^3$ per cropped hectare. In 1980/81 water use increased dramatically to 7,500 $m^3$ per cropped ha. During the same period, the cropped area increased from about 4,000 ha to 18,740 ha and cropping intensity increased from 75-90 percent to 119 percent. Water use during 1980/81 exceeded estimated crop requirements, employing 92 percent (140.6 M $m^3$) of the water use expected at full development.

c. Cost recovery

Collections of water and land betterment charges by ORMVAD now provide for 90-95 percent of the cost of O and M, according to ORMVAD's Director. This is expected to rise in the future so that funds will be available for making replacements. Our understanding is that no capital recovery payments are made to the national general revenue account.

Our analysis is that collections of water and betterment charges should approach 100 percent in the Doukkala I Project. Farmers interviewed, in contrast to many other places in the world, did not complain about paying these charges; indeed they expressed willingness to pay even though charges had been raised recently. Farmers did not seem to know what they were paying for water, but this was denied by ORMVAD officials who said they knew all right but did not want to tell us. Undoubtedly, a major factor in the success of collections in Doukkala is because it is deducted from the sugar beet account as a portion of the total input package cost. Since all farmers grow sugar beet, cost recovery is good. The farmers we talked to seemed very pleased with ORMVAD. They receive a reliable water supply and farming is evidently profitable. We think that farmer satisfaction and the method of cost recovery are important factors in the success of collections in the Doukkala I Project.

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[37]Conversation with ORMVAD Director, March 27, 1985.



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d. Farmer participation

Farmers did not participate in irrigation system design but they were certainly involved in land consolidation activities. With the regularization this made possible, many of the design decisions in which farmers could participate, such as location of outlets, roads, watercourses and drainage were already settled. It is hard to see how farmers could have contributed much to the design of pumping stations, downstream-controlled canals, pressurized pipelines and automatic valves which are technical issues. Had they more experience, they might have looked at alternative portable system arrangements, but it is hard to visualize an alternative to portable pipe. It is possible that some efficiencies could have been made in the scale and size of the block and possibly in the location of quartenary hydrants but this is merely conjectural and the scope for it limited by the "trame B" layout alternative selected under the Investment Code.

Farmers solved most of their immediate problems of interfacing with ORMVAD during the operations phase through their block representatives. However, they have not responded to the idea of more formal organizations at that level. Larger organizations are being formed at the division (500 ha) level. So far the responsibilities are to decide on rotations. Their share of responsibilities may have to be expanded as the system begins to wear out and replacements and repairs become more critical.

e. Summary

During its four-year existence the Doukkala I Project has been technically and financially successful at the farm and project levels. This results from a well conceived technical design providing a reliable and easy to use water supply. The preliminary step of regularizing farm boundaries was an important contributing factor as was the provision of adequate and reliable supplies of agricultural inputs. The success has been achieved under mandatory cropping rotations which farmers find help them better achieve their subsistence and cash flow objectives. At project level, ORMVAD has had considerable flexibility to adjust the cropping pattern to adapt to local conditions with the result that total benefits are significantly increased over what was expected.

2. Chichaoua

a. Background

(1) Description

Chichaoua is a traditional SMSI system located near a town of the same name in the Northern Atlas piedmont in Marrakech province about 70 km west of Marrakech. The irrigation system is gravity-fed being supplied by perennial springs that serve an area of

about 1,900 ha. The springs provide a stable supply of about 1,170 liters per second (l/s) of water to the headworks which consist of a diversion of about 18 km from the source of the spring.

The water is delivered through concrete lined channels and earthen seguias. A fairly extensive rehabilitation of the system was done in the 1940s. Concrete feed canals from the main spring, a syphon and an aqueduct were constructed as well as a concrete distribution network in the Tajoujet sub-perimeter. The syphons and aqueduct have since been destroyed by floods so a temporary diversion has now been built.

The team visited the site of the main diversion point where two main lined canals and two intermittently served ditches originated at different gradients. Whereas the upstream river flow was 600 l/s, at the diversion point it was estimated at 400 l/s. The larger of the two lined canals had three gates and the smaller had only one. No local turnouts were observed in the lined channels. Most of the 40-to-50-year-old lining was observed to be in place but it is cracked and badly eroded in some places. A walk down one of the canals revealed that field ditches are not well-maintained and are overgrown with weeds. However, we saw no leakage from the turnouts which were basically simple earth dams.

A visit to a downstream farm served by the irrigation system showed that water is taken out of a lined channel there and distributed by a ditch parallel to the fields. Here too, the ditch was very weedy, poorly sloped and there appeared to be waste at the top end of the fields. The lined channel was almost completely eroded on the bottom and partly up the sides.

(2) Agriculture in project area

(a) General

The climate in the Chichaoua area is Mediterranean with an average annual rainfall of 178 mm. Sharp year-to-year fluctuations in rainfall make this virtually a semiarid area. Soils are mostly clay-sand, about 80 cm deep and with good permeability and no salinity. Although year round there is a relatively stable supply of water for irrigation from the springs of Chichaoua, water demand patterns create a substantial average surplus during most of the year and a deficit in the dry season. As shown in Table 3-11 demand for irrigation water varies by a factor of seven from 85 l/s in November to 600 l/s in September. The result is that only 12-14 percent of water needs can be met by rainfall in April, August and September.

(b) Farm size and land holding pattern

The population in the area is about 14,400 people who represent about 2,000 households. There are about 1,690



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Table 3-11: Current and Post Rehabilitation Irrigation Water Balance and Cost of Project--Chichaoua (l/s)

| | Rainfall 178 mm | |
|---|---|---|
| | Month of Low Balance (Sept.) | Month of High Balance (Nov.) |
| Present Irrigation System and Cropping Pattern (24 hr. irrigation) | | |
| Demand for irrigation water | | |
| Net demand at parcel[a] | 607 | 85 |
| Gross demand at headworks | 1,356[b] | 189[b] |
| Water availability at headworks | 1,163 | 1,174 |
| Balance | -193 | 985 |
| With Rehabilitation Project (24 hr. irrigation) | | |
| Demand for irrigation water | | |
| Net demand at parcel[a] | 565 | 135 |
| Gross demand at headworks | 941[c] | 226[c] |
| Water availability at headworks | 1,163 | 1,174 |
| Balance | 222 | 948 |

| | (DH m) | | | Foreign Exchange |
|---|---|---|---|---|
| Cost Estimates for Rehabilitation | Local | Foreign | Total | % |
| Irrigation infrastructure | 8.1 | 5.0 | 13.1 | 40 |
| Support costs | 3.4 | 0.6 | 4.0 | 15 |
| On-farm investments | 0.5 | 0.4 | 0.9 | 45 |
| Total | 12.0 | 6.0 | 18.0 | 33 |

[a]Account taken of evapotranspiration and rainfall.

[b]Assumes field efficiency of 70 percent, conveyance eff. 65 percent, overall eff. 45.5 percent.

[c]Assumes field efficiency of 75 percent, conveyance eff. of 80 percent, overall eff. 60 percent.

Source: The World Bank, Staff Apparisal Report of the Small and Medium Scale Irrigation Project (Washington, DC: February 10, 1983).



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farms and the average plot size is 1.13 ha. Seventy-two percent of holdings below one ha land are privately owned but a large number of farmers are members of three agrarian reform cooperatives.

(c) Crop yields, productivity and farm income

Table 3-12 shows the land use patterns. Of the total cultivated land (2,525 ha) about 77 percent is devoted to cereals, mainly barley, wheat and maize. Orchards take up 36 percent of the cultivated land on which primarily olives are grown. A relatively small proportion of the land is devoted to summer and winter vegetables and to forage production which includes planting of alfalfa. Cropping intensity in the region is about 135 percent of which about 100 percent is in winter and perennial crops and 35 percent in the summer.

Table 3-12 also shows that current crop yields are relatively low and well below the potential. Thus, wheat yields are 0.9 t/ha, barley 1.2 t/ha and maize 0.8 t/ha. It is estimated that these yields could be increased about threefold. Similarly, olive yields could be increased from the current 1.2 t/ha to about 4.0 t/ha as could yields of vegetables. As shown in Table 3-13, estimated farm incomes range between DH 1,300/yr for the smallest size farm to DH 4,000/yr of a 1.5 ha size farm and as high as DH 26,800 for the largest size.

The team visited a downstream farmer with nine ha of land, half of which was in fallow because of lack of water. The farmer was a member of a cooperative which had been formed from a colonial estate under the Agrarian Reform Law. The farmer's crops included broad beans, wheat and melons and he had a grove of olives which received priority in irrigation. The farmer's fields, crops and ditches were not impressive. Crops were not well tended. Neither was an orchard of fruit trees that also appeared to be very old and needed replacement. One of the farmer's problems clearly was the shortage of water supply even though it was reliable. There were obviously other problems as well which probably included lack of a market, extension services and improved inputs, but we could not verify these ideas.

b. System management

Management of the Chichaoua irrigation system is governed by traditional water rights which are quite complex and generally not recorded. Each ditch or canal has its WUA which employs a ditch rider. The team interviewed a ditch rider for one of the associations on a lateral serving an 85 ha area and about 200 people. The ditch rider verified that a number of associations on the laterals maintained and operated their pieces of the system but there was no larger federation of WUAs that governed the entire network.

Water is supplied to farms on a rotational basis at the rate of 60 l/s for a specified length of time. Each individual's share of the water flow is acknowledged by traditional rights and the



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Table 3-12: Current and Projected Land Use and Crop Yields--Chichaoua

| | Current Land Use | | Projected Land Use | | Current Crop Yields | Projected Crop Yields |
|---|---|---|---|---|---|---|
| | Area | % | Area | % | Tons/ha | Tons/ha |
| Wheat | 300 | 16 | 390 | 20.5 | 0.9 | 2.5 |
| Barley | 650 | 24 | 310 | 16.5 | 1.2 | 2.8 |
| Maize | 515 | 27 | 390 | 20.5 | 0.8 | 3.0 |
| Cereals Total | 1,465 | 77 | 1,090 | 57.5 | | |
| Winter vegetables | 125 | 7 | 175 | 9 | 17.0 | 24.0 |
| Summer vegetables | 110 | 6 | 260 | 13.5 | 18.0 | 24.0 |
| Vegetables Total | 235 | 11 | 435 | 22.5 | | |
| Forage | 140 | 7[a] | 305 | 16[b] | 24.0 | 42.0 |
| Orchards: | | | | | | |
| Olives | 555 | 27 | 555 | 21 | 1.2 | 4.0 |
| Other | 130 | 9 | 720 | 9 | | |
| Orchards Total | 685 | 36 | 720 | 30 | | |
| Total land used | 2,525 | | 2,550 | | | |
| Irrigable area | 1,900 | | 1,900 | | | |
| Harvest intensity | 135 | | 143 | | | |

[a]Only planted in winter.

Source: The World Bank, Staff Apparisal Report of the Small and Medium Scale Irrigation Project (Washington, DC: February 10, 1983).



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Table 3-13: Comparison of Farm Incomes With and Without Rehabilitation Project, Incremental Value Added and Permanent Farm Employment Added--Chichaoua

| | Total Irrigable Area (ha) | Number of Farms | Income Per Farm[a] Without Project | With Project (DH '000s) | Incremental |
|---|---|---|---|---|---|
| Model 1 (0.56 ha) | 677 | 1,209 | 1.3 | 3.3 | 2.0 |
| Model 2 (1.59 ha) | 684 | 430 | 4.0 | 10.5 | 6.6 |
| Model 3 (11 ha) | 539 | 40 | 26.8 | 68.0 | 41.2 |
| Total | 1,900 | 1,688 | | | |

| | Crops | Livestock (DH m) | Total | Incremental Permanent Farm Employment at Full Development (man-years) |
|---|---|---|---|---|
| Incremental Gross Value of Production | 9.0 | 1.5 | 10.5 | 490 |

[a]Income excludes off-farm and non-farm income.

Source: The World Bank, Staff Apparisal Report of the Small and Medium Scale Irrigation Project (Washington, DC: February 10, 1983).



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ditch rider claimed to know exactly what these were although they were unwritten. Each farmer was aware of when his turn occurred and its length, but except for the ditch rider, the turns of other farmers were not necessarily known by everyone. The turns could be as short as five minutes or as long as an hour.

The ditch rider was responsible for supplying the water according to the generally acknowledged water rights. He reported that there were seldom conflicts over water in his area and that people were generally satisfied, but we were unable to verify this. The ditch rider had been selected over 20 years ago for this position. He himself was a landowner with holdings upstream from the first diversion. His landholdings were larger than the average for the area. He was obviously a trusted and respected member of the community. The WUA paid the ditch rider a salary for which the users were charged DH 47/ha/yr. Members of the cooperative WUA downstream paid DH 25/ha/yr which amounted to about the same given that water shortages compelled farmers to leave half their land fallow.

Although the water delivery administration seemed to be well-organized by the WUAs through the hired ditch riders, maintenance was obviously not paid as much attention. This was evident both at the diversion point and again downstream at the farm level. The lining of channels was eroded and cracked and ditches were overgrown with weeds. At the farm level there was a lot of wastage of water at the tops of fields in distributing the water from the main ditch. The lack of adequate maintenance is the likely reason that the Chichaoua system has undergone several rehabilitations and is now slated as one of the SMSI schemes to be rehabilitated through a World Bank project.

c. Water charges

At present it is not appropriate to discuss cost recovery in relation to the Chichaoua system because the farmers have not so far been responsible for contributing towards the periodic rehabilitations made by the government. However, cost recovery is being planned under the World Bank SMSI project and aspects of this will be discussed in Section d.

Water charges exist at Chichaoua and reference has already been made to the collections made for payment of ditch riders. An interesting dimension at Chichaoua is the existence of a water market. Since land is more abundant than water and the two are not tied to each other, water rights are sold on an annual basis. The cost of 60 l/s of the stream flow for one hour every two weeks is DH 500. This translates into DH 0.089/$m^3$ which is approximately the amount being charged on the LSI perimeters. The correspondence between the charges is likely coincidental.



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d. Development plans

Discussion of the Chichaoua system would be incomplete without mention of the plans for the system's rehabilitation which is to be undertaken at a total cost of DH 18 M. (See Table 3-11.) This includes irrigation infrastructure rehabilitation and is to be accompanied by other on-farm investments, improved extension services and credit facilities. Infrastructure development under the project at Chichaoua will include lining or rehabilitation of about 57 km of deteriorated primary and secondary seguias and concrete canals. Two syphons totalling 450 m will be built to carry water under the Bou Enfir and Chichaoua stream beds. In addition, a drainage network and erosion control works will be constructed and 56 km of existing unsurfaced roads rehabilitated.

It is expected, as a result, of this project that the water balance in Chichaoua will be greatly improved because of more efficient use. The deficits will be eliminated and the average balance available for downstream use will be increased by more than 50 percent to about 560 l/s. (See Table 3-11.)

The intended benefits are slightly increased cropping intensity as a result of improved crop yields and planting of higher valued crops such as stone and pome fruits. At Chichaoua on-farm investment from the project will be in establishment of 40 ha of orchards. Details of the projected increase in land use and crop yields are given in Table 3-12.

A shift is projected out of cereals and into the higher valued vegetable crops. This would reflect expected gains in yields per ha of cereals and the opportunity for small farmers to obtain higher incomes from intensified and diversified crop production following upon improved water availability. As shown in Table 3-13, a greater than two-fold increase in farm income is projected for the two smallest size models which comprise the vast majority of farms. In order to achieve these goals the project plans to simultaneously develop extension programs to provide the farmers with required information for increased production, to encourage on-farm investments and to increased use of inputs. As the traditional systems have problems because of lack of levelling and inappropriate doses and timing of watering, the DPAs will help improve on-farm water management practices.

Improved O and M will also be a project concern. The overall goal is to give as much responsibility as possible to water users. Since cooperation among water users has existed for generations at Chichaoua, the WUAs will be expected to undertake management and financing of all aspects of O and M from the very beginning. However, it will be necessary to regularize water rights as a first step in improved farmer participation in O and M.

Cost recovery will be made a part of the rehabilitation project. The 1984 law provides for negotiated agreements with local WUAs



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to arrive at mutually agreed-upon charges. The formula proposed for Chichaoua under the project is to set rates that would cover 100 percent of O and M costs and 40 percent of investment costs. The imputed value of O and M performed in kind by water users is estimated at DH 165/ha/yr. A range of rates is specified for investment cost recovery to allow for flexibility in terms of farmer ability to pay (as it varies greatly in the traditional systems) and other considerations.

e. Summary

The most interesting feature of the Chichaoua irrigation system is the existence of a market for water where it is sold at DH 0.089/$m^3$. Water distribution is well-organized and administered on the basis of traditional water rights by salaried ditch riders appointed by local WUAs. System maintenance, however, is not given much attention causing inefficiencies and water losses and recurring rehabilitation requirements. Landholdings are small and fragmented and crop yields generally low. The planned rehabilitation with World Bank assistance is designed to improve the downstream water scarcity and dry season shortages. Provisions have also been made for on-farm investments in improved water management practices, better extension and input delivery. The WUAs will be expected to assume full responsibility for O and M and to fully finance it. Users will also be expected to pay 40 percent of investment costs.

D. Summary and Conclusions: Study Issues

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

At farm, project and national levels recovery of annual O and M costs on Doukkala I is feasible and will likely occur. Using the 1981 monetary levels of the PRC and that year's exchange rate of US$ 1 = DH 5.00, the investment cost is DH 26,800/ha. Following the Morocco model for payment of betterment taxes over 17 years at 4 percent, this amounts to DH 2,208/ha/yr, or US$ 442. This has to be weighed against the incomes of the small farmers: it would reduce the estimated 0.5 ha projected farm income from US$ 975 to US$ 756; the 1.0 ha from US$ 2,230 to US$ 1,788; 2.0 ha from US$ 3,670 to US$ 2,786; and the 5 ha from US$ 9,790 to US$ 7,580. With 75 percent of the farms in the project below 2.0 ha in size and an average size of 0.9 ha, full recovery of capital investment from these small farms does not seem feasible. But this category of farms occupies only 32 percent of the land area. Recovery from the remaining 68 percent would probably be feasible. Cost recovery on the national scale would be more problematic because not all irrigation projects are as successful as Doukkala. This is a relatively profitable project with an estimated internal rate of return of more than 20 percent.

The Chichaoua system did not shed any light on this issue because farmers have not yet had to pay for any improvements made on the system by the government. However, clearly farmers are willing to pay for



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their water and for the ditch rider as evidenced by the existence of the market in water. This factor should make it more likely than in other places that the cost recovery goals of the new rehabilitation project will be met if rates are set equitably and realistically. Whether this will prove true remains to be seen.

With respect to the effect of direct versus indirect charges on improved cost recovery, probably no one knows what the indirect charges are. Indirect charges would have an effect on farm incomes and could affect ability to pay. Furthermore, the direct charge is levied indirectly in that it is deducted from the value of the crop purchased by the state.

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

At all levels, farmer, project and national, as far as Doukkala I is concerned the answer is no. The high level of cost recovery achieved at Doukkala can be attributed to several factors which have nothing to do with farmer participation. (In fact, farmer participation and control are limited on the project.) These factors are: improved and reliable water supply, efficient system management by project officials, improved yields and incomes for farmers (as a result of prices for farm commodities rising faster than subsidized inputs). Most important, perhaps, is the method of charging which is to deduct water charges as a part of the total input bill. This is done when the sugar beet crop is purchased from the farmers. The implication then is that under the special circumstances of a successful project, with a total package of prescribed cropping patterns and input services for high value crop production, a guaranteed price and market and direct deduction for water charges it is possible to have good cost recovery.

Once again, cost recovery has not been an issue at Chichaoua although farmers buy and sell their water rights depending on their landholdings, cropping needs and water availability.

3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?

The thesis that reliable and adequate water supply are essential to improved cost recovery is strongly supported at farm and project levels. High but appropriate technology in the Doukkala I project has ensured a reliable and adequate supply and this lesson is not lost at the national level. Direct measurement of volumes using water meters did not work out. Shift to charging on a cropped area basis has not hindered collection of water charges on this project.

Although the cost recovery issue could not be studied at Chichaoua, the existence of a reliable water supply and its scarcity combine with the separation of land and water rights to make a market in water. Farmers are willing to pay for water because it is scarce



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and because it is reliably delivered. Lack of measurement technology is not a hindrance to charges because the water is delivered by timed flows monitored by the ditch rider. Further, due to the importance of irrigation, farmers are willing to pay charges towards the ditch rider's salary.

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water?

Recent increases in water rates bring the promise for adequate revenues for O and M for Doukkala I. Given the technology in use and the capability of the ORMVAD, this is probably sufficient for the project but the conclusion cannot be extrapolated to the national level because of the variety of projects and management responsibility in the country. At farm level, maintenance of the portable systems is a farmer responsibility and theoretically, would not be affected by increased charges. In practice, reduction of farm income through higher water charges could lead to poorer maintenance of these components. Nominally, however, the improved capacity of ORMVAD's personnel will help farmers because they still rely on technical assistance and material support from the agency.

We have no evidence that a higher cost for water will result in its reduced or more efficient use. The water meters never really got into service so the hypothesis that direct volumetric measurement would improve efficiency was never really tested. The theory is plausible within the rather narrow limits of variation from optimality that are likely to occur given sprinkler technology.

Water charges at Chichaoua are completely unrelated to maintenance although there is some relation to operation in that user charges are applied to ditch rider salaries. Farmers are willing to pay for an assured water supply and are traditionally organized for that purpose. However, they have not extended the organization for purposes of maintaining the system.

From all appearances and based on discussions with officials at the provincial agricultural ministry, water is used efficiently because it is scarce. Efficiency would not be affected by changes in the cost of water. In any case, it is possible that an equilibrium market price of sorts prevails at Chichaoua.

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

This proposition is not testable on the Doukkala project. The farmers have developed their own simple organizational arrangements for participation at block level using a block representative as intermediary. Our assessment is that more intensive participation at block level would be forced and would be uninteresting to farmers and would not yield improvements. Participation in scheduling at division



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level has potential for minor improvements of operations. We think these improvements, if any, would be relatively marginal in the system. We do not see how participation at above division levels on this technically complex system, which already operates "on demand," could improve on O and M. The situation here is unusual because of the nature of the system.

At Chichaoua, farmers have long been organized into traditional WUAs but this has not had any noticeable impact on O and M. In fact, system maintenance is quite neglected. On the other hand, because of the necessity to secure irrigation water for their crops, farmers are willing to pay charges and to pay for a ditch rider to monitor the rotations.

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# IRRIGATION PRICING AND MANAGEMENT

## ANNEX 4

## The Philippines

Submitted to: Ms. Joan Atherton
Social Science Analyst
U.S. Agency for International Development
Office of Policy Development and Program Review
Bureau of Program and Policy Coordination

Submitted by: Ian D. Carruthers
N.S. Peabody, III
A.A. Bishop
A.D. LeBaron
Rekha Mehra
Ramchand Oad
Dean Peterson
Dennis H. Wood

DEVRES, INC.
2426 Ontario Road, N.W.
Washington, D.C. 20009
(202) 797-9610
Cable: DEVRES
Telex: 440184

Contract No.: OTR-0091-C-00-4466-00

September 30, 1985

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The Philippines

Ian D. Carruthers,
Principal Investigator
Dean F. Peterson,
Irrigation Engineer
Rekha Mehra,
Economist and Social/
Institutional Specialist

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ADCC | Agricultural Development Coordinating Council |
| BSIA | Bafting-Siclong Irrigators Association |
| CIS | Communal Irrigation System |
| FFIA | Federation of Farmer Irrigators Association |
| FIA | Farmer Irrigators Association |
| FIG | Farmer Irrigator Group |
| FSDC | Farm Systems Development Corporation |
| GNP | Gross National Product |
| HYV | High Yielding Variety |
| IA | Irrigator Association |
| IOMP | Input-Output Monitoring Program |
| IPC | Institute of Philippine Culture |
| NEDA | National Economic Development Agency |
| NFA | National Food Authority |
| NIA | National Irrigation Administration |
| NIS | National Irrigation System |
| NWRC | National Water Resources Council |
| O and M | Operations and Maintenance |
| OM | Operations Manager |
| PAC | Provincial Agricultural Committee |
| PDC | Provincial Development Council |
| PIA | Pinaburyuhan Irrigators Association |
| PIS | Pinaburyuhan Irrigation System |
| RUG | Rotalecuel Unit Group |
| SEC | Securities and Exchange Commission |
| UPRIIS | Upper Pampanga River Integrated Irrigation System |
| UPRP | Upper Pampanga River Project |
| WM | Water Manager |
| WMT | Water Management Technician |



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## CURRENCY EQUIVALENTS

US$ 1.00 - ₱ (Philippine Pesos) 17.60

## WEIGHTS AND MEASURES

| | | |
|---|---|---|
| 1 hectare (ha) | = | 10,000 $m^2$<br>2.471 acres |
| 100 hectares (ha) | = | 1 $km^2$ |
| 1 kilogram (kg) | = | 2.204 pounds |
| 1 metric ton (MT or t) | = | 1,000 kg<br>2,204 pounds |
| 1 kilometer (km) | = | 0.621 miles |
| 1 square kilometers ($km^2$) | = | 100 ha |
| 1 millimeter (mm) | = | 0.04 inch |
| 1 cubic meter ($m^3$) | = | 1,000 liters |
| 1 liter | = | 1.066 quarts |



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## LIST OF PEOPLE INTERVIEWED

Mr. Benjamin V. Bagadion
Assistant Administrator for Operations
National Irrigation Administration (NIA)
Quezon City

Mr. Wilfredo S. Tiangco
Operations Manager
Upper Pampanga River Integrated System (UPRIIS)
NIA
Cabanatuan City

Dr. Leonardo C. Lucero
Director Institutional Development Division
UPRIIS
Cabanatuan City

Mr. Sebastian J. Julian
Director, System Management Department
NIA
Quezon City

Mr. Avelino M. Mejia
Chief, Institutional Development Department
NIA
Quezon City

Mr. Orlando Cablayan
Head of Corporate Planning
NIA
Quezon City

Ms. Lucille Capistrano
Irrigation Development Department
Farm Systems Development Corporation (FSDC)
Quezon City

Ms. Grace Ignacio
Irrigators Organization Program Specialist
Community Irrigation Development Program (CIDIP)
Quezon City

Ms. Vicky Pineda
Irrigators Organization Program Specialist
CIDIP
NIA
Quezon City

Ms. Arvie R. Aguila
Farmers Organization Specialist



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CIDIP
NIA
Quezon City

Mr. Liborio S. Cabanilla
Economics Department
University of the Philippines
Los Banos

Mr. Kunio Takase
Director, Irrigation and Rural Development
Asian Development Bank
Manila

Dr. T.K. Jayaraman
Senior Project Economist
Asian Development Bank
Manila

Dr. J.C. Flinn
Agricultural Economist
International Rice Research Institute (IRRI)
Los Banos

Mr. Jerry Sison
Irrigation Economist
IRRI
Los Banos

Dr. Hammond Murray-Rust
Irrigation Engineer
IRRI
Los Banos

Dr. M.S. Swaminathan
Director General
IRRI
Los Banos

Mr. Douglas Clark
Agricultural Development Officer
United States Agency for International Development (USAID)

Mr. David Alverson
Project Officer
United States Agency for International Development (USAID)

ANNEX 4

## The Philippines

### A. Background

#### 1. Economic background

##### a. Macroeconomic conditions and policy

The Philippines is currently faced with a severe economic and financial crisis. Real GNP growth which averaged 6 percent per annum in the 1970s has declined during the past four years and was expected to be minus 6 percent in 1984. The investment-savings gap which was negligible in the early 1970s began to grow towards the end of the decade and stood at 8 percent of GNP by 1982-83. The current account deficit rose from 5 percent of GNP in 1979 to 8 percent by 1983. With rising real international interest rates, the Philippines' external debt ratio rose from 1.4 percent of GNP in 1979 to 4.7 percent of GNP in 1983. By August 1983, external credit lines were terminated, capital flight had accelerated and the government was compelled to declare a moratorium on debt repayments and to seek means for their rescheduling--the only country in Asia to do so.[1]

One of the factors contributing to the Philippine economic crisis was the international recession which started in 1979. The problems were compounded by the Government's continued expansion of public investments up to 1982 despite the growing current account deficit. Agricultural production growth slowed in the 1980s and actually declined in 1983. Contributing factors were a prolonged drought, unfavorable trading conditions and government marketing and price control policies which dampened production incentives. Manufacturers suffered because high protection for import substitution manufacturing led to inefficiencies and increased reliance on imported inputs and capital goods. The downturn in the economy resulted in excess capacity in manufactures for domestic consumption. Export manufacturing was similarly import intensive and had little impact on the growing unemployment problem. Exports of both agricultural and manufactured goods declined, having been effected by the deteriorating terms of trade and the drought that reduced the volume of agricultural exports.

The combined effect of structural weaknesses in the economy and government policies have resulted in increased under- and unemployment; a liquidity crisis among financial institutions (some of which are approaching insolvency); a slow-down in private investment; declining real wages; and accelerated inflation rates of 45-50 percent per

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[1]The World Bank, The Philippines: An Agenda for Adjustment and Growth (Washington, DC: The World Bank, November 30, 1984), pp. i-viii; 105 and 12-16.



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annum. Since the Philippines and its Asian neighbors have been exposed to similar external shocks, economic analysts believe that present economic performance in the Philippines is largely explained by its internal political and economic policies.[2] For example, while neighboring countries like Korea, Taiwan, and Malaysia assumed an outward, export-oriented policy, the Philippines adopted an import substitution policy through a mixture of tariff and non-tariff interventions. For a while (1960-1970) this policy helped the country attain moderate economic growth rates but since domestic demand did not grow fast enough, growth in value added from these industries declined. It likewise became increasingly apparent that these industries were inefficient and therefore non-competitive in the world market. Furthermore, they were capital biased because of policies that artificially cheapened capital and hence labor absorption was low.

A related feature was the government's increasing involvement in economic activity as is shown in Table 4-1. Both the shares of government consumption and investment (infrastructure development) increased greatly in the 1970s while the Central Government deficit grew. The savings-investment gap increased as did dependence on external borrowings to finance public and private investments. The high inflation rate resulted directly from the ambitious construction program whose returns were slow in being realized. Further, the investments themselves were not as productive as originally envisioned.

The current extremely unfavorable balance of payments situation has arisen because of several factors. First, the dependence on short-term external borrowing to finance current deficits has already been pointed out. The problem was compounded by increasing interest rates on these loans. Secondly, the protection afforded to import substituting import dependent industries penalized export oriented industries. Thirdly, currency overvaluation (prior to the recent devaluations) fueled imports and dampened exports. Finally, the growing political instability resulted in foreign capital flight.

By the end of 1984, the Government was attempting to improve and expand its stabilization program by reducing credit for the public and private sectors, adopting a floating exchange rate, improving the level and structure of taxation, reducing imports and giving increased incentives for export production. However, these measures have been mostly inadequate. The exchange rate adjustment, for example, has had little impact. The economic environment in 1985 is, therefore, one of reduced public expenditures and smaller budgets for government agencies.

The austerity measures have had their impact upon irrigation as on every other sector of the economy. This has meant reduced investment

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[2]"An Analysis of the Philippine Economic Crisis--A Workshop Report," (Quezon City: University of the Philippines, School of Economics, n.d.).

Table 4-1: Selected Economic Data, 1971 to 1982
(annual average in millions)

| | 1971-75 | 1976-80 | 1981-82 |
|---|---|---|---|
| Private Consumption (in current pesos) | 53,419.0 | 126,145.2 | |
| Government Consumption (in current pesos) | 7,141.0 | 16,757.2 | |
| Government Construction (in current pesos) | 2,047.8 | 10,547.2 | |
| Private Construction (in current pesos) | 3,979.6 | 14,158.8 | |
| Share of Government in Total Construction (%) | 33.9 | 42.7 | |
| Overall Deficit of Central Government | | | |
| (in current pesos) | 842.3 | 2,252.0 | 13,180.0 |
| (in 1972 pesos) | 1,124.0 | 1,708.0 | 3,585.0 |
| Government Expenditure Share in GNP (%) | 12.37 | 15.41 | 17.66 |
| Government Deficit Share in in GNP (%) | 2.83 | 2.19 | 3.88 |
| Excess of Investment Over Savings (in current pesos) | 1,900.0 | 9,100.00 | 20,550.0 |
| Current Account Deficits (in US$) | 105.2 | 1,320.4 | 2,820.0 |

Source: Compiled from the National Economic Development Agency, the Philippine National Account Statistics and Key Indicators of Developing Member Countries of the Asian Development Bank (April 1983).



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in new irrigation development and a shift towards emphasizing rehabilitation and development of the smaller communal systems. On the institutional side, it has meant greater concern with cost recovery and with the development of farmer organizations capable of assuming responsibility for operations and maintenance (O and M) on their own systems.

b. The rural and agricultural sector

Agriculture in the Philippines provides employment for over half the labor force, contributes over 30 percent of net domestic product and generates 40 percent of export earnings.[3] It is characterized by small family-operated farms, the average size being 2.7 ha. The distribution of cultivated land is highly skewed with 61 percent of farmers having less than three ha and owning only 24 percent of all farm land while 5 percent have more than ten ha and represent 34 percent of farm land ownership. Landless laborers comprise 16 percent of the population in the agricultural sector.[4] Tenancy is common, particularly among rice and corn farmers. As an example, the distribution of rice farm holdings is shown in Table 4-2.

There are large income variations among farmers and rural poverty exists particularly among subsistence farmers in rainfed rice and corn production, shifting agriculturalists in mountain areas and in inaccessible resource poor areas. An agrarian reform program was instituted by the Government in 1972 to transfer land ownership to tenant farmers on rice and corn lands. Landowners with over seven ha were required to sell the land to tenants who could pay for the land over 15 years thus becoming owner cultivators. Under a second scheme, for lands up to seven ha, tenants were given security of tenure on land being cultivated. About 1.4 million families were targeted under both programs which have been partially fulfilled, reaching 80 percent of intended beneficiaries in the first case and 70 percent in the second.

The focus of agricultural development in the 1970s was on achieving rice self-sufficiency. Irrigation development in rice-producing areas was an important aspect of this process. Rice production on irrigated lands as a proportion of total area planted increased from less than 50 percent in 1968 to about 58 percent in 1983. During the same period, the adoption of high yielding rice varieties (HYVs) increased as well so that the area planted in HYVs

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[3]The World Bank, Philippines Agricultural Sector/Inputs Project (Washington, DC: The World Bank, 1984).

[4]The World Bank, An Agenda for Adjustment, p. 63.



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Table 4-2: Distribution of Rice Farm Holdings

| Size of Farm (ha) | Percent of Farms | Percent of Area |
|---|---|---|
| Less than 1.0 | 14.6 | 2.9 |
| 1-3 | 54.1 | 33.6 |
| 3-5 | 21.5 | 28.3 |
| 5-10 | 7.3 | 16.6 |
| 10-25 | 2.2 | 10.8 |
| 25.0 and above | 0.3 | 7.8 |
| TOTAL | 100.0 | 100.0 |

Source: The World Bank, The Philippines: Irrigation Program Review (Washington, DC: The World Bank, 1982).



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went from less than 50 percent in 1968 to 58 percent in 1983.[5] Rice yields on irrigated lands increased from 1.65 t/ha in 1965 to 2.84 t/ha in 1982, while yields in rainfed areas went from 1.19 t/ha to 1.93 t/ha in the same period.[6] Accompanying the productivity improvements in irrigated rice production were corresponding increases in the incomes of farmers. Despite declining farmer margins from 1977 to 1981, real farm incomes were higher after irrigation making possible the adoption of new technologies. From being a major importer of rice, the Philippines for a while became a small exporter although now it has once again become a net importer of rice.

The other major cereal crop is corn which with rice accounts for about 75 percent of cultivated land. Other important crops are sugar and coconuts which are grown for export while the cereal crops are for domestic consumption. During the 1970s agriculture grew at the rate of 4.5 percent a year, the growth coming from both expansion of cultivated area and yield improvements. Performance has varied greatly by sub-sector with rice, sugar and banana yields increasing considerably, corn and tobacco more slowly, and coconuts and abaca declining. A comparison of area, yields and production of rice, corn and sugar is given in Table 4-3. The area under rice has remained relatively stable at around 3.5 M ha but the area in sugarcane has fluctuated severely due to unstable prices. The areas in corn, coconut and other crops have increased greatly. As most cultivable land is already in use, future growth in production will have to come from higher yields and more intensive land use. In the 1980s, growth rates in agriculture have slowed, falling to 3.5 percent in 1982 and in 1983 to 1 percent which is below the rate of population growth.

There has been a steady decline in the contribution of agriculture to total export value from 73 percent in 1970-72 to about 50 percent in 1978-80 and 38.3 percent in 1981-83. The most important agricultural commodities in 1978-80 was coconut products which accounted for 20 percent of total exports followed by sugar with 8 percent, forest products with 10.3 percent and all other agricultural exports with 11 percent.

Although agriculture remains a significant source of export earnings, macroeconomic and commodity-specific policies have tended to favor industry and to penalize agriculture. Consequently, resources have shifted away from agriculture and its contribution to national output and employment have declined as has the level of exports.

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[5]M.C. Cruz and R. Siy, Issues in Irrigation Water Management in the Philippines, Agricultural Policy Working Group Mini-Workshop on Rice Policy, University of the Philippines at Los Banos, January 3-4, 1985, pp. 3.

[6]The World Bank, The Philippines: Irrigation Program Review (Washington, DC: The World Bank, 1982), p. 61.



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Table 4-3: Area, Yield and Production of Three Major Crops

| Crop | 1970 | | | 1975 | | | 1981 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Area (000s ha) | Yield (t/ha) | Prod. (000s t) | Area (000s ha) | Yield (t/ha) | Prod. (000s t) | Area (000s) ha) | Yield (t/ha) | Prod. (000s t) |
| Rice | 3,115 | 1.68 | 5,233 | 3,540 | 1.60 | 5,660 | 3,330 | 2.27 | 7,572 |
| Corn | 2,390 | 0.84 | 2,008 | 3,060 | 0.84 | 2,570 | 3,560 | 0.98 | 3,489 |
| Sugar | 425 | 5.03 | 2,127 | 480 | 5.14 | 2,474 | 414 | 5.97 | 2,395 |

Source: The World Bank, The Philippines: Irrigation Program Review (Washington, DC: The World Bank, 1982).



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Domestic pricing policies also had an adverse effect upon agriculture. The Government's objective was to stabilize producer and consumer prices of rice by buying from farmers at guaranteed prices, releasing stocks to dampen price increases and imposing controls on retail prices. The National Food Authority (NFA) had an instrumental role in the price support process, an increasing role in marketing of food grains and pulses and a virtual monopoly to export rice and import corn, soybean meal and wheat. Altogether, the Government's efforts were successful in obtaining low consumer prices but less successful in maintaining producer prices. In addition, implicit tariffs on important farm inputs kept domestic prices well above border prices. This dampened agricultural growth.

Recent policy reforms have been directed at reducing the role of the NFA, and basically, attempting to phase out government interventions that reduce production and private sector incentives. There is also a move towards greater liberalization of domestic and foreign trade in agricultural products. While some form of government intervention may be required to moderate price fluctuations, it is intended that there will be greater reliance on competitive pricing.[7]

2. Irrigation development

a. General

The Philippines has a lengthy tradition of irrigation development which predates the Spanish. There were already 25,000 ha of irrigated rice terraces in Northern Luzon before the Spanish arrived. The latter then developed 30,000 ha of irrigated area near Manila and the Philippine Government began its role in the 1900s. The major phase of irrigation expansion took place after the creation of the National Irrigation Administration (NIA) in 1964. By 1983, the total service area under irrigation had increased from 541,000 ha to 1,385,940 ha. This represents an increase of 156 percent or 7.8 percent per year. There are now two main types of irrigation systems in the Philippines--the National Irrigation Systems (NIS) which in 1983 covered 40 percent of total irrigated areas, and the Communal Irrigation Systems (CIS) which represent 49 percent of irrigated area. A third category, Private Irrigation Systems (PIS) (usually pumps serving an area of 20-25 ha) also exists but it comprises only 11 percent of total irrigated area.[8]

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[7]The World Bank, Philippines: Agricultural Sector, pp. 13-14.

[8]L. Cabanilla, "Study of Operation and Maintenance Problems in Irrigation: The Philippine Case" (Manila: USAID, November 1984), pp. 5-6.



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The Philippine Government made large investments in irrigation infrastructure development during the 1970s. Irrigation's share of the infrastructure development budget grew from 8 percent in 1970 to 11.6 percent in 1978. It declined in 1980 to 9.2 percent. An allocation of about 11 percent of the budget had been planned for irrigation construction in the 1980s but given the current financial situation in the country, it is likely that the goal will be revised. Current indications are that construction will be deemphasized in order to focus more upon rehabilitation of existing projects and improved O and M. Such a program would include upgrading and rehabilitating irrigation systems to facilitate operation at improved efficiency levels.

b. Current status of irrigation development

(1) Description

The areas covered by existing irrigation systems and the potential for future development in the five major geographical regions of the Philippines are shown in Table 4-4. These are Northern Luzon, Central Luzon, Southern Luzon, the Visayas and Mindanao. In Northern Luzon, the mountainous Ilocos region has 15,000 ha of irrigation while the potential in the Cagayan Valley is being developed under the Magat and Chico River Projects which are together planned to provide for 122,000 ha of irrigation. There are, in addition, 20,000 ha provided by small projects. Central Luzon has the most irrigated area and considerable potential for further development. The total potential irrigable area is 820,000 ha of which 360,000 ha are irrigated and 160,000 ha are CIS or pump systems. This is the major rice-growing region of the Philippines and the site of the Upper Pampanga River Project which was visited by the team.[9]

Irrigation is also highly developed in the Southern Tagalog region of Southern Luzon, which has 17 irrigation systems covering 41,000 ha. There is not much potential for further new development here or on Mindoro Island, but Bicol has 50,000 ha currently under irrigation and the potential for further new development. The Visayas consist of six major islands of which Panay has the most irrigated land (about 40,000 ha), while Negros has 13,000 ha. Only communal systems exist in Bohol, Cebu and Samar. There are 225,000 ha of irrigation in Mindanao but the potential exists for expanding irrigation area by 325,000 ha.

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[9]The World Bank, The Philippines: Irrigation Program Review, p. 29.

Table 4-4: Areas Served by Irrigation Systems, 1980
(000s ha)

| Regions | National Systems | | | Existing Communal Systems | Existing Pump and Other Irrigation Systems | Total Area Served | Total Area to be Served in Future[b] |
|---|---|---|---|---|---|---|---|
| | Existing | Under Construction | Total | | | | |
| Northern Luzon | 80[a] (40) | 110 | 190 | 165 | 40 | 285 | 395 |
| Central Luzon | 200 (35) | 20 | 220 | 115 | 45 | 360 | 380 |
| Southern Luzon | 55 (50) | 75 | 130 | 80 | 40 | 175 | 250 |
| Visayas | 70 (45) | 25 | 95 | 60 | 35 | 165 | 190 |
| Mindanao | 65 (35) | 100 | 165 | 130 | 30 | 225 | 325 |
| Philippines | 470 (205) | 330 | 800 | 550 | 190 | 1,210 | 1,540 |

[a]Figures in parenthesis are areas under rehabilitation.
[b]Excluding communal systems under construction.

Source: The World Bank, The Philippines: Irrigation Program Review (Washington, DC: The World Bank, 1982).



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(2) Types of systems

(a) The National Irrigation Systems

The NIS, which are built, operated and maintained by the National Irrigation Administration range in size from about 100 ha to 80,000 ha. Existing systems cover an area of about 470,000 ha of which 205,000 were being upgraded in 1980. Total cropped area is 640,000 ha which yields a cropping intensity of 137 percent. The service unit in these regions is about 50 ha with a turnout at ten ha sub-units having ditches to carry water to the farms. The canals are equipped with gates to allow water control over large areas. The systems are also provided with service roads along the main canals and laterals to facilitate access for O and M. Responsibility for O and M lies primarily with the NIA representatives at the regional level. The officials are authorized to collect fees for their services. The record of fee collection and O and M has been inadequate and the NIA's recent financial difficulties have resulted in an increased emphasis on making users responsible for their local systems through organization of Irrigator Associations. These developments will be discussed at greater length in Section B.

(b) The Communal Irrigation Systems (CIS)

The CIS vary in size from a few hectares to 4,000 ha and cover nearly 600,000 ha. There are about 5,700 systems, most of them built before 1965. Cropping intensity on these systems is about 130 percent. Performance varies greatly depending upon a variety of factors that include soil and water conditions and construction and maintenance levels. Where river flows are dependable, these systems provide adequate and reliable water supplies. The Government has pursued a policy of rehabilitating and upgrading some of them by such means as replacing temporary dams with permanent diversion weirs and upgrading canals and service roads. Government assistance to communals rose rapidly in the 20-year period from the 1950s to the 1970s resulting by 1980 in the improvement of about 900 systems which encompassed an area of over 350,000 ha.[10]

Management of communal systems varies, the smaller ones often being informally managed by village leaders or large landowners. More formal management structures exist on the larger systems with 90 percent of those over 100 ha having Irrigator Associations (IAs) to facilitate farmer participation in O and M. Some of these IAs have

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[10]The World Bank, Staff Appraisal Report: Philippines Communal Irrigation Development Project (Washington, DC: The World Bank, 1982), p. 8.



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paid personnel to operate control structures; other IAs perform their own maintenance and carry out administrative duties and some also collect irrigation fees.[11]

(c) Pump irrigation systems

Pump systems provide irrigation for about 150,000 ha but there is no reliable inventory of these projects or of the development potential. The only data available to the team were the results of a survey done in 1971-72 in Quezon and Batangas provinces of 52 owner-operated small-scale pumps.[12] The study found that pump users were basically satisfied with the water distribution system as it was able to ensure delivery of the minimum water requirement for all farms even during times of scarcity. Irrigation charges varied but the most common was in-kind payment of 20 percent of net product divided between tenant and landlord in both wet and dry seasons. The major problem encountered by pump owners was a shortage of funds for repairs. The problems were compounded by the difficulty of obtaining spare parts and the shortage of skilled mechanics. More recently, the most significant problem has been high energy costs which is likely to limit further pump irrigation development.

## B. The National Irrigation Administration and Policy

### 1. Organization of irrigation administration

The major organization having responsibility for irrigation in the Philippines is a government corporation called the National Irrigation Administration. Several other institutions are also involved, namely: The National Water Resources Council (NWRC), the Farm Systems Development Corporation (FSDC) and the Bureau of Flood Control and Drainage of the Ministry of Public Works.

#### a. The National Irrigation Administration

The NIA was established in 1964 as a successor organization to the Irrigation Division of the Bureau of Public Works whose staff and responsibilities it inherited. It was entrusted with the task of constructing and administering the entire irrigation system of the country including the collection of water rates from users. As a corporate entity, it was empowered to collect fees and to negotiate loans with foreign lending institutions. The governing body of the NIA is a Board of Directors composed of a Chairman, who is the Minister of Public Works, and five members including the Ministers of Agriculture and of Planning, and the General Manager of the National Power Corporation. The Administrator is responsible for management of

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[11] Ibid., p. 9.

[12] D.L. Evangelista, R.D. Torres and M.M. Faigmane, "The Economics of Groundwater Irrigation" in Water Management in Philippine Irrigation Systems: Research and Operations. Los Banos: International Rice Research Institute, 1973, pp. 195-206.



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four divisions each under an Assistant Administrator: Development and Implementation, Engineering and Operations, Finance and Management, and Administration and Personnel. The first two Divisions are responsible for technical matters while the latter two provide support services.

Figure 1 shows the organization of the NIA with the Central Office and its four main Divisions located in Manila. There are 12 regional offices and 72 provincial offices responsible for the administration of both the NIS and CIS that fall under the NIA's province. Foreign assisted projects have a separate administrative agency at the Provincial Irrigation Office level. The Regional Irrigation Offices also have Divisions for specialized functions such as Engineering, Equipment, Administration, Dam Construction and Institutional Development. The last Division has recently assumed greater importance because of the increased emphasis on development of farmer associations. In 1979, the total staff employed by the NIA numbered 35,500 people.

The NIA's funding is obtained from several different sources including loans and grants from international agencies, budget appropriations from the national government, irrigation service fee collections, amortization payments from construction loans to water user organizations and payments from the sale or rental of equipment. Initial funding was provided by the Government. In 1974, annual capitalization was increased from ₱ 30 M to ₱ 2 billion and, in July 1980, to ₱ 10 billion. The agency is also authorized to charge 5 percent from foreign loan funds as administrative or management fees. Over 80 percent of its operating income comes from irrigation fees, equipment rental and interest earnings.[13]

Until 1980, the Treasury also provided subsidies for O and M on the NIS. This is no longer the case but it now receives appropriations for construction of CIS projects that in 1983 amounted to ₱ 122.5 M (see Table 4-5). In 1984, the CIS construction budget was expected to decline to ₱ 90 M.

Between 10-20 percent of the NIAs annual budget goes towards operating expenses which in 1983 amounted to ₱ 256 M, the largest expense being for salaries. Irrigation fees provided ₱ 74 M or 29 percent of operating income. As shown in Table 4-5, income from foreign sources provided ₱ 944 M or 45 percent of the NIA budget.

The consolidated income and expense statement for the 1978-83 period is shown in Table 4-6. Annual operating expenditures rose from ₱ 107 M in 1978 to ₱ 244.7 M in 1981 mostly because of improved personnel pay scales. However, by 1983, expenditure declined to

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[13]Cruz and Siy, Issues in Irrigation Water Management, p. 3.



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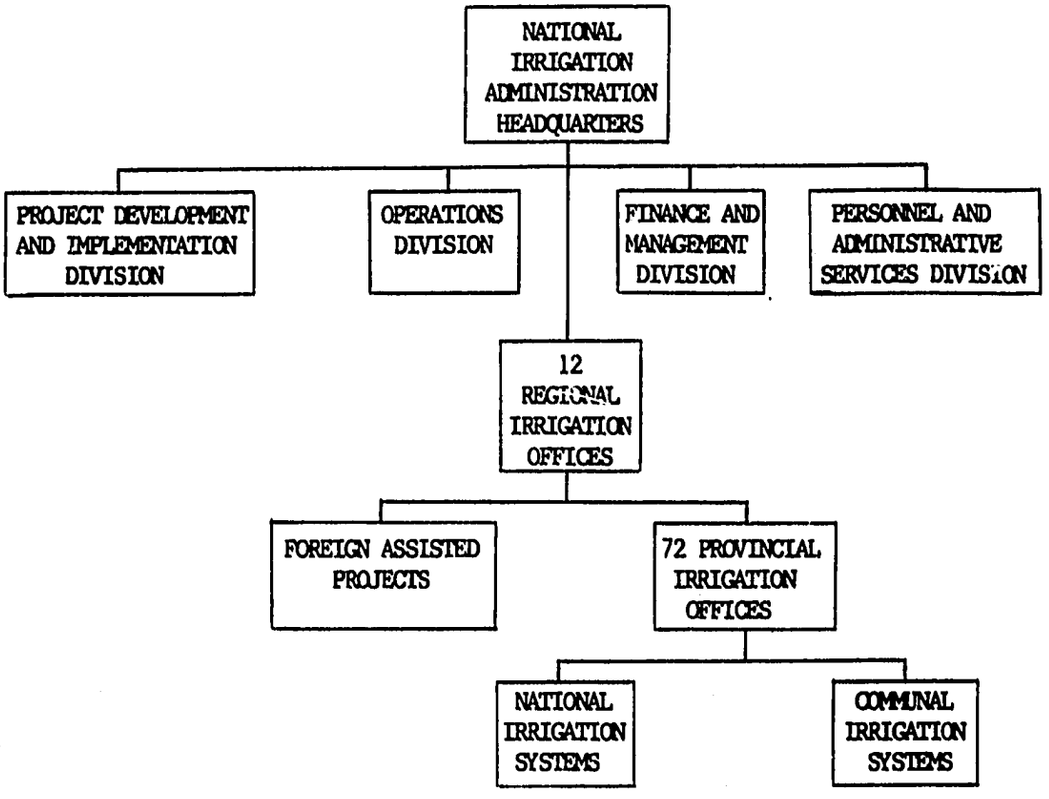


IRRIGATION PRICING AND MANAGEMENT: THE PHILIPPINES

Figure 4-1: Organization of The National Irrigation Administration

Source: Adapted from Figure 1.1 in the World Bank, Staff Appraisal Report: Philippines Communal Irrigation Development Project (Washington, DC: The World Bank, 1982).



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Table 4-5: The National Irrigation Administration's Budget, 1983
(000s Pesos)

| | |
|---|---|
| **Current Operating Expenditures** | |
| Personal services | 193,875 |
| Operating expenses | 62,125 |
| Subtotal | 256,000 |
| **Capital Expenditures** | |
| Foreign loan-assisted projects | 1,625,616 |
| Locally funded projects | 202,303 |
| Subtotal | 1,827,939 |
| Total Expenditures | 2,083,939 |
| **Funded by:** | |
| General Appropriations | |
| Corporate equity | 760,000 |
| Communal irrigation program | 122,500 |
| NIA Operating Income | 257,000 |
| Foreign Loans | 944,439 |

Source: National Irrigation Administration, Annual Report 1983.



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Table 4-6: The NIA's Actual Operating Income and Expenses: 1978-83
(M of Pesos)

| | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|---|---|
| INCOME: | | | | | | |
| Irrigation Fees | 36.72 | 45.35 | 59.24 | 52.74 | 57.49 | 72.71 |
| Equipment Rental and Pump Amortization | 12.36 | 11.74 | 23.33 | 23.80 | 30.83 | 29.79 |
| Interest | | | | | | 121.79[a] |
| Others[b] | 84.55 | 92.87 | 73.76 | 81.14 | 132.38 | 22.43 |
| TOTAL | 133.63 | 149.96 | 156.33 | 157.68 | 220.70 | 246.73 |
| EXPENDITURES: | | | | | | |
| Personnel | 89.08 | 124.51 | 80.64 | 166.66 | 165.26 | 137.08 |
| Administrative Depreciation Financial | 8.46 | 14.71 | 5.94 | 5.44 | 17.28 | 28.63 |
| Miscellaneous | 9.66 | 15.85 | 22.67 | 72.63 | 28.57 | 16.70 |
| TOTAL | 107.20 | 155.07 | 109.25 | 244.73 | 211.11 | 182.41 |
| PROFIT (LOSS) | 26.43 | (5.11) | 47.08 | (87.05) | 9.59 | 64.31 |
| MANAGEMENT FEE | - | 76.64 | - | 104.45 | 104.45 | 81.24 |
| NET AFTER FEE | 26.43 | 71.53 | 47.08 | 17.40 | 114.04 | 145.55 |

[a]Interest is from charter of NIA's capital funds.

[b]Excluding 5 percent Management Fee.

Source: NIA Corporate Planning Staff, The Agricultural Input Loan: Irrigation Study (Manila: NIA, November 1984).

₱ 182 M as a result of economy measures adopted by the agency. Only in two years, 1979 and 1981, was operating income less than operating expenditure but the deficits were made up by earnings from management fees.

Projections done by the NIA's Corporate Planning Staff show that operating expenses could reach a high of ₱ 576 M by 1993. Although much of the operating income could be provided by irrigation fees these would not be fully adequate. If the agency were to assume responsibility for debt servicing, projected annual operating losses would amount to ₱ 100-200 M between 1988-93 and the NIA would not be able to sustain debt servicing beyond 1993.[14]

b. Other institutions involved in irrigation

The National Water Resources Council (NWRC) was created in 1974 with the objective of formulating rules and regulations for the use and management of water resources for all purposes including irrigation and other domestic and industrial uses. It is also responsible for coordination of the activities of the various water resource agencies and the issuance of water permits.

The Farm Systems Development Corporation (FSDC), established in 1975, was entrusted with a variety of tasks, the most important being that of organizing farmers into Irrigator Associations on the CIS or pump systems. The FSDC was also given responsibility by the NIA for collecting 90 percent of the costs of constructing communal systems. In addition, the FSDC has been involved in extension, cottage industry development, storage and processing. The multiplicity of responsibilities proved detrimental to FSDC's main organizational tasks for it was largely unsuccessful in setting up IAs. Consequently, the NIA has assumed all farmer organizational tasks for systems over 100 ha and only some of those with less than 100 ha will be left to the FSDC.

The Bureau of Flood Control and Drainage in the Ministry of Public Works and Highways has been indirectly involved in irrigation through construction of earthen dams at the heads of watersheds primarily for flood control. There are side benefits for irrigation, fish production, and others. By 1981, ten such projects had been completed, each having impact on an average of 100 ha. Their productive impact is relatively small and costs have tended to be high.

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[14]NIA Corporate Planning Staff, The Agricultural Input Loan: Irrigation Study (Manila: NIA, November, 1984), p. 17.



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## 2. Irrigation policies and practice

### a. General

The 1974 Water Code of the Philippines sets the tone for the general policy direction of irrigation development in the country. The Code establishes the basic principles and framework relating to appropriation, control and conservation of water to achieve optimum development and rational utilization. It defines the rights and obligations of water users, adopts basic provisions to carry out matters relating to use and protection of water and identifies administrative agencies to enforce the code.

### b. Irrigation management

#### (1) Organization for O and M

##### (a) The National Irrigation Systems and farmer participation

At the national level, planning and coordination of O and M is done by the Systems Management Department of the NIA which prepares annual budgets and reviews plans and programs for O and M and for repairs. The Operations Division of the Regional Irrigation Office monitors system level O and M and the work is actually performed by water masters and ditchtenders under the supervision of the Irrigation Superintendent. These officials are primarily responsible for the timely and equitable distribution of water and for maintenance of canals, structures and measuring devices. On some of the larger systems, the organizational structure is more complex involving a separate collection section, a repair and improvement section and a hydrology unit.

The varieties of tasks performed by the office of the Irrigation Superintendent include development and dissemination of cropping schedules to farmers, farm level water delivery and maintenance of records on water distribution, maintenance or repair of canals, structures and access roads and fee collections. The major management problem at the farm level is that of delivering properly controlled quantities of water to the fields at the appropriate times during the cropping season. For this purpose, the initial design was for a rotational water delivery system whereby four or five 10-ha units comprised one rotation area. Each rotation area has a gated turnout, flow measurement devices and appropriate conveyance structures. Water was to be distributed on a timed schedule with continuous flow in a rotation area while turns for water were to be rotated among ten-hectare blocks. A major difficulty in proper operation is that although 68 percent of the systems were designed for rotational irrigation, only a small percentage actually follow the schedule. Most practice continuous irrigation. In fact, the rotational scheme was officially discontinued in 1978 in favor of continuous and simultaneous

delivery, thereby acknowledging the actual practice among farmers.[15] The result is water flow cannot be properly controlled and farmers at the head end tend to over-irrigate while tailenders are deprived of their water share.[16] Illegal turnouts are also a problem especially during times of scarcity.

The Water Management Technician (WMT) is the official at the farm level responsible for a 500 ha rotation area where his functions are to improve water management practices, educate farmers on proper methods of water control and, in general, to prepare them for eventually assuming control of O and M at the field level. Ditchtenders are in charge of monitoring up to 3.5 km of canals while gatekeepers operate and maintain three major gates and 1.5 km of canals. The ditchtenders often receive complaints about inadequate water supplies as they are most directly in contact with farmers.

O and M on the national systems has generally been inadequate as there has been a chronic shortage of funds.[17] Lack of funds has meant inability to purchase necessary maintenance equipment thus compounding the O and M problem. Further, lack of proper O and M and inadequacies in the water delivery system have been reflected in low water fee collection rates. This has resulted in fewer funds and lower levels of O and M in a downward spiral.[18] More recently, the Government's weakening financial situation has added an additional burden to the NIA's ability to undertake efficient O and M. Consequently, there has been a growing emphasis over the past few years upon developing Irrigator Associations among farmers, the objective being to organize farmers to assume increasing responsibility for O and M and for fee collection.

Farmers are organized into Farmer Irrigator Groups (FIGs) within hydrologic boundaries starting at the rotational level which is approximately a 50-ha area served by one turnout. The farmers elect officers such as a President, Secretary and Treasurer and sometimes unit leaders for the sub-farm ditch level. As the organizations develop they are formally integrated into a bigger group known as the Farmer Irrigators Association (FIA). Consisting of at least two or three FIGs, the FIA is registered with the Securities and Exchange Commission (SEC), making it a formal organization. To perform the roles of management, maintenance, dispute resolution and fee collection, a Board of Directors is elected to lead the group.

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[15]M. Svendsen and E. Lopez, "Six Rotational Areas in the Penaranda River Irrigaiton System" (Ithaca: Cornell University, 1980), pp. 9-12.

[16]Cruz and Siy, Issues in Irrigation Water Management, p. 7.

[17]Government allocations for O and M were discontinued in 1980.

[18]The World Bank, The Philippines: Irrigation Program Review, p. 19.



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Specialized committees such as Education and Training, Audit and Inventory, Finance and Development, Irrigation Management, Agricultural Supervision and Complaints Committees are also formed.

At first, the FIGs were only expected to maintain the tertiary level canals and the NIA offered incentives such as a fee collection bonus determined by the attained collection efficiency. The NIA has now instituted a policy of speeding up the organizational development process in order that farmers may assume responsibility for O and M on sectors of the main canal and laterals in addition to the tertiaries. The NIA expects to derive two specific economic benefits from this process. First, if O and M activities are entirely assumed by the farmers groups, the ditchtenders job becomes superfluous and the NIA obtains a savings on his salary. Second, the NIA hopes that fee collection efficiency can be improved with the help of farmers. A number of incentive schemes have been devised to promote this objective. For example, in one scheme in the Bicol region, the farmer association is allowed to keep 35 percent of total collections if it achieves a 50 percent collection rate. But if collections exceed 50 percent, the association is allowed to retain 65 percent of the amount collected over the target of 50 percent of charges.[19]

As a result of its intensified efforts over the past few years, maintenance of over 884 km of irrigation canals under 241 sections throughout the country have been undertaken by IAs. Ditchtenders have been retired. In addition, seven national systems servicing 1,690 ha have been completely turned over to IAs.[20]

(b) The Communal Irrigation Systems and farmer participation

The necessity for establishing viable IAs on the communal systems was felt sooner than on the NIS because in 1974 the government decreed that rehabilitation and construction costs on the CIS had to be shared by beneficiaries. Thus, farmers were required to provide 10 percent of construction costs and to enter into an agreement with the NIA to amortize the total cost of construction over a 50-year period. The initial payment could be contributed in the form of money, labor, rights of way or materials.

In order to assist the communal systems develop means for repaying long-term costs and to ensure that O and M requirements would be met by the local communities, the NIA helped to establish Irrigator Associations (IAs). A distinctive feature of the NIA's program was to employ a participatory approach which started with a Ford Foundation assisted pilot project in 1976. The idea was to involve farmers in the organizational process from the very start at the preconstruction

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[19]Cruz and Siy, Issues in Irrigation Water Management, p. 7.

[20]NIA, The Agricultural Input Loan, p. 21.



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phase. This would give them a sense of ownership and involvement and would facilitate their understanding of and capacity to assume responsibility for the system after construction was completed. Community Organizers were employed to do the organizational work with farmers helping them build financial and water management capability and to train leaders. The institutional development process is designed for implementation over a period of several years (generally about six) ending with the complete takeover of the system by the IA.

The shift in emphasis on institutional development of the CIS required a substantial reorientation of policy and attitude within NIA. Originally, the organization was charged with expanding an irrigated area and had therefore focused primarily on design and construction. By the mid-1970s, it was required to develop functioning irrigation systems rather than simply to construct them. This meant it had to take account of both physical structures and the social forces that affected organizational arrangements. It required implementing a change of attitude among its personnel, particularly the Provincial and Project Engineers, in order to make them more sensitive to the role of farmers and community organizers in achieving the new institutional objectives.[21]

The system is then managed by a set of officers composed usually of the President, Vice President, Secretary and Treasurer elected by the [illegible] members for a period of two or three years. Canal cleaning and maintenance and repair are done by hired workers or by members of the IA who contribute labor in lieu of fees payment. By 1985, there were 150 participatory communal projects in various stages of development. Some of the IAs have been successful enough to raise the required 10 percent of construction costs especially when these have been below ₱ 3,000/ha. As a trial program, NIA offered complete exemption from amortization payments to associations that could raise labor and material contributions equivalent to 30 percent of construction costs. Several associations around the country succeeded in achieving the 30 percent target while some others came close to doing so.

According to the NIA officials, the quality of O and M is better and there are fewer conflicts over water distribution on systems with active IAs.[22] Conversations with other observers did not indicate that this was uniformly so. Perhaps some of the success on the CIS systems stems from the fact that they are smaller and lower cost systems and

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[21]This process of instituting the attitudinal change is described at length in E.C. de Jesus. "Bureaucratic Reorientation at the National Irrigation Administration: A Philippine Case Study" (Manila: Asian Institute of Management, September 1982).

[22]Cruz and Siy, Issues in Irrigation Water Management, p. 18.



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therefore more manageable.[23] However, the NIA's policy is to employ the institutional development techniques used on the CIS to speed up the process of developing IAs on the NIS.

(2) The cost of O and M

Table 4-7 shows average expenditures per hectare on O and M for sample irrigation systems.[24] The average cost per hectare is ₱ 176 although it is much lower on the CIS at ₱ 67/ha than on the NIS. Further, the pump systems are almost three times as expensive to operate because of high energy costs than are the gravity systems. In the case of the NIS personnel costs are the major expense while this is not the case on the sample CIS. The NIA's future development plans are designed to reduce personnel costs by getting FIGs and FIAs to assume full responsibility for O and M at the tertiary level so that the position of ditchtender can be eliminated as farmers do this work themselves.

c. Cost recovery

(1) Policy

In the Philippines, current national policy with regard to irrigation fees is set forth in Resolution No. 20, Series of 1978, of the National Economic and Development Authority (NEDA). Under this resolution, the government assumes responsibility for paying the interest on funds invested in the NIA irrigation projects. The NIA is supposed to impose charges on farmer beneficiaries that are sufficient to cover 100 percent of the costs of O and M, plus repayment of total outlay on construction within 50 years without interest. However, some specific constraints are placed on the magnitude of irrigation fees:

- Fees should be within the farmers' capacity to pay;
- Fees should not impair the incentive to use irrigation water; and
- Fees should not be charged to repay the costs of power, reforestation, roads, and flood control in multipurpose projects.

Obviously, there is a degree of conflict between imposing fees that are high enough to cover all costs except interest on loans yet low enough to be within farmers' capacity to pay.

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[23]Conversation with Jerry Sison.

[24]L. Cabanilla, "Study of O and M Problems in Irrigation," p. 31.



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Table 4-7: O and M Expenses by Type of System, 1983
(₱/ha)

| | Personnel | Power Cost | Other | Total |
|---|---|---|---|---|
| Type of System | | | | |
| National | | | | |
| Gravity | 138 | 0 | 12 | 150 |
| Pump | 157 | 246 | 39 | 442 |
| Gravity and Pump | 207 | 58 | 29 | 294 |
| Communal | | | | |
| Gravity | 23 | 0 | 44 | 67 |
| All | 115 | 33 | 28 | 176 |

Source: L. Cabanilla, Study of Operation and Maintenance Problems in Irrigation: The Philippine Case (Manilla: USAID, November 1984).



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(2) Level of charges

From 1946 to 1966, the irrigation fee rate was fixed at ₱ 12 per ha per year regardless of season, crop and type of system. Starting in 1966 until June 30, 1975, this was increased to ₱ 25/ha during the wet season and ₱ 35/ha during the dry season for rice. For crops other than rice the rate was ₱ 20 per ha. The NIA Board of Directors approved a major change in fees that took effect on July 1, 1975. Instead of fees being expressed in pesos, they are now in cavans (50 kg) of palay (paddy) per ha. In general, on gravity irrigation systems, the fee is now two cavans/ha in the wet season and three cavans/ha in the dry season. These rates represent approximately 2-3 percent of production. Exceptions to these rates are in the Upper Pampanga River Improvement System (UPRIIS) where the rates are 2.5 cavans in the wet season and 3.5 cavans in the dry season. Higher rates are also charged in Northern Luzon and Mindoro. These amount to 3.5 cavans and 4.5 cavans for the wet and dry seasons respectively.[25] Lower rates prevail on the smaller communal irrigation systems where the rates are set by the farmers themselves. On the average, the charge is one cavan/ha per season which is used to pay for amortization of construction or rehabilitation costs.[26]

The water rates levied on pump systems vary both from the gravity systems and between systems in different regions. Thus, in Ilocos Norte, the wet season rate is eight cavans/ha and in the dry season 12 cavans/ha. The Libmanan-Cabusao Pump Irrigation System has a fixed rate of six cavans/ha for both seasons. The rates are different as well for irrigation systems serving non-rice regions.[27] For crops such as sugarcane, banana and other annual crops, the charge is five cavans/ha per year in gravity systems and eight cavans in pump systems. Payment is required in cash equivalent based on the support price.

A noteworthy feature of the irrigation fee system is that it is expressed in kind so that there is an automatic indexation. Thus, the cash equivalent of the fee increases with the support price for palay. However, due to rice pricing policies that favor the urban consumer, indexation does not function properly. In fact, the irrigation fee has been declining in real terms. (See Table 4-8). Further, as the rates are fixed, if the terms of trade in agriculture deteriorate, the share received by irrigation declines simultaneously.

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[25]Cruz and Siy, Issues in Irrigation Water Management, p. 11.

[26]Cabanilla, "Study of O and M Problems in Irrigation," p. 33.

[27]Irrigated area in non-rice crops represents a very small proportion of total irrigation hectarage. Of the total area of 513,926 ha served by the NIS in 1982, only 20,557 ha were planted in other crops.



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Table 4-8: Nominal and Real Fee Rates by Season on Gravity Irrigation System (₱/ha)

| Year | Nominal Wet | Nominal Dry | Real Wet | Real Dry |
|---|---|---|---|---|
| 1946-66 | 12.00 | 12.00 | - | - |
| 1966-75 | 25.00 | 35.00 | - | - |
| 1975 | 100.00[a] | 150.00 | 130.00[b] | 196.00 |
| 1976 | 110.00 | 165.00 | 132.00 | 199.00 |
| 1977 | 110.00 | 165.00 | 120.00 | 179.00 |
| 1978 | 110.00 | 165.00 | 110.00 | 165.00 |
| 1979 | 130.00 | 195.00 | 107.00 | 161.00 |
| 1980 | 140.00 | 210.00 | 92.00 | 138.00 |
| 1981 | 151.00 | 226.50 | 88.00 | 132.00 |
| 1982 | 165.00 | 247.50 | 85.00 | 128.00 |
| 1983 | 178.00 | 267.00 | 82.00 | 123.00 |
| 1984 | 223.00 | 334.50 | 80.00 | 120.00 |

[a]Cash equivalents for the rates set as Cavans (50 kg/ha).
[b]Nominal values deflated by Price Index on Services (1978=100).

Source: L. Cabanilla, Study of Operation and Maintenance Problems in Irrigation: The Philippine Case (Manila: USAID, November 1984).



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Farmers are permitted to pay irrigation fees either in kind (palay) or the equivalent in cash. Collection in kind, however, is not implemented very seriously by the NIA because the agency's lack of post harvest storage facilities results in large losses.

(3) Fee collection rates

Rates of fee collection for the NIS are highly variable ranging from as low as 30-35 percent up to 80 percent, with a system-wide average of about 56-57 percent.[28] This is evident from Table 4-9 which compares collections on two systems in the NIS.[29] The NIA's fee collection record improved between 1969 and 1974 from 50 percent of total collectibles to 66 percent.[30] However, there was a sharp decline from 1975 to 1976 when new rates were introduced and fees doubled ₱ 60 per double cropped ha. Collection declined to 31 percent. By 1981, it had again increased to 53 percent.

Prior to 1983, average collection rates on the NIS were about 56 percent with some areas achieving rates as high as 80 percent and others as low as 3-35 percent. The leading example of effective fee collection is the Bicol region where collections used to average 50 percent. After rehabilitation of the system in 1983, collections shot up to 100 percent. This is the best paying NIA system whose success can be attributed to improved management. Although there is not much farmer participation on the system, the rapport between officials and farmers is good and the system is reliable.[31]

Collection rates on communal systems are substantially lower than on national systems for a variety of reasons. But, as de los Reyes points out, a closer examination of the issue is necessary to properly determine actual fee payment levels. Even though farmers may not post official charges, they often pay a variety of non-official charges including gifts to water tenders, right-of-way payments to other farmers and contribution of labor for system maintenance.[32] Thus, some farmers who do not pay official irrigation fees or only make partial

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[28]Conversation with Ben Bagadion and Cabanilla, "Study of O and M Problems in Irrigation," p. 34.

[29]It should be noted that UPRIIS is reported to have a lower average rate of collections than the NIS as a whole. (Conversation with Ben Bagadion.)

[30]Cruz and Siy, Issues in Irrigation Water Management, p. 12.

[31]Interview with Jerry Sison.

[32]R.P. de los Reyes, "Stereotypes and Facts in Irrigation Management: Preliminary Findings from a Case Study of a Philippine Communal Gravity System," in Irrigation Policy and Management in Southeast Asia (Los Banos: IRRI, 1978), pp. 194-198.

Table 4-9: Fee Recovery Rates on National Irrigation Systems
(Amount collected as percent of fees due)

| Year | Upper Pampanga River Project (78,400 ha) | Cotabato Irrigation Project (8,900 ha) |
|---|---|---|
| 1974 | NA[a] | 71 |
| 1975 | NA | 30 |
| 1976 | 23 | 8 |
| 1977 | 34 | NA |
| 1978 | 28 | NA |
| 1979 | 29[b] | NA |

[a]NA = Not Available.
[b]Represents collection for dry season crop only.

Source: The World Bank, The Philippines: Irrigation Program Review (Washington, DC: The World Bank, 1982).

payments actually pay a substantial amount. Thus, de los Reyes estimated that 172 of 424 sample farmers in Camarines Sur by contributing their labor paid an imputed value of about ₱ 300 in addition to the average irrigation fee of ₱ 158. By the same means, those who worked but did not pay the fee were still contributing ₱ 145 above what they owed the association for water.

In principle, sanctions exist for non-payment of fees. Farmers can be penalized by such means as cutting off the water supply or charging interest on overdue accounts, but the measures are difficult to apply. For example, water control facilities do not allow water to be cut off from only delinquent farmers. Further, it is difficult for political reasons to curtail water supply. An interesting finding by Cabanilla is that higher delinquency rates exist among the larger, richer, more powerful farmers.[33]

More effective methods of improving collection efficiencies are informal means of pressure such as exist between farmers when they are organized into user associations. One example is of the Angat Maasim River Irrigation System where collection performance increased 15 percent after the formation of user associations.[34] Higher collection rates are also found on smaller systems where the rapport between irrigation officials and farmers is best. Good collection has also been associated with newer or newly rehabilitated systems that function more efficiently and where farmers get a fair and reliable share of water supply. This was found to be the case, for example, in the Bicol region where collection rates increased from 50 to 100 percent following system rehabilitation in 1983.[35]

(4) Adequacy of charges and future planning

The fee structure of the NIA was devised with the objective of meeting all O and M costs plus construction costs over a 50-year period without interest. Table 4-10 shows that the NIA's fee collections did not cover O and M expenses for the years from 1979-83. In 1980, available funds for O and M on the NIS were ₱ 152/ha while the estimated cost was ₱ 164/ha. As discussed above, fee collection is a major problem on most systems. The rate of fee collection in 1982 was 60 percent resulting in a deficit of ₱ 42/ha for O and M costs. Based on the NIA's estimates, collections must be 80-85 percent for full recovery of O and M costs.

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[33]Cabanilla, "Study of O and M Problems in Irrigation," p. 40.

[34]Ibid., p. 13, and conversation with Ben Bagadion.

[35]Conversation with Jerry Sison.

Table 4-10: The NIA's Total Irrigation Fee Collection and O and M Fund Releases, 1979-83
(M of Pesos)

| Year | Total Collections | Fund Releases |
|---|---|---|
| 1979 | 45.35 | 66.15 |
| 1980 | 59.24 | 85.75 |
| 1981 | 52.74 | 103.45 |
| 1982 | 57.49 | 108.14 |
| 1983 | 72.72 | 100.99 |

Source: NIA Corporate Planning Staff, The Agricultural Input Loan: Irrigation Study, (Manila: NIA, November 1984).

The increasing financial difficulties in the government have caused it to require the NIA to assume responsibility for debt servicing including repayment of principal in addition to recovery of all O and M costs. The Corporate Planning Staff of the NIA in 1984 investigated the feasibility of assuming these financial burdens. It determined that in order to recover all irrigation loans at actual interest rates within the recovery period plus O and M costs, irrigation fee rates would have to be revised up to nine to ten cavans/ha of rice and 10-12 cavans/ha in the wet and dry seasons respectively for gravity systems.[36] Rates on pump systems would have to be proportionately higher because of high energy costs. This amounts to about 6 percent of production. Since the principal on foreign loans is due starting 1988, capital cost recovery from irrigation fees alone will not be feasible, although it may be possible to achieve full recovery of O and M costs.

## C. Irrigation Projects

### 1. Upper Pampanga River Integrated Irrigation System (UPRIIS)

#### a. Background

##### (1) Description

The project is located in the Upper Pampanga Basin in Central Luzon, 150-300 km north of Manila. It is part of one of the five large river basins in the country. Some new facilities were constructed and rehabilitation was done in this river basin, referred to as the country's "rice granary", by NIA soon after its formation in 1964. In 1969, this was followed by implementation of a major irrigation project termed the Upper Pampanga River Project (UPRP) financed by a World Bank loan for US$ 34 M. One of the project objectives was to increase paddy production from 130,000 to 570,000 tons annually. Another was to increase cropping intensity from 143 percent to 198 percent.

The project entailed construction of the earth fill Pantabangan Dam across the Pampanga River to provide reservoir storage of 3,000 M $m^3$ and six existing diversion dams on the Talavera and Pampanga Rivers. Some local creeks were rehabilitated and modified to make better use of natural inflows and to accommodate additional supplies from the Pantabangan Reservoir which was finished in 1974. A 100-MW hydroelectric plant was installed at the toe of Pantebangan Dam with a re-regulation dam some five km downstream. A low-head power plant of 12 MW capacity was installed at the re-regulation dam. Facilities for close control of water delivery were instituted to serve 32,400 ha of rice fields for the first time, and 46,000 ha of existing systems were brought up to standard. Irrigation service began in 1974.

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[36]The NIA Corporate Planning Staff, The Agricultural Input Loan.

In a normal year, the project is designed to provide a dependable water supply to 77,000 ha during the wet season and 72,000 ha during the dry season. The system was designed for the rotational method of irrigation.[37] The UPRIIS service area now also includes the Aurara-Penaranda Project supported by the World Bank and completed in 1978 which expanded Zone IV of UPRIIS and has an area of about 26,000 ha. Most of the analysis herein includes only the UPRP.[38]

According to the Project Operations Manager (OM), the water supply will serve 90 percent of the area in a good year. During the 1984 drought, only 34 percent was served. Current-year water supplies will serve 65,000 ha.[39] Ng and Lethem report that shortages were expected to occur about every ten years, but at the time of their report (1980), none had occurred.[40] The area is in the path of tropical storms. There is at least one major storm each year. Rainfall is about 1800 mm annually concentrated in the wet season. Soils are generally suited for rice, but also for growing other crops. The rice production target for the region is 800,000 t/year.

There is inadequate reservoir storage to insure supplies for all of the area (about two-thirds of dry season and one-half during wet season) all of the time so that some of the area is served by less reliable run-of-the-river supplies. The system is gravity-fed with the canal network supplying outlets serving rotational areas of about 50 ha. Distribution within these blocks is up to the farmers. Some delivery is field-to-field.

The hydroelectric facilities produce 70 MW of firm power supplied to the National Power Council's Luzon grid. This is possible, as we understand it, without interfering with irrigation because of the re-regulation dam. The Operations Manager did not expect that irrigation flows might be preempted for hydropower in the future, but

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[37]UPRIIS, Operation and Maintenance Manual (Cabanatuan City: UPRIIS, 1985), pp. 1-3.

[38]Ng, Ronald and Frances Lethem, Monitoring Systems and Irrigation Management: An Experience in the Philippines (Washington, DC: The World Bank, September 1982), pp. 10-11.

[39]Conversations with UPRIIS Operations Manager at Cabanatuan, April 3, 1984.

[40]Ng and Lethem, Monitoring Systems, p. 11.

did not rule out this possibility. Other project benefits include flood control because of reservoir storage, fish conservation and recreation.[41]

There are some privately-owned shallow dug wells in the area which are pumped during periods of drought. There were some tube wells at one time, but we were told that these had been abandoned because of the high cost of pumping water compared to surface supplies.

(2) Agriculture in the project area

The UPRP system covers most of Nueva Ecija Province and parts of Balacan and Pampanga provinces. It includes 24 municipalities. About 26,000 farm families are served. Most land holdings are in the one to five ha range with an average size of 2.15 ha.[42] Ng and Lethem report an average of 1.6 ha elsewhere in their report.[43] UPRIIS reports a service area of 99,362 ha and 54,194 farmer irrigators, an average of 1.83 ha in the greater UPRIIS area.[44] Ng and Lethem report that under land reform laws, sharecropping has virtually disappeared from the area.[45] Later in the report Ng and Lethem report about 50 percent leaseholdings.[46] These differences may reflect the status at various times during the land reform activities as well as the problems of registering land title changes.

By 1979/80, dry season rice yields exceeded 5.0 t/ha of paddy on 24 percent of the planted area, although more than half of the area was still producing yields below the average. Some 16 percent of the land area is judged suitable for cultivation of crops other than rice, such as maize, vegetables and beans. However, diversification to other crops has been slow. All farmers in the project area are planting per ha to 76 kg/ha high-yield varieties. Fertilizer use rose from 55 kg nitrogen/ha to 76 kg/ha during the three years prior to 1979/80.[47]

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[41]UPRIIS, Operation and Maintenance Manual, pp. 5-6. Personal interview with Operations Manager, April 3, 1985.

[42]Ng and Lethem, Monitoring Systems, p. 21.

[43]Ibid, p. 66.

[44]UPRIIS, Organization and Development of Farmer - Irrigators Association (Zone Team Approach) Completion Report, (Cabanatuan City UPRIIS NIA, January, 1985), p. 2.

[45]Ng and Lethem, Monitoring Systems, p. 21.

[46]Ibid, p. 67.

[47]Ibid., p. 66.

In a general way, the agricultural status described in the literature was verified by our conversations with the Operations Manager and by the local leader of Poblacion Sur (Cabanatuan City), who is also a farmer. Poblacion Sur, an enclave of about 2,000 people is located in the central part of the project service area. We visited this official at his residence. Perhaps a dozen people were present and most participated, peripherally at least, in the discussion. Among them were two or three UPRIIS employees and presumably some other farmers and villagers. This official reported that holdings average about three ha in this area. Two crops of rice are grown with fertilizer and, given current high reliability of water supplies, very good yields, five to seven t/ha, are received. With development of a water users' association in his turnout area (50 ha), water service has substantially improved according to this leader. We do not conclude from this conversation that water service was not good before or that the principal reason for satisfactory water source was formation of the IA. The interviewee was an obvious enthusiast. The documentation on project success indicates that service must have been quite good over the project's history.

Production goals targeted for 1983 were largely being achieved by 1979/80. The 1979 wet season average yield of 3.5 t/ha was more than 90 percent of the level projected at full development and the 1970/80 dry season yield of four t/ha approaches the full development projected yield. These yields projected over the project area approximate the full development target of 570,000 T. Though shifting from single to double cropping started slowly, cropping intensity was close to appraisal targets by 1979/80. Full development took only eight years, instead of the 13 years projected at appraisal. A 1980 World Bank audit indicated an increase in the rate of return to 14 percent from the earlier projected 13 percent.[48]

The average farmer (1980) received a gross return of US$ 531/ha for his wet season, and US$ 668/ha for his dry season crop. Net farm income deducting imputed value of farm labor is over US$ 550/ha annually. Farm income is highest for owner operated farms in the 2-3 ha size range, approaching US$ 726/ha (1979/80). For leaseholders in the same size range, it is US$ 527 and for all farmers together in this size range income is US$ 627. The average farmer, with a farm size of 1.6 ha, received an annual net income of about US$ 900 from irrigated agriculture according to Ng and Lethem.[49]

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[48]Ng and Lethem, Monitoring Systems, p. 64.

[49]Ibid, p. 67. These are in current (1979/80) dollars. US exchange rate is not cited. Working back using the above yields gives prices of US$ 152/t for wet season and US$ 167/t for dry season.

(3) Functioning of irrigation in project area

The level of irrigation service is discussed generally in the preceding section. Agricultural management during 1975-82 was based on a massive monitoring and feedback system involving some 278 indicators ranging through input use and availability, cultural practices, soil and crop status and water supply. Twenty-five of these were concerned with water and irrigation, and include management, physical and agronomic items. Ng and Lethem published annual summary information on these indicators for wet seasons (1976-80) and for dry seasons (1977-78 to 1979-80).[50] These results are discussed below.

During the wet season adoption of recommended cropping schedules increased from 80 percent in 1976 to 95 percent in 1980. Adequacy and timeliness of water supply was reported at various critical times (planning, tillering, tillering to vegetative stage). In 1980, these indicators were either 95 or 96 percent of being adequate or timely, up from those for 1976 where they were 94 percent adequate at planting, but ranged from 78 to 84 percent for the other three indicators. Adequacy of facilities maintenance and canal cleaning and maintenance was judged at 83 percent in 1976. This indicator steadily increased to 98 percent in 1980. For the dry season, all water and irrigation indicators were in the 90-98 percent range during the three-year period and tended to improve during the course of the period.[51] Based on these reports and our discussions, we conclude that the functioning of the irrigation and water supply system and maintenance has been good.[52]

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[50]Ibid., Annex A.

[51]However, since this was written, Mark Svendsen has pointed out that the reports of good performance from the monitoring study should be treated with caution as all data were derived from survey questionnaires seldom checked for consistency with actual system performance.

[52]Observations commonly utilized by evaluators appraising the effectiveness of irrigation systems include physical inspection, and examination of various agricultural production factors and water balance studies such as cropping intensity and its variations, comparing field demand hydrographs with water releases, etc. Often the latter software indicators yield the best insights. For a discussion of diagnostic analysis or rapid appraisal of the effectiveness of irrigation systems see Robert Chambers. "Diagnostic Methodologies for Improving Land Irrigation Systems". Discussion Paper No. 8. Ford Foundation, New Dehli, 1983.

The Monitoring System developed some linear regression models designed to relate agricultural success to various indicators, but no information was found on the relative weighting which could be attributed to water and irrigation factors in contrast to other inputs and services in the agricultural production sector.

The OM indicated that his biggest problem was water charge collections. This is aggravated because of periodic calamities from typhoons. While there are some exemptions of water charges for such catastrophies, these disasters nevertheless aggravate the farmer's inability or unwillingness to pay. The OM's second critical problem is management during drought years. There is some opportunity to carry over reservoir storage, though how this would be managed in anticipation of future droughts was not discussed. There are some shortcomings in being able to check water surface elevations in canals to deliver water properly to outlets during the dry season. Silting occurs at a steady rate and continues, but the Manager did not name it as one of his major problems. Maintenance of farm-market roads is a problem, but some assistance may be given by the Public Works Department as the result of UPRIIS management working through the provincial Governor.

b. Project management

(1) Bureaucratic level

(a) Interagency linkages

Realizing that full cooperation of agencies outside of the NIA administrative control and of concerned private entities would be necessary to fulfill the objectives of increasing production from 130,000 to 570,000 T of paddy annually, the NIA established the Agricultural Development Coordinating Council (ADCC).[53] This Council was in place during 1975-82. In 1982, the Provincial Agricultural Council (PAC) was created by Executive Order and replaced the ADCC.[54]

- Agricultural Development Coordinating Council: The ADCC was composed of the provincial heads of the various agricultural line agencies with a member from the credit sector and a farmer member. The UPRP Project Manager and later the UPRIIS Operations Manager chaired the Council with the Governor of Nueva Ecija Province, serving as Honorary Chairman. In order to provide ADCC with reliable information to perform its function, NIA also set up an Input-Output Monitoring Program (IOMP). The IOMP was designed to provide information on the availability and use of inputs such as seeds, fertilizer and

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[53] Ng and Lethem, Monitoring Systems, p. 23.

[54] UPRIIS, Operation and Maintenance Manual, p. 67.

pesticides and monitored results achieved. It had a staff of 42 persons and collected information on 278 indicators using sample survey techniques. Though under NIA, the IOMP operated independently from the UPRIIS Operations Manager reporting through the Irrigation Assistance Department in NIA headquarters to the Assistant Administrator for Operations. In practice, as noted above, the monitoring and evaluation program was not particularly effective.

In 1975, the ADCC prepared a five-year development plan which targeted levels of input to be achieved during the 1976-80 period. Situation reports were developed fortnightly and selected information was made available to concerned agency officials including the UPRIIS operations staff as appropriate so that timely action could be taken without waiting for the regular meeting. Summary information was also prepared for the monthly meetings of the ADCC. The reports were also reviewed and discussed at the Provincial Development Council (PDC) of Nueva Ecija chaired by the Governor and at the NIA headquarters where a senior official from the National Food and Agriculture Council was also present. While much of the data was usefully presented in simple compilation form, other data received statistical analyses at some appropriate level including use of linear regression modeling.

- Provincial Agricultural Committee (PAC): Because the PAC is created by law and is directly under the office of the Provincial Governor, the UPRIIS Management believes this arrangement may be more effective than the ADCC. Collection and monitoring of data appear to have been simplified. However, it still includes monitoring of a substantial number of physical and agronomic variables.[55]

(b) Project operations

The UPRIIS integrates the operation of five different irrigation systems. The organization is headed by an OM headquartered in Cabanatuan City who reports directly to the NIA Assistant Administrator for Operations. The OM is supported by staff divisions with responsibility for Engineering and Operations, Administration, Equipment, Dam and Reservoir and Institutional Development, and a Water Control Coordinating Center which formulates plans and programs water releases based on information processed through the line divisions.

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[55]UPRIIS, Operation and Maintenance Manual, Chapter III, pp. 23-49.

The service area is divided into four districts each headed by a District Manager. Districts are responsible for implementing the UPRIIS program within the district area. Administratively, district officers are divided into three sections with responsibility for:

- Repair and Maintenance;
- Operations; and
- Administration.

The Operations Section is supported by a staff hydrologist. The district is divided into zones of about 8,000 ha each under a zone engineer and further into water management divisions of about 750 ha each headed by an assistant water management technologist or a watermaster supported by ditch tenders. The basic rotational unit, served by one outlet has an area of about 50 ha. Zone engineers are graduates in civil or agricultural engineering with five years or more experience. Assistant water management technologists are college graduates usually in agriculture. Watermasters, gatekeepers and ditch tenders are high school graduates with experience and/or specialized training.[56]

The OM presides over a complex range of responsibilities and tasks. These include safely operating the dams, reservoirs and canals and keeping them maintained; planning, scheduling and delivering water to outlets efficiently in optimal quantities at the proper times; and, in the case of UPRIIS, integrating and coordinating agricultural inputs and supporting services other than irrigation for increasing production. The UPRIIS has developed a fairly comprehensive system of long- and short-term planning and scheduling utilizing the information described in the previous section, but the team was unable to determine the extent of its effectiveness in actual practice.

(c) Institutional Development Division

This Division is headed at the UPRIIS level by a separate officer who is attached to the Office of the OM, but who also reports to the Director of the Institutional Development Department under the Assistant Administrator for Operations at the NIA headquarters in Manila. At first, organization of irrigation farmers was undertaken exclusively by the Farm Systems Development Corporation (FSDC), an entity of the Ministry of Human Settlements. About seven years ago, NIA initiated its own program for institutional development,

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[56]UPRIIS, Operation and Maintenance Manual, pp. 9-22 and discussions with Operations Manager, April 3, 1985.



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working on NIA projects and on traditional community ones.[57] For UPRIIS, the Institutional Development Division Chief has wide discretion in how he approaches his task of developing water user associations that will assume much of the responsibility for collection of water charges and for operating and maintaining tertiary portions of the system.[58] - [59] This is in response to a very strong national policy designed to increase NIA revenues and to relieve formerly subsidized O and M costs to NIA.

The FIGs or water user associations are first formed at the water service unit or outlet (50 ha) level and then organized into the larger federations of FIAs at the division level as described in Section B.2.b. There is one overall farmer organization for the UPRIIS.

Organizationally, each of the four districts in the project area is divided into three units, each headed by an Institutional Development Officer who works through the divisional level water management technician (WMT) or watermaster (WM). WMTs and WMs are provided with substantial resource materials in the form of field training and audio-visual aids.

(2) Farm level management

The farmers in any rotation unit served by an outlet (about 50 ha) are responsible for distribution of water and maintenance of facilities within the unit. They are supported in this activity through extension, but the effectiveness of this support could not be evaluated.

For his production responsibilities, the farmer gets support from a number of agencies. This support is planned and monitored through the ADCC or, since 1982, the PAC, as described. Farmer organizations are expected to participate in both long- and short-term scheduling activities.[60]

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[57]See Korten, Francis F., Building National Capacity to Develop Water User Associations--Experience from the Philippines, World Bank Staff Working Paper No. 528, (Washington, DC: The World Bank, July, 1982), for description and analysis of community-based systems.

[58]Interview with Chief of Institutional Development Division, UPRIIS, April 3, 1985. This officer has a bachelor's degree in agricultural engineering and a PhD in agricultural and irrigation engineering from a US university.

[59]UPRIIS, Organization and Development.

[60]UPRIIS, Operation and Maintenance Manual, p. 27.

In addition to water charges, the Government levies a land tax equivalent to 1 percent of assessed valuation. The average tax amount is about ₱ 60 per ha.[63]

(b) Collection mechanisms

Bills prepared by field personnel (usually WMT/WMs) are delivered to farmers by bill collectors or other field personnel. Bills may be paid either in cash or in kind. Cash receipts or receipts from sales are deposited in the nearest Philippine National Bank branch.[64] A 10 percent discount is given for early payment, but a 1 percent per month interest charge is levied on bills two months or more in arrears. Consideration has been given to linking payment of water charges to eligibility for Land Bank loans but this does not seem practical administratively even if it were a good idea.[65] UPRIIS, as does the NIA, regards Farmer Irrigation Associations as the most promising approach to improving collections.

One step taken by UPRIIS to improve collections is through the collection campaign. All staff members are expected to participate in generating enthusiasm during collection campaign meetings. National studies have shown that good rapport and constant dialogues between NIA staff members and farmer clients is helpful. Steps taken by UPRIIS, as in other national systems, include:

- Deputization of collectors from personnel ranks other than the regular ones;
- Participation in the collection thrust of irrigators associations;
- Creation of a Special Collection Committee to cater to special clients; and
- Sending of demand letters to delinquent water users.

UPRIIS-NIA says it has "accorded defaulting collectors with disciplinary action to maintain the trust of the payers while top collectors are given accolade, their efforts noted for future reference."[66]

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[63]Ng and Lethem, Monitoring System, p. 72.

[64]L.S. Cabanilla, Study of Operation and Maintenance, p. 48.

[65]Ng and Lethem, Monitoring Systems, p. 72.

[66]UPRIIS, Operation and Maintenance Manual, pp. 46-47.

(c) Rates of recovery

The UPRIIS Operations Manager stated that collection rates are low. He did not volunteer a value. No documentation was provided although the OM had intended to do so. The only other information on collection rates is that collected by the IOMP in situation reports one month after each seasonal harvest. In 1979, for the wet season, full payment had been made of 27 percent of water charges and partial payment of 9 percent with 55 percent intending to pay. For the dry season, full payment had been made for 34 percent, partial payment for 16 percent with 50 percent intending to pay. Collection rates were reported to have improved to over 60 percent in 1980 as a result of a concerted mobilization effort by NIA personnel, accompanied by a public relations campaign. We are indebted to Mark Svendsen for this information. In spite of intentions, collections fall far short of the 85 percent needed to fully finance O and M.[67]

(2) Application of charges

Water charge collections are pooled at NIA headquarters, supplemented using revenues from other sources, and rebudgeted for O and M to national projects. While the Operations Manager listed water charge collections as his most difficult and pressing problem, a reasonably acceptable level of operating and maintaining the system is being achieved.

d. Farmer participation and perception: Farmer organizations for water management

The activities of UPRIIS' Institutional Development Division were briefly described in Section C.1.(c), B.1.c. A total of 281 FIAs are planned. These FIA's would serve a membership of 54,194 farmers occupying 99,362 ha within the 127 divisions contained in the project area. The average FIA would serve 354 ha and 193 farmer-irrigators, with slightly more than two FIAs per Water Management Division.

In order to encourage the development of farmer organizations, the NIA has the following incentive schemes:

- Collection Incentive: When an FIA achieves 70 percent collections it is allowed to retain 2.5 percent of the collection as a bonus. This increases to 3 percent of the collection if 100 percent of the fees are collected; and

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[67]Ng and Lethem, Monitoring Systems, p. 72, Discussions with Operations Manager, April 3, 1985.



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- Maintenance Contract: The FIA may contract to maintain a portion of a canal ordinarily handled by a ditchtender. This formal contract cites legislative authority, specifies NIA and FIA obligations and compensation to be paid. Contracts are renewable annually. On the draft sample we were shown, the length of canal to be maintained was 4.10 km.[68] A length of 3.5 km was mentioned both by UPRIIS and by NIA headquarters officials as about the length which one ditchtender can handle.

As of the end of calendar year 1984, 94 FIAs had been organized, 39 were registered with the Securities and Exchange Commission and 31 had entered into a contract with NIA to collect irrigation fees. Five of the latter had attained collection incentives and maintenance of canal sections had been turned over to farmers in six instances.[69] In the latter case, the ditch tender's position was terminated as farmers made maintenance contracts.

Institutional development achievements were reviewed and plans discussed at workshops held in each zone during September-October, 1984. Based on these discussions the following targets were set for 1985: A total of 130 FIAs organized (57 additional) with 117 registered, 105 with contracts to collect water charges and maintenance contracts negotiated with 12.[70]

Aside from the sketchy information given above and the enthusiastic endorsement of the local leader at Poblacion Sur, we have little information on how effective the FIAs are or can be expected to be in the UPRIIS area.

All of the people we talked to are members of a bureaucracy which has been asked to put itself out of business (at least in part) and many will lose their jobs. Yet they are proceeding with the task of farmer organization with a will and with confidence. This optimism is certainly exemplified by the attitude of the NIA Assistant Administrator for Operations who expressed great confidence that the efforts will fully succeed. We did not, however, talk to many people at levels whose jobs were at risk, except two or three who joined us at the local leader's house at Poblacion Sur. They seemed to agree that there had been improvements under the user associations and engaged in light-hearted banter about their impending early retirement.

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[68] Ibid.

[69] UFPRIIS, Organization and Development.

[70] Ibid., p. 2, 10.

2. Laur (Pinagburyuhan) Project

a. Background

(1) Description

Laur Municipality is located in Nueva Ecija Province in a small valley some 20 km northeast of Cabanatuan City and 100 km northerly from Manila. There are two irrigation systems in the valley. The Pinagburyuhan System (PIS) irrigates about 900 ha contiguous to the town. The Bagting-Siclong System serves about 300 ha located in three barrios about 7 km from Laur. No information was found about the origins of the Pinagbuyruhan system but an irrigator's association existed as early as 1920. The Bagting-Siclong System was built about 1932 when seven farmers organized the Bagting-Siclong Irrigators Association (BSIA).[71]

The diversion structure is a brush dam serving two concrete headgates and main and lateral canals. About 1980, the Pinagburyuhan Irrigators Association (PIA) entered into an agreement with the NIA for a rehabilitation project. This included construction of a permanent dam which would also serve the BSIA area and reconstruction and remodeling of the canals to serve approximately 2,000 ha. Construction of the canals and of the dam went ahead concurrently. The canals were completed, but the pile foundations for the dam were washed out by a typhoon flood and the dam has not been finished.[72]

The PIA manager gave the impression that the reason for not completing the dam is financial including the question of the irrigator's ability to repay the ₱ 5,000,000 - ₱ 10,000,000 M ($300,000 - $600,000) that the dam might cost. Subsequent conversations with the Officer in Charge of the Communal Projects Implementation Department in NIA headquarters revealed, however, that the problem was a technical one regarding the safe design of the dam. This issue was on the agenda for decision by the NIA within the week. The NIA's intentions are to complete the system. The cost estimate will be included in the pending decision but could be larger than the ₱ 5-10 M mentioned above. Meanwhile, irrigation continues on about 900 ha using a temporary rock and brush dam. According to the PIA Manager, this dam is washed out at least once annually, sometimes three times, and costs about ₱ 35,000 to replace each time it is destroyed.

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[71]Unson, Delia Cecelia Ochoa. Social Development and the Communal Irrigation System in Laur, Nueva Ecija: Baseline and Selected Interim Monitoring Results. Final Report," (Atenea de Manila University, Quezon City, Institute of Philippine Culture, 1978). This is the principal documentary source for material included in this chapter.

[72]Interview with PIA Manager at Laur, March 28, 1985.



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The Laur Project was picked by the NIA in 1976 as a pilot project under its Communal Projects Implementation Program in which two irrigation associations would be developed with the objective that their members fully participate and become self reliant in managing their irrigation systems. More specifically, the objectives were to (a) involve association members in the planning, construction and rehabilitation of their irrigation systems, (b) strengthen self reliance of existing indigenous organizations, and (c) transform irrigation associations into cooperatives able to respond to other needs of their members. Strategies included use of community organizers, farmer participation in group dynamics and leadership seminars, and eventually, participation in the planning and construction of a rehabilitated and expanded project and assumption of responsibility for its continued operation and maintenance. Results were to be studied and, if successful, adopted for the development of communal associations throughout the country. NIA and the Ford Foundation, a co-sponsor of the effort, requested the Institute of Philippine Culture (IPC) to evaluate and determine the effectiveness of the pilot project.[73]

The NIA had an ongoing program of some 250 projects per year. Between 1976 and 1980, only 15 projects serving 275 ha using the new participatory approach were started. Projections for the end of 1983 were that 347 projects serving 52,550 ha would be constructed or under planning using the new approach. By December 31, 1982, 21 of these projects serving 3,250 ha had been completed.[74]

(2) Agriculture in the project area

The project area has a population of about 10,000 with 2,140 households. Average family size is 6.6 persons.[75] Average farm size for PIA members is about two ha. The area has a high proportion of owner tenants.[76] Unson reports 17 percent share tenants and 53 percent lessees (1976). The primary crop is rice and two crops are planted each year: March/April - June/July and July/August - November/December. PIA members planted both seasons and averaged about two ha per crop. The most important secondary crop is onions, but other secondary crops include vegetables, sugarcane, maize and peanuts. Secondary crops are grown during December-March. Farmers who

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[73]Unson, Social Development.

[74]Bagadion, B. V. and Francis F. Korten. "Developing Irrigators Organizations: A Learning Process Approach to a Participatory Irrigation Program," Draft prepared for inclusion in Putting People First, Michel Cornea, ed. to be published by the World Bank.

[75]Unson, Social Development, pp. 37-65.

[76]Interview with Association Manager.



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have water and sufficient capital plant all three crops. Most farmers who lack irrigation plant only the wet season rice crops; those with limited capital are unable to plant onions.

Yields (1976) were 2.5 t/ha (dry season) and 2.23 t/ha (wet season). According to the Association Manager, introduction of high yielding varieties during the past ten years has raised the potential by 2.5 t/ha. This official reported that he could not remember when there had been a shortage of fertilizer or pesticide. Fields are tilled by either buffalo or tractor. There are several large tractors in the area.

The median income of PIA members was ₱ 9,321 total, of which ₱ 3,800 was in cash. The PIA applicants[77] total income may be judged by comparison with 1976 Philippine rural area poverty threshold levels of ₱ 5,386 for food and ₱ 8,976 in total.

(3) Functioning of the irrigation system

Most of the efforts of the Association go into replacing the brush and rock diversion dam when it is washed out while some attention is also given to rehabilitation of channels. Because of water scarcity, rotational scheduling has been introduced, but there have been problems with adhering to it. The failure to complete the system has complicated matters for the Association, so that it is difficult to improve discipline. Generally, the distribution channels and the condition of the fields indicate a reasonable level of maintenance.

The Association Manager indicates that present yields are 2.5-4.0 t/ha, but could be raised to 5 t/ha with reliable irrigation insured by the permanent dam.

b. Project management

Present Association membership exceeds 700. This has grown from the 370 members and 65 applicants reported in 1976. There are 11 directors, one from each of the districts served. They elect the President and Vice President and select the Manager. A Treasurer and Secretary are also named. The present Treasurer is paid a salary and resides at the headquarters building. Approximately 30 kapitans (group leaders) serve under the Directors. The functions of the organization are to operate and maintain the system, mobilize labor sessions to do repairs, clean channels, hold meetings of directors and members, resolve conflicts and collect annual dues. The PIA also has the responsibility to continue negotiations with the NIA

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[77]Applicants are farmers who have applied for association membership whose lands are not served by irrigation, but would be under the improved project.



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regarding completion of the project. During the planning and construction phase, the Association arranged for participation of its members in various planning and construction activities.

c. Farmer participation and perceptions

(1) Background

Under the NIA's Communal Project Implementation strategy, farmer participation begins well in advance of planning and construction. This preparatory work is designed to develop individual and organizational interest and capability so that eventual participation will be fruitful. Beginning in 1976, using pilot programs, NIA began developing a methodology for achieving systematic involvement of participants. At the same time, NIA used these programs and their subsequent implementation experience as a learning exercise for NIA institutionally and for its staff members.[78]

NIA recognized the need to understand the existing social structure including existing irrigation organizations so that these could be built upon and important indigenous social constraints would not be overlooked. Realizing the danger of building false expectations, the first step in the farmer participation methodology is to ensure technical feasibility based on a social technical profile. If a decision is made to go ahead, organizational development, training and collection of technical information follow. This eventually leads to a plan for construction and repayment. Then NIA gradually adds a cadre of institutional organizers who, with the technical people, proceed with the institutional development phase. This includes participant training and involvement in the collection of information, planning, design, procurement of rights-of-way and construction. The NIA has now developed a 28-week institutional program and flow chart leading to initiation of construction.[79] Users are also involved in various aspects of construction, providing labor and materials, assisting in monitoring and cost control, etc. After construction, the NIA attempts to negotiate an agreement to turn the completed system over to the irrigation association for continued operation, maintenance and management.

(2) Farmer organization for irrigation management

Since Laur was an early pilot program, the details of development varied somewhat from the present process. Information about the origin, structure, and membership of the PIA is given in Section (1) above. Sometime prior to the time of initiation of the program (1976), the former single PIA association had split into two,

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[78]Bagadion, Benjamin V. and Frances F. Korten, Developing Irrigators' Organizations.

[79]Ibid., Figure 2.



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one for each of the main canals. Reconciling differences and agreeing on leadership led to a rather slow start by PIA. The present problems facing PIA's leadership stem from the delay in completing construction of the dam.

(3) Functioning of farmer participation

(a) Tasks during institutional development phase

Unson suggests the following ten tasks as necessary for the institutional development process at Laur:[80]

- Group dynamics seminar - This required organizing a Committee to develop the logistics, obtain the financing and hold the seminar. The activity also required a visit to the NIA headquarters at Manila by the Committee to arrange financing;

- Drafting and ratifying or amending a set of by-laws - Attempting to draft a set of by-laws by PIA brought into focus several areas of conflict within the organization. These were primarily over the interests of the majority of ordinary farmers vs. influence of a fairly powerful ministry;

- Holding proper elections - The PIA had some difficulty in holding satisfactory elections because the membership perceived that some decisions were being made by municipal leaders, particularly the Mayor, or covertly by factions of directors. Eventually, with the Mayor's agreement, a proper election was held;

- Farmers preparation of their own plan for their irrigation system, that is, the location of the dam site, and the main and lateral canals - The Association created a Special Committee on Physical Plan. Its function was to consult farmers from all barrios to insure that their needs were met in the plan which the Association would present to the NIA;

- Participation of farmers in the surveying of their land - Farmers, including Committee and *capata* representatives assigned on a rotational basis accompanied the NIA survey team. They discussed the feasibility of their plan and assisted with getting rights-of-entry, clearing paths, and providing survey markers. Though PIA was slow to get started, causing delays, they eventually responded and provided valuable service in persuading a recalcitrant farmer to permit entry;

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[80] Unson, Social Development, Appendix A.



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- Acquisition of water rights - Formal acquisition of water rights from the river by the Association required a complex application supported by survey maps, articles of incorporation, proof of registration and a certified true list of tax declarations of real property for all members. Compiling the latter is a substantial task. It was done by volunteers and was made more difficult by the growing list of new members;

- Acquisition of right-of-way waivers - The Association had the responsibility to negotiate formal written rights-of-way waivers voluntarily relinquishing land for channels and other structures;

- Preparation for and attendance at leadership seminars - Unlike the group dynamics seminar, the leadership seminars had to be financed by the Association who also had to arrange for the meeting place and amenities. The PIA recognized its need to air its leadership problems and responded quite effectively in organizing this seminar;

- Readiness of farmers to contribute voluntary labor for the construction of their irrigation system - This, in effect, is a pledge by an association to provide a defined amount of voluntary labor. In addition, an inventory is made of skilled and semi-skilled personnel available; and

- Preparation of repayment scheme - This will be described in Section D.

(b) Evaluation of performance

Comparisons between the BSIA and the PIA show some interesting contrasts. The BSIA was able to complete all ten tasks quite efficiently and effectively, whereas the PIA had difficulty with all of them except the leadership seminar. At the conclusion of the IPC evaluation (August 1977), PIA had not completed its water rights application, obtained all of the required rights-of-way waivers, identified fully farmers' willingness to contribute voluntary labor nor developed a repayment plan. Isles and Collado report at a later date that "one of these two associations (obviously PIA) was so divided by internal political conflicts that plans for construction assistance were suspended."[81]

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[81]Isles, Carlos and Manuel L. Collado. "Farmer Participation in Communal Irrigation Development: Lessons from Laur," MS prepared for publication in Philippine Agricultural Engineering Journal, undated.



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Unson[82] reports several additional criteria for rating association performance. Each criterion is measured by a prestated set of indicators resulting in a percentage score. The results are based on a sample survey of 15 percent of association members and applicants.

The results are summarized in Table 4-11. Conflicts and conflict resolution within each of the two organizations shows a sharp contrast as do the other indicators. Most BSIA respondents did not perceive that there were any conflicts. Those that did occur were usually resolved among the parties involved or at a general assembly of members. For PIA, prior to recombining the two organizations, the arbiter was usually the president, but this did not provide a solution when the parties were not from the same organization. Conflicts usually arose over water distribution problems such as water stealing and disputes over scheduling. One case finally had to be brought before the Judge Advocate General's Office for decision. Under the combined PIA, difficulties continued. Discontent with the performance of their officers by many members became a major issue. Members were unwilling to accept decisions of their directors; however there was less reliance on municipal authorities. Participation in decision making by members remained low. Discontent led to a petition by about 10 percent of the members to remove the directors. Unfortunately, NIA officials bore a considerable portion of the brunt of the anger and frustration of the Association's officers.

Reasons for the PIA's poor performance could be attributed to several factors besides the conflicts associated with the earlier schism into two associations. The BSIA is a relatively small compact group quite isolated from the Laur municipality. The PIA serves a much larger constituency in which municipal authorities, particularly the Mayor, exercise considerable power over irrigation matters.[83] Transfer of this power to the Association was resisted.

In spite of difficulties that included disappointment about the dam, the PIA was able eventually to qualify for NIA assistance and to continue to function. The difficulties encountered do not mean that effective participation through user associations is unlikely; only that some cases are more difficult than others.

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[82]Unson, Social Development, Ch. V.

[83]NIA communal projects are generally less than 1,000 ha. The average size of 347 participatory projects completed or under planning between 1976 and 1983 was 152 ha. Bagadion and Korten, Developing Irrigators Organizations, Table 1. p. 11.



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Table 4-11: Comparison of the Performance of Two Communal Irrigation Systems--the BSIA and the PIA

| | Percent Score | | | |
|---|---|---|---|---|
| | BSIA[a] | | PIA[b] | |
| | Time 1 | Time 2 | Time 1 | Time 2 |
| System Management | | | | |
| Management style and capability | 98 | 100 | 14 | 64 |
| Meetings | 88 | 96 | 25 | 67 |
| Water distribution schedule | 58 | 58 | 25 | 33 |
| Cropping patterns | 0 | 0 | 0 | 0 |
| Financial capability | 83 | 83 | 20 | 40 |
| System Maintenance | 83 | 92 | 17 | 33 |
| Conflict Resolution | 100 | 100 | 25 | 25 |

[a]BSIA = Bagting-Siclong Irrigation Association.
[b]PIA = Pinagburyuhan Irrigation System.

Source: D.C.O. Unson, Social Development and the Communal Irrigation System in Laur, Neuva Ecija: Baseline and Selected Interim Monitoring Results, Final Report (Quezon City: Institute of Philippine Culture, 1978).

d. Cost recovery

Annual dues for PIA members are ₱ 70/ha which are applied to the costs of O and M. Repayment charges are not being made and will not be collected until the project is completed. Collection success ranges from 20 to 50 percent. The Manager thinks that collections will approach 100 percent when the system is made reliable by constructing the permanent dam. Officers of the Association are asked to assist in collection of dues from delinquents and are given a share of these dues as an inducement. This year, the Association has collected just enough to meet its costs--mostly for replacing the dam. The Treasurer has to wait for his salary from time to time, but the Association manages to make ends meet.

Under its contract with NIA, the Association worked out a repayment plan which was then negotiated with NIA. The Manager thinks that farmers will honor this commitment once the new dam is installed and the system made reliable. The Team did not ascertain the specific terms of PIA's repayment agreement with NIA. However, the general arrangement presumably follows the pattern established for the CIS of paying 10 percent of construction costs in cash, paddy, right-of-way or labor.

In addition, there are irrigation dues which amount to 75 kg/ha/annum of paddy. Of this, 25 kg is retained by the Association and 50 kg/ha goes toward repayment of the balance of the capital costs. Time for repayment, up to a maximum of 50 years, depends upon the cost of the project. Repayment is at zero interest. Though the original agreement is negotiated in terms of paddy, the repayment obligation is indexed to pesos based on paddy prices at the time the agreement takes effect. Thus inflation reduces the real cost of repayment. When asked if the users would be willing to pay for cost recovery at realistic interest rates, the Association Manager was non-committal, but left the Team with the impression that this was rather a strange new idea.[84]

D. Summary and Conclusions: Study Issues

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

At UPRIIS, the O and M charge is less than 5 percent of the gross returns. Therefore, from the point of view of the irrigator, there is little question about the feasibility of direct payment. The

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[84]This could hardly have been because of financial naivete. The Manager discussed the Country's balance of payments problem including IMF terms at considerable length and in detail. He is very concerned about the implications to the future Philippine economy and displayed a remarkable understanding of the technical problems at national level.

problem, however, is to increase the rate of collection. UPRIIS and NIA officials stated that 85 percent collection is required to meet O and M costs and this is not being achieved at UPRIIS.

Capital cost recovery is another matter. The precedent in the Philippines is that repayment for the NIS schemes is indexed to the peso at the time of investment and repaid at zero interest over a period of 50 years and even this has not been collected. We would anticipate that changing this concept at the farm level would be difficult. At NIA, there was some optimism that the rate might be raised somewhat and collection improved.

We do not think full recovery of capital costs from farmers is a feasible goal on the UPRIIS project because of the small size of most of the farms. Given the complex structure of subsidies and price fixing, it is not possible to know how much, if any, net gain to the treasury from these indirect sources could be attributed to recovery of irrigation capital costs. Some increase in direct collections could be feasible if accompanied by reductions in subsidies and price fixing, but this is a risky policy issue and has to be weighed against the effects of raising food prices for urban consumers.

O and M charges are already being collected by the Pinagburyuhan associations. However, the collection rate is low and it is not clear whether the amount collected will be sufficient once the associations assume full responsibility for O and M. Given present conditions, it seems likely that this component of cost recovery is feasible.

The user contribution of 10 percent of capital cost at the time of construction has not been much of a problem either. The remaining portion of capital cost recovery may also be feasible, primarily because farmer repayment is interest free and not indexed to real peso value. The average cost of 21 CIS projects completed by 1982 was about ₱ 3,000/ha or about ₱ 360/ha/annum at 12 percent interest for 50-year recovery.[85] The repayment share amounts to only about two percent of total production, even with indexing.

Although the costs of the PIA project may be higher, no attempt has been made to index these costs and it is possible that repayment is within the financial capability of most farmers. This is true despite the fact that even with irrigation, nearly half of the PIA members were at or below poverty level in 1970. On the other hand, irrigation raised median incomes of PIA farmers by nearly three times (see Section 2.a.(2).

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[85]Bagadion and Korten, Developing Irrigators Organizations, Table 2.

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

This is still untested on UPRIIS. The NIA's strategy is to shift O and M costs to farmer irrigator organizations as they become established on the assumption that increased farmer participation will result in improved cost recovery but this has not actually been proven. Neither does the PIA experience confirm this one way or another.

3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?

The UPRIIS experience has shown that although the system provided reliable and adequate water supply and water measurement technology was employed, collection of water charges did not increase.[86]

On the CIS scheme, the officials interviewed suggested that lack of adequate and reliable water supplies constrained water charge collections. They believed that 100 percent of O and M costs could be recovered if and when an adequate water supply was made available. They also suggested that farmers would be willing to pay a portion of capital costs if the dam they needed was constructed. Given the fact that the association members paid some charges even under conditions of unreliable water supply and were willing to contribute both funds and labor for repeated construction of the brush dam, it is possible that improved water supply from a permanent dam might result in better collection rates. Whether this would amount to the 100 percent asserted by the officials is debatable and may be explained by the officials' desire to present a favorable cost recovery outlook that would inspire investment in the dam. In conclusion, it may be that reliable and adequate water supply are necessary for improved cost recovery but these conditions may not be sufficient.

The PIA experience provides no evidence on the issues of delivery and measurement technology and their impact on cost recovery.

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[86]At UPRIIS, timed rotation of measured streams rather than direct volume measurement is used but water charges are on a crop area basis. It should be noted that the installed water measurement technology of double-gated turnouts at the 50-ha Rotational Areas was only used minimally. Measurements are regularly taken and used only at a handful of points within the system while a somewhat larger number of points are monitored for "historical" purposes. We are indebted to Mark Svendsen for this valuable insight.

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water?

At UPRIIS, O and M is good at the present level of water charges so that increase in charges are unlikely to have much of an impact. On the national systems, as a whole, the NIA's capability to subsidize O and M is declining and it requires 85 percent collection rates on the projects to maintain present levels of O and M. In this case, improved collection levels are required to maintain levels of O and M.

The PIA experience does not provide evidence on this issue. However, on the 21 CIS projects studied by Bagadion and Korten, the total value of voluntary maintenance activities, time spent in collecting fees and management and cash outlays under the Aslong communal project approximately equaled the O and M dues charged by the association.[87] Beyond these contributions, increased water charges over the present level do not seem necessary.

Since water charges are uniform throughout the Philippines, it was not possible to obtain evidence on efficiency of water use relative to cost of water on either project visited.

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

Participation is just beginning on the UPRIIS project. O and M, under NIA, is already good. A carefully designed research effort of fairly long duration (five years) would be necessary to determine the answer and perhaps should be undertaken.

Although no information was available on this issue at Laur, some information on the CIS is available from Bagadion and Korten. They compare field channel utilization on the Upper Lalo system where farmers participated in deciding on channel location with the UPRIIS project, where farmers did not participate. On the Upper Lalo System, farmers suggested modifications of about 60 percent of the locations resulting in a channel length factor of 90 m/ha instead of the NIA value of 94 m/ha. One year later, 68 out of 69 channels were carrying water in a manner satisfactory to the farmers. On UPRIIS, for a sample study of six rotational areas, the NIA designed and constructed channels with a channel length factor of 75 m/ha, and "the great majority of these new channels were erased (by the farmers) as fast as

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[87]Bagadion and Korten, Developing Irrigators Organizations, pp. 33-37.

they were completed."[88] The farmers reverted to using channels existing before the rehabilitation; at the time of the study, in a ratio of 34 m/ha.

It could be inferred that O and M on the Upper Lalo was better (most authorities believe that a channel length factor of about 75 m/ha is desirable for paddy irrigation) and therefore that user participation in deciding on field channel location led to improved O and M. However, the authors caution that this does not mean that farmers always know best. About 25 percent of the farmer-suggested locations needed revision for technical reasons. These revisions were made jointly with the farmers.

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[88]Mark Svendsen, "Irrigator Collective Behavior in Three Philippine Irrigation Systems." Paper presented to a seminar on Investment Decisions to Further Develop and Make Use of Southeast Asia's Irrigation Resources (Bangkok: Kampangsaen Campus of Kasetsart University, 17-21 August, 1981), p.11.



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# IRRIGATION PRICING AND MANAGEMENT

## ANNEX 5

## Indonesia

Submitted to: Ms. Joan Atherton
Social Science Analyst
U.S. Agency for International Development
Office of Policy Development and Program Review
Bureau of Program and Policy Coordination

Submitted by: Ian D. Carruthers
N.S. Peabody, III
A.A. Bishop
A.D. LeBaron
Rekha Mehra
Ramchand Oad
Dean Peterson
Dennis H. Wood

DEVRES, INC.
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(202) 797-9610
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Indonesia

Ian D. Carruthers,
Principal Investigator
Dean F. Peterson,
Irrigation Engineer
Rekha Mehra,
Economist and Social/Institutional
Specialist

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AID | Agency for International Development |
| APBN | Central government sectoral budget for irrigation |
| BULOG | National Logistics Agency (for rice procurement) |
| DGWRD | Directorate General of Water Resources Development |
| DPU | Department of Public Works |
| GDP | Gross Domestic Product |
| GNP | Gross National Product |
| HYV | High Yield Varieties |
| IBRD | International Bank of Reconstruction and Development |
| IPEDA | Land tax |
| KPIP | Kali Progo Irrigation Project |
| LNG | Natural gas |
| M | Million(s) |
| O and M | Operations and Maintenance |
| PROSIDA | Proyek Irigasi IDA (an executive body of DGWRD) |
| PU | Public Works |
| P3A | Name for Water User Associations in Indonesia |
| PPL | Ministry of Agriculture extension field staff |
| WUA | Water User Association |



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## CURRENCY EQUIVALENTS

US$ 1.00 = Rp. (Indonesian Rupiah) 11,000 .

## WEIGHTS AND MEASURES

| | | |
|---|---|---|
| 1 hectare (ha) | = | 10,000 $m^2$ |
| | = | 2.471 acres |
| 100 hectares (ha) | = | 1 $km^2$ |
| 1 kilogram (kg) | = | 2.204 pounds |
| 1 metric ton (MT or t) | = | 1,000 kg |
| 1 kilometer (km) | = | 0.621 miles |
| 1 square kilometer ($km^2$) | = | 100 ha |
| 1 millileter (mm) | = | 0.04 inch |
| 1 cubic meter ($m^3$) | = | 0.061 cubic inch |
| 1 liter | = | 1.066 quarts |



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## LIST OF PEOPLE INTERVIEWED

Jakarta

Mr. Soewasono
Director of Irrigation I
Ministry of Public Works

Mr. Bangbam Priyatomo
Irrigation I
Ministry of Public Works

Mr. E.A. Salim
National Development Planning Board (BAPPENAS)

Mr. Lars Jeurling
World Bank
Jakarta

Mr. Cornelis des Bouvrie
World Bank
Jakarta

Mr. Richard B. Cobb
Chief, Office of Agriculture and Rural Development
USAID/Jakarta

Ms. Nancy Tumavick
Head of Irrigation Division
USAID/Jakarta

Dr. David Robinson
Social Scientist
USAID/Jakarta

Mr. Jose De Hamza
Project Officer
USAID/Jakarta

Mr. Alvin Newman
Engineer
USAID/Jakarta

Dr. David Seckler
Senior Development Policy Advisor
USAID/Jakarta

Dr. David C. Korten
Asia Regional Advisor on Development Management
USAID



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West Sumatra

Mr. Sabri Kasim
Chief Engineer
Departemen PU Sumbar
Padang

Mr. Basuki
Chief of Irrigation
Departemen PU
Padang

Yogyakarta

Mr. Julistiyo
Directorate of Irrigation
Jakarta

Mr. Ircham
Acting Project Manager
Kali Progo Project (KPIP)

Mr. Wahyuno
Assistant for Planning and Design
KPIP

Mr. Purivanto
Assistant for Tertiary Development
KPIP

Mr. Imam Sadewo
Assistant for Operation and Management
KPIP



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ANNEX 5

Indonesia

## A. Background

### 1. Economic background

#### a. Macroeconomic conditions and policy

Following a period of rapid expansion in the 1970s, Indonesia's economic growth slowed down in 1982 and 1983. Several factors were responsible for the adverse economic developments, the most important of which was the international recession which depressed demand and reduced prices, significantly for oil, but also for the country's traditional agricultural commodity exports. The government's speedy though cautious response included such measures as the adoption of an austere budget for 1983-84, reduction in subsidies on petroleum products, devaluation of the Rupiah by 28 percent and far-reaching tax reform. Nevertheless, the real Gross Domestic Product (GDP) growth rate increased only slightly from 4.2 percent in 1983 to 4.5 percent in 1984. Furthermore, the cautious mood persists both in the government and among the business community in 1985.[1]

Sectoral value added for the years 1979-82 is shown in Table 5-1 which also shows total value of GDP for those years. The percentage distribution of GDP by sector of origin is also shown for 1982. The agricultural sector is the largest, contributing more than 29 percent to overall GDP. It is followed by commerce and the manufacturing sectors which contribute 17.5 percent and 15.4 percent respectively. Indonesia's per capital Gross National Product (GNP) was estimated at US$ 560 in 1983.

The agricultural sector demonstrated improvement between 1983 and 1984 led by the largest rice crop on record, and followed by impressive gains in output of cassava, peanuts, coconuts, tea, palm oil and soybeans. Real output in the agricultural sector as a whole grew about 5 percent between 1983 and 1984, but the manufacturing sector did not do as well.[2] Although fertilizer and cement showed continued growth, electronics, textiles and vehicle assembly were in recession. Clearly, there is now substantial surplus capacity in the manufacturing sector with many factories producing at less than 50 percent of capacity.[3] Possible causes are the Government's licensing policies and a degree of over-optimism on the part of foreign investors in the early 1980s which led to over-investment. When consumer demand fell away in 1982, industries such as clothing, footwear and motor cycles were particularly hard hit.

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[1]The World Bank, Indonesia: Policies and Prospects for Economic Growth and Transformation (Washington, D.C.: The World Bank, April 1984).

[2]Peter McCawley, "Survey of Recent Developments," Bulletin of Indonesia Economic Studies, April 1985.

[3]Ibid., p. 9.

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Table 5-1: Gross Domestic Product by Sector of Origin at Constant 1973 Market Prices
(Billion Rp.)

| Sector | 1979 | 1980 | 1981 | 1982 | Distribution of GDP 1982 (percent) |
|---|---|---|---|---|---|
| Agriculture | 3,256 | 3,425 | 3,595 | 3,668 | 29.8 |
| Farm food crops | 1,909 | 2,073 | 2,261 | 2,294 | |
| Farm non-food crops | 402 | 417 | 430 | 459 | |
| Estate crops | 231 | 233 | 244 | 285 | |
| Livestock, forestry and fisheries | 714 | 702 | 660 | 630 | |
| Mining and quarrying | 1,047 | 1,035 | 1,069 | 940 | 7.6 |
| Manufacturing | 1,395 | 1,750 | 1,878 | 1,901 | 15.4 |
| Electricity, gas and water | 69 | 78 | 90 | 106 | 0.9 |
| Construction | 562 | 639 | 720 | 758 | 6.2 |
| Commerce | 1,681 | 1,852 | 2,043 | 2,159 | 17.5 |
| Transport and communications | 560 | 609 | 677 | 717 | 5.8 |
| Banking | 180 | 208 | 231 | 258 | 2.1 |
| Public administration and defense | 805 | 972 | 1,076 | 1,115 | 9.0 |
| Other | 610 | 647 | 678 | 703 | 5.7 |
| TOTAL GDP | 10,165 | 11,215 | 12,057 | 12,325 | 100.0 |

Source: The World Bank, Indonesia: Policies and Prospects for Economic Growth and Transformation, (Washington, D.C.: The World Bank, April 1984).

Few data are available on the construction and service sectors (wholesale and retail trade, transport and government) which comprise 50 percent of the economy. Performance estimates differ but it seems that the construction sector held up well under the recessionary conditions for a time.[4] However, it is expected to slow down with government spending decreasing on development projects which provide the bulk of contracts in the construction sector. With manufacturing in recession and declining imports it is also likely that wholesale and retail trade will also be effected.

Despite these setbacks, the economy has exhibited some resilience. For example, oil and natural gas LNG production rebounded in 1983 growing 6 percent after having declined 12 percent in the previous year. Inflation was restricted to 12 percent in 1983 despite the cost-push shocks engendered by the rise in domestic oil prices and the devaluation of the Rupiah. Inflation dropped to 8 percent in 1984 and was expected to remain below 10 percent in 1985-86.

The balance of payments situation is also favorable. In the first nine months of 1984 Indonesian exports grew by 8 percent and imports fell by 14 percent as compared with the same period in the previous year. This resulted in an increase in the balance of trade surplus and a reduction in the current account deficit. For fiscal year 1983-84, the current account deficit is estimated at about US$ 4.2 billion (equivalent to 6 percent of GDP) compared with US$ 7.3 billion in the previous year. The foreign exchange reserves at the end of December 1984 amounted to a comfortable US$ 10 billion. There has been a significant change in export revenue composition with the share of non-oil exports growing from 11 percent to 17 percent in two years. Part of the decline in the import bill can be attributed to the success of the Government's import substitution policies and part to the effects of reduced demand accompanying the recession.

Indonesia's medium-term growth prospects depend to a large degree on developments in the international economy, particularly on the world oil market which is difficult to predict. Slow growth in export revenues is expected since a large proportion will be contributed by oil. The outlook is more optimistic for non-oil exports which are projected to grow 6 percent per annum until 1990. Overall GDP growth is expected to be about 5 percent and investment growth is projected at over 5 percent during 1986-90. These rates will be achievable if the import intensity of investments is reduced below recent levels.[5]

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[4]See, for example, McCawley, "Survey"; and the World Bank, Indonesia: Policies and Prospects.

[5]The World Bank, Indonesia: Policies and Prospects, p. x.



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Employment creation is the most serious developmental problem confronting Indonesia given a population growth rate of 2.7 percent per annum. This implies that 1.8 million people will be added to the labor force every year during the 1980s. Although no dramatic increases in unemployment are expected, certain policy implications follow for sustaining employment and gains in achieved income levels. One of these pertains to the agricultural sector since it will continue to be the principal source of employment. Efforts should be made to increase cropping intensities in irrigation areas and to diversify crop production and raise yields in rainfed agriculture to sustain labor demand.[6]

b. The agricultural and rural sector

(1) Current situation and outlook

The agricultural sector is of overwhelming importance in Indonesia as nearly 80 percent of the population lives in rural areas and agriculture is the main source of income for about two-thirds of rural households and one-tenth of urban households. The country has 15.6 million smallholder families who produce subsistence and cash crops on 15.8 million ha. There are also 1,800 estates on 2.2 million ha that produce mostly rubber, sugar, tea, palm oil and tobacco. Developments over the past 15 years have caused agriculture's share of GDP to decline from 40 percent to 30 percent between 1968 and 1981. In the same period, agriculture's share of exports dropped from 45 percent to 33 percent mainly because of the increased value of oil exports. However, agriculture remains a vital element of Indonesia's economy.[7]

Although agriculture's share of total employment has declined, it still employs 61 percent of the labor force. In the 1980s, agriculture is the largest single source of employment. Land reclamation and irrigation development outside Java promise to provide continued employment in agriculture on increased smallholder area, while rehabilitation of irrigation systems in Java are also encouraging for employment provision in agriculture on that island.

One of the major objectives of government policy in the agricultural and rural sector is food self-sufficiency, particularly in rice. Other objectives are the improvement of rural employment and incomes; supply of rice to urban consumers at a "reasonable" and relatively stable price; promotion of agricultural exports, especially of smallholder tree crops; and sustainable use of Indonesia's land, water and other natural resources.

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[6]Ibid, p. 11.

[7]The World Bank, Staff Appraisal Report. Indonesia: Sixteenth Irrigation Project (Washington, D.C.: The World Bank, 1982), p. 2.



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Rice is the country's primary food crop followed by cassava, corn and sweet potatoes. Other important crops are palm oil, coconut, rubber, sugar and soybeans. Output of major agricultural commodities and annual rates of growth are shown in Table 5-2. The keystone of Indonesia's agricultural policy, attainment of self-sufficiency in rice production, was achieved in 1984 when output amounted to just under 25 million tons. This was an increase of 3 percent over the previous year, a somewhat slower pace than the average of 6 percent per annum achieved over the previous five years.

Both the area planted to rice (including multiple cropping) and yield increases have contributed to expanded output. A combination of factors is responsible for this success including extended and improved irrigation, changes in rice growing technology (use of high yielding varieties (HYV) and fertilizers) and government price incentives. Assuming continuing investments in irrigation and supporting services at present levels, rice output is projected to grow at a rate of 3.5 percent per annum through 1990, resulting in estimated output of 28.5 million tons in that year. Already, management of surplus rice stocks is posing two major problems for the National Logistics Agency (BULOG), the Government's rice procurement agency. The first problem is storage and the second that of maintaining the floor price of rice in rural areas given the expected glut.[8]

Production of palawija or non-rice crops increased sharply in 1984, contributing toward a real growth rate of 5 percent in agriculture as a whole. The long-term trend for rate of growth in palawija crops is not quite so encouraging. Since little support has been given to palawija production, output has been low by world standards. The problems associated with palawija production on large estates are lack of adoption of HYVs, low fertilizer usage, poor management and lack of marketing arrangements. Smallholder farms have the additional problem of lack of credit availability and extension services.[9] Further, secondary crops are less intensively managed compared with rice and farmers tend to forego secondary crop production as intensity of rice cropping increases. However, secondary food crops are important in that they provide a third of total staple food calories consumed and more than that for the very poor. Clearly, they cannot afford to be neglected.

(2) Price policies

Price levels for rice and fertilizer reflect substantial economic and budget subsidies that arise from the Government's price policies. The objectives of the price policies originally formulated in 1969 were as follows: First, to establish a

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[8]The Government's commitment to direct purchase of rice from farmers at guaranteed prices is an important welfare objective.

[9]McCrawley, "Survey", pp. 2-9.



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Table 5-2: Production of Selected Agricultural Crops, 1979-84
(000 tons)

| | 1979 | 1983 | 1984 | Annual Growth Rates 5 years 1979-84 | 1983-84 |
|---|---|---|---|---|---|
| **Food Crops** | | | | | |
| Rice | 17,872 | 23,961 | 24,701 | 6 | 3 |
| Maize | 3,606 | 5,095 | 5,412 | 7 | 6 |
| Cassava | 13,751 | 11,651 | 14,702 | -1 | 26 |
| Sweet Potatoes | 2,194 | 2,044 | 2,257 | -- | 10 |
| Peanuts | 424 | 469 | 535 | 3 | 14 |
| Soybeans | 680 | 568 | 783 | -- | 38 |
| **Fisheries** | | | | | |
| Sea | 1,318 | 1,600 | 1,670 | 5 | 4 |
| Inland | 430 | 520 | 549 | 5 | 6 |
| **Large Estate Crops[a]** | | | | | |
| Palm Oil | 642 | 907 | 1,038 | 10 | 14 |
| Palm Kernals | 108 | 161 | 141 | 7 | -12 |
| Tea | 125 | 113 | 116 | -1 | 3 |
| **Smallholder Crops[b]** | | | | | |
| Rubber | 898 | 1,230 | 1,107 | 4 | -10 |
| Sugar | 1,601 | 1,693 | 1,769 | 1 | 4 |
| Coconuts | 1,582 | 1,607 | 2,015 | 3 | 25 |
| Coffee | 228 | 302 | 309 | 5 | 2 |
| Cloves | 35 | 45 | 56 | 8 | 24 |
| Pepper | 47 | 40 | 41 | -2 | 2 |
| Tobacco | 87 | 120 | 121 | 5 | 1 |
| Cotton | 1 | 8 | 40 | c | c |

[a]Predominantly estate crops; figures given are for estate and smallholder production combined.
[b]Predominantly smallholder crops; figures given are for estate and smallholder production combined.
[c]Very high due to low base.

Source: McCawley, "Survey of Recent Developments," Bulletin of Indonesian Economic Studies, April 1985.

floor price high enough to stimulate production; second, to establish a ceiling price that would ensure a reasonable price for consumers; and third, to maintain sufficient range between the two prices so as to provide traders and millers reasonable profit after holding rice stocks between crop seasons. The policy also intended to ensure equitable regional rice distribution and parity between domestic and world prices. In practice, these policies have resulted in substantial economic and budget subsidies, particularly for fertilizers.

As Table 5-3 shows, Indonesia's domestic price for rice generally stayed below the import parity price between 1970-82 except when the world price was well below its long-run trend level. This implies an economic subsidy to rice consumers. The World Bank projects the world rice price to increase significantly between 1982 and 1990 and thus, if the domestic price of rice in Indonesia remains unchanged in real terms it will continue to stay below the long-run import parity price through the decade.[10] As a result of not pricing rice at its economic cost (as represented by the world market price), consumption will be overstimulated and production and farmer incomes will be depressed.

Domestic fertilizer prices of urea and triple superphosphate were less than half their import prices until November 1983. There were also substantial subsidies for ammonium sulphate and potassium chloride. This provided an offsetting economic subsidy to rice producers but implies budget costs to the Government. The total budget cost of fertilizer subsidies in 1981-82 was estimated at US$ 360 million which was equivalent to 30 percent of the development budget for the agricultural sector.[11] (The estimate of US$ 370 million does not include the implicit subsidy to fertilizer production due to pricing of natural gas below its economic cost.) Given no increase in real price, the subsidy is projected to be about US$ 500 million by 1990.[12] The second smaller budget subsidy arises because BULOG's selling price for rice does not adequately reflect the full cost of storage and marketing.

The World Bank has shown that under alternative price policy scenarios which involve reduced subsidies and compensating rice price increases for farmers, Indonesia could substantially reduce budget subsidies while maintaining rice self-sufficiency and farm incomes.[13] The long-run inflationary impact of higher prices for rice would range from 1-4 percent, the impact occurring gradually over a number of years.

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[10]The World Bank, Indonesia: Policy Options and Strategies for Major Food Crops (Washington: The World Bank, 1983), p. 55.

[11]Ibid., p. vii.

[12]Ibid.

[13]Ibid, p. 64.



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Table 5-3: Trends in Imported and Actual Rice Prices in Jakarta
(US$ per ton)

| Year | Imported Rice: FOB Bangkok (25% broken) | Imported Rice: Cost of Retail Jakarta | Actual Jakarta Retail |
|---|---|---|---|
| 1970 | 125.3 | 148.64 | 112.4 |
| 1971 | 93.9 | 115.45 | 109.3 |
| 1972 | 103.6 | 127.45 | 119.0 |
| 1973 | 116.3 | 175.76 | 205.2 |
| 1974 | 493.2 | 558.69 | 242.2 |
| 1975 | 311.8 | 380.49 | 262.7 |
| 1976 | 222.3 | 263.37 | 309.6 |
| 1977 | 237.4 | 287.33 | 319.6 |
| 1978 | 327.9 | 382.22 | 318.8 |
| 1979 | 308.3 | 362.00 | 272.5 |
| 1980 | 403.9 | 466.40 | 319.0 |
| 1981 | 416.4 | 470.10 | 325.0 |
| 1982 | 271.6 | 320.90 | 348.0 |

Source: The World Bank, Indonesia: Policy Options and Strategies for Major Food Crops (Washington, D.C.: The World Bank, 1983).



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## 2. Irrigation development

### a. General

The high priority attached to irrigation development in Indonesia is primarily in order to become self-sufficient in food production, particularly in rice. Irrigated agriculture is also an important source of income in rural areas and is necessary in the planning of new areas of transmigration and settlement in the less intensively cultivated Outer Islands. Indonesia has a monsoon climate that provides 1,500-3,000 mm of rainfall per annum, but supplemental irrigation is necessary. Although total rainfall is adequate for paddy rice production, distributional variation results in periods of inadequate moisture for optimum rice production. At such times, availability of irrigation improves production while dry season production of rice is impossible without irrigation. On the other hand, drainage is equally important in Indonesia because excessive rainfall causes crop damage in some parts of the country.

### b. Current status of irrigation development

There are essentially three types of irrigation systems in Indonesia--technical irrigation, semi-technical irrigation and simple irrigation.[14] Technical irrigation systems are those which have a water supply separate from the drainage system and where the discharge of water can be measured and controlled at a number of points. All such structures are permanent. Semi-technical systems have fewer permanent structures, only one measuring device and supply and drainage systems are not always fully separate. The simple irrigation systems, sometimes known as desa or village systems, are theoretically not under Government control but are constructed, operated and managed by the villagers. They generally have semi-permanent or temporary structures and have no water measurement or control devices. The areas covered by the different types of systems are shown in Table 5-4. Groundwater development is fairly limited but is being expanded in certain parts of Java. There is also some private investment in small wells and pump sets, while the Government has started pilot schemes using large tubewells.

The potential area for irrigation development is about 5.4 million ha. Another 350,000 ha of swamp development area exists, primarily in Sumatra and Kalimantan, which is more properly regarded as drainage rather than irrigation area. The total nominal service area of existing irrigation systems under the control of the Department of Public Works (DPU) is about 4.2 million ha. The DPU is responsible for the operation and maintenance (O and M) of this area as far as the tertiary outlet, while below that level farmers are responsible for

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[14]Some classifications added "wild" irrigation but the data on this is limited.



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Table 5-4: Types and Areas of Existing Irrigation Systems
(million ha)

| Region | Gravity Irrigation | | | | Tidal and Swamp Lands | Total | Percent (%) |
|---|---|---|---|---|---|---|---|
| | Technical | Semi-Technical | Simple | Village | | | |
| Java | 1.63 | 0.38 | 0.55 | 0.53 | - | 3.10 | 62 |
| Bali | - | 0.04 | 0.01 | 0.05 | - | 0.10 | 2 |
| Sumatera | 0.22 | 0.32 | 0.28 | 0.29 | 0.03 | 1.15 | 23 |
| Kalimantan | - | 0.02 | 0.04 | 0.02 | 0.04 | 0.11 | 2 |
| Sulawesi | 0.14 | 0.09 | 0.05 | 0.09 | - | 0.35 | 7 |
| Nusa Tenggara | 0.07 | 0.06 | 0.05 | 0.04 | - | 0.21 | 4 |
| TOTAL | 2.06 | 0.91 | 0.98 | 1.02 | 0.07 | 5.03 | 100 |

Source: The World Bank, Indonesia: Irrigation Program Review (Washington, D.C.: The World Bank, 1978).





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their own O and M. There are less reliable estimates of the irrigated areas managed at the local level by the farmers alone, independent of the government. Estimates put the area at about 1.2 million ha. The actual area of irrigated land is reduced by the quality of the available irrigation. The DPU estimated in 1977 that approximately one million ha of existing government controlled systems (or 25 percent of the total area) was in need of augmented water supplies, rehabilitation, tertiary or on-farm canals. Of this area, Sumatra accounted for about
420,000 ha, Java for 294,000 ha and Sulawesi for 145,000 ha.

The geographical distribution of irrigated area between regions as shown in Table 5-4 indicates that 62 percent of the total is in Java which also has more technically advanced systems than the other islands. Although Java has only 7 percent of Indonesia's land area, its rice production supports 66 percent of the population. Hence, the extent of irrigated areas in Indonesia are in reasonable balance with the broad distribution of population, although not exactly so. This is because irrigation development depends upon a variety of factors other than demography including accessibility to water sources, topography and soils.

Most of the irrigation systems are supplied by run-of-the-river diversion. Of the few large dams and reservoirs in existence, the largest is Jatiluhur in West Java which has a command area of 304,000 ha and is administered by a special Authority. There are also other large systems in downstream coastal areas that depend upon a single dam, barrage or weir but a larger proportion of irrigated area is supplied by relatively small upstream systems which are highly interdependent. In other words, they draw on the same rivers and catchment areas for their water. This complicates the administrative task of the DPU for a Section Office having responsibility for an area of 20,000 to 40,000 ha may have more than 25 separate systems to administer. Indeed, irrigation in Indonesia is highly diverse topographically, culturally and administratively both among the islands and within particular regions and provinces.

Typical problems generally encountered in irrigation systems are excessive silt deposits in weirs, intakes and canal structures that result in capacity losses. Erosion is also a problem along canal banks and on inspection roads. In some places, where farmers maintain drains, they dam them to provide an additional water supply pool and cause flooding in other places.

c. Past trends in irrigation investment

There was little investment in irrigation development in Indonesia in the first three decades after independence resulting in serious deterioration of some physical structures to the extent that by the mid-1960s many of the large systems were becoming inoperable. Lack of controlled and equitable water distribution caused severe competition among users and further deterioration from deliberate



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destruction of gates and canal banks. A major rehabilitation program was started in the late 1960s focused on Java. With support from external donors such as the World Bank, diversion structures and canal systems were reconstructed. In the late 1970s, the focus shifted to development of new irrigation in the Outer Islands, mostly for transmigration and settlement schemes. In Java, more emphasis was given to tertiary system rehabilitation and reorganization through increased attention for improved O and M and technical training for staff.

In the late 1970s, irrigation accounted for about 5 percent of the total national budget including routine expenditures and foreign aid. In 1977-78, the local currency development budget allocated to irrigation was about 9.5 percent. Between 1974-75 and 1977-78, the development budget for irrigation increased at an average annual rate of about 50 percent or 35 percent in real terms. The Government's investment in irrigation during Repelita III and IV are shown in Table 5-5. Expenditure on rehabilitation is budgeted to account for about 29 percent of the total, and expenditure on large scale systems is budgeted for about 27 percent. Rehabilitation accounts for 27 percent of the area being developed and tertiary development for about 11 percent. The largest incremental production is expected to come from large scale systems and tidal and swamp development.

d. The role of irrigation in agricultural development

The primary use of irrigated land in Indonesia is for rice production while palawija crops are grown during the dry season where irrigation systems are incapable of delivering adequate water supplies for rice cultivation. Table 5-6 shows that the area of harvested rice increased from 6.36 million ha to 7.23 million ha between 1968-76. There was a corresponding decline in the area of dry land rice harvested (0.5 million ha) but 0.4 million ha were added to total area harvested either by extension or irrigation areas or increased cropping intensity on irrigated areas. Paddy production from irrigated areas increased at an average rate of 4 percent per annum compared with a rate of increase of total production of about 3.8 percent per annum.

As shown in Table 5-6, per ha yield of paddy on sawah areas has been double that on dry land areas, a significant part of the difference being attributable to irrigation. It is important to remember that yield increases do not depend upon irrigation alone. But significant improvements can be achieved on irrigated land when combined with increased fertilizer use and other improved cultivation and water management practices. In addition, rice cropping intensity is higher on land with more sophisticated irrigation systems. Thus, cropping intensity on Java and Bali, where irrigation is most highly developed, was 1.5 in 1976, but it was only 1.16 in the rest of Indonesia.



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Table 5-5: Investment and Irrigation Area Developed for Repelita III and IV

| | Investment in Constant (1982/83 Billion Rp.) | | | Areas Developed (000s ha) | | | Incremental Production (tons/ ha) | Unit Cost (000s Rp.) | Unit Cost (US$) |
|---|---|---|---|---|---|---|---|---|---|
| | Repelita III | Repelita IV | Total | Repelita III | Repelita IV | Total | | | |
| 1. Simple irrigation | 92.8 | 109.3 | 202.1 | 147.0 | 198.0 | 345.0 | 1.6 | 590.0 | 920.0 |
| 2. Medium scale | 145.9 | 197.9 | 343.8 | 55.0 | 133.0 | 188.0 | 2.2 | 1,830.0 | 2,860.0 |
| 3. Large scale | | | | | | | | | |
| (without dam) | (1,102.0) 442.0 | - 1,109.7 | 1,102.7 | 131.0 | 411.0 (223.0) | 542.0 | 3.2 | 2,460.0 | 3,840.0 |
| (with dam) | (449.0) | | 449.0 | | | | | | |
| 4. Rehabilitation | 757.7 | 417.2 | 1,173.9 | 729.0 | 594.0 | 1,323.0 | 0.8 | 890.0 | 1,390.0 |
| 5. Tertiary | 81.6 | 123.7 | 205.3 | 522.0 | 778.0 | 1,300.0 | 0.6 | 160.0 | 250.0 |
| 6. Tidal swamp | 110.4 | 245.4 | 355.8 | 347.0 | 452.0 | 799.0 | 2.5 | 450.0 (2,590.0)a | 700.0 (4,050.0)a |
| 7. Inland swamp | 43.9 | 69.3 | 113.2 | 116.0 | 240.0 | 356.0 | 1.0 | 320.0b | 500.0b |
| 8. Groundwater | 53.4 | 57.8 | 111.2 | 12.0 | 21.5 | 33.5 | 4.0 | (1,540.0) | (2,400.0) |
| TOTAL | 1,726.7 | 2,330.3 | 4,057.0 | 1,928.0 | 2,827.5 | 4,886.5 | | | |

[a]Including land clearing and settlement and infrastructure cost.

[b]Seems very high because large amounts of project preparation costs have been included. The real value of unit costs should be the values in brackets.

Source: Directorate General of Water Resources Development, Ministry of Public Works, May 1982.

Table 5-6: Harvested Area, Production and Average Yield of Paddy Rice, 1968-76

| | Area Harvested (million ha) | Paddy Production[a] (MT) | Yield[a] (t/ha) |
|---|---|---|---|
| **Irrigated and Wet Land[b]** | | | |
| 1968 | 6.36 | 16.10 | 2.53 |
| 1972 | 6.61 | 18.72 | 2.84 |
| 1976 | 7.23 | 22.63 | 3.13 |
| Average annual growth rate 1968-70 to 1974-76 | 1.9% | 4.3% | 2.4% |
| **Unirrigated and Dry Land** | | | |
| 1968 | 1.66 | 1.88 | 1.13 |
| 1972 | 1.31 | 1.56 | 1.19 |
| 1976 | 1.14 | 1.54 | 1.35 |
| Average annual growth rate 1968-70 to 1974-76 | -4.8% | -2.4% | 2.4% |
| **Total Irrigated, Wet Land, Unirrigated and Dry Land** | | | |
| 1968 | 8.02 | 17.95 | 2.24 |
| 1972 | 7.90 | 20.28 | 2.57 |
| 1976 | 8.37 | 24.17 | 2.89 |
| Average annual growth rate 1968-70 to 1974-76 | 0.9% | 3.8% | 2.9% |

[a]Production and yield are in terms of rough paddy.

[b]Refers to irrigated and rainfed sawah. (Sawah refers to all rice fields, irrigated or rainfed, which have low banks or bunds built around them to retain water.)

Source: The World Bank, Indonesia: Irrigation Program Review (Washington, D.C.: The World Bank, 1978).



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e. Future development potential in irrigation

Table 5-7 summarizes the areas identified as having potential for irrigation development. Of the total 5.8 million ha, about 5.1 million ha or almost 90 percent will involve construction of new irrigation or swamp development projects on islands other than Java. On Java, the intent is to concentrate on more intensive system rehabilitation including construction of tertiaries. Another objective is to increase cropping intensities by augmenting dry-season water supplies. On the Outer Islands more emphasis is planned on new construction and swamp and tidal reclamation. New construction is intended to stress small and medium sized projects which are an important part of the Government's program of regional development, food production and income distribution. Some of these will be the "Sederhana" type of project which are described in Section C.2.[15]

B. National Irrigation Administration and Policy

1. Organization of the irrigation administration

a. The Directorate General of Water Resources Development

The chief government agency responsible for irrigation development is the Directorate General of Water Resources Development (DGWRD) of the DPU. The agency is responsible for planning, direction and supervision of a variety of activities including rehabilitation of existing irrigation systems, flood control, river basin planning and development, development of new irrigation and reclamation of swamp lands. Figure 5-1 shows the DGWRD's organization for accomplishing these tasks. The main functions of the DGWRD are performed by six directorates and a number of executive bodies. The various directorates are in turn organized along functional lines. The Assistant Director General is responsible for a range of administrative activities while the Directorates of Programming and Planning, and Logistics are responsible for support activities. Separate executive agencies exist or are formed to manage special projects funded by external agencies such as the International Bank for Reconstruction and Development (IBRD). Proyek Irigasi IDA (PROSIDA), which was established to execute IBRD-assisted projects, is an example of one such agency.

Legally, responsibility for irrigation development is decentralized and the Provincial Public Works Departments are an integral part of the provincial government, the central DPU providing only "technical guidance." However, the Provincial Dinas PU is responsible for operating the budget provided by the central Ministry as well as its own provincial budget. Decentralization is not strictly maintained in actual practice because of the considerable expansion of

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[15]Briefly, the Sederhana Program was designed to build and rehabilitate small-scale irrigation systems.



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Table 5-7: Areas Identified for Potential Future Irrigation Development
(million ha)

| Province | Gravity Irrigation: New Development | Gravity Irrigation: Rehabilitation | Swamp and Tidal | Groundwater | Total |
|---|---|---|---|---|---|
| Java | 0.42 | 0.59 | - | 0.05 | 1.06 |
| Sumatera | 1.90 | 0.09 | 0.81 | - | 2.81 |
| Kalimantan | 0.68 | 0.02 | 0.62 | - | 1.33 |
| Sulawesi | 0.34 | 0.04 | - | - | 0.39 |
| Nusa Tenggara | 0.08 | 0.01 | - | - | 0.09 |
| Maluku | 0.16 | - | - | - | 0.16 |
| Irian Jaya | 0.01 | - | - | - | 0.01 |
| TOTAL[b] | 3.59 | 0.76 | 1.44 | 0.05 | 5.84 |

[a]Includes Madura and Bali.
[b]Totals may be incorrect due to rounding error.

Source: The World Bank, Indonesia: Irrigation Program Review (Washington, D.C.: The World Bank, 1978).

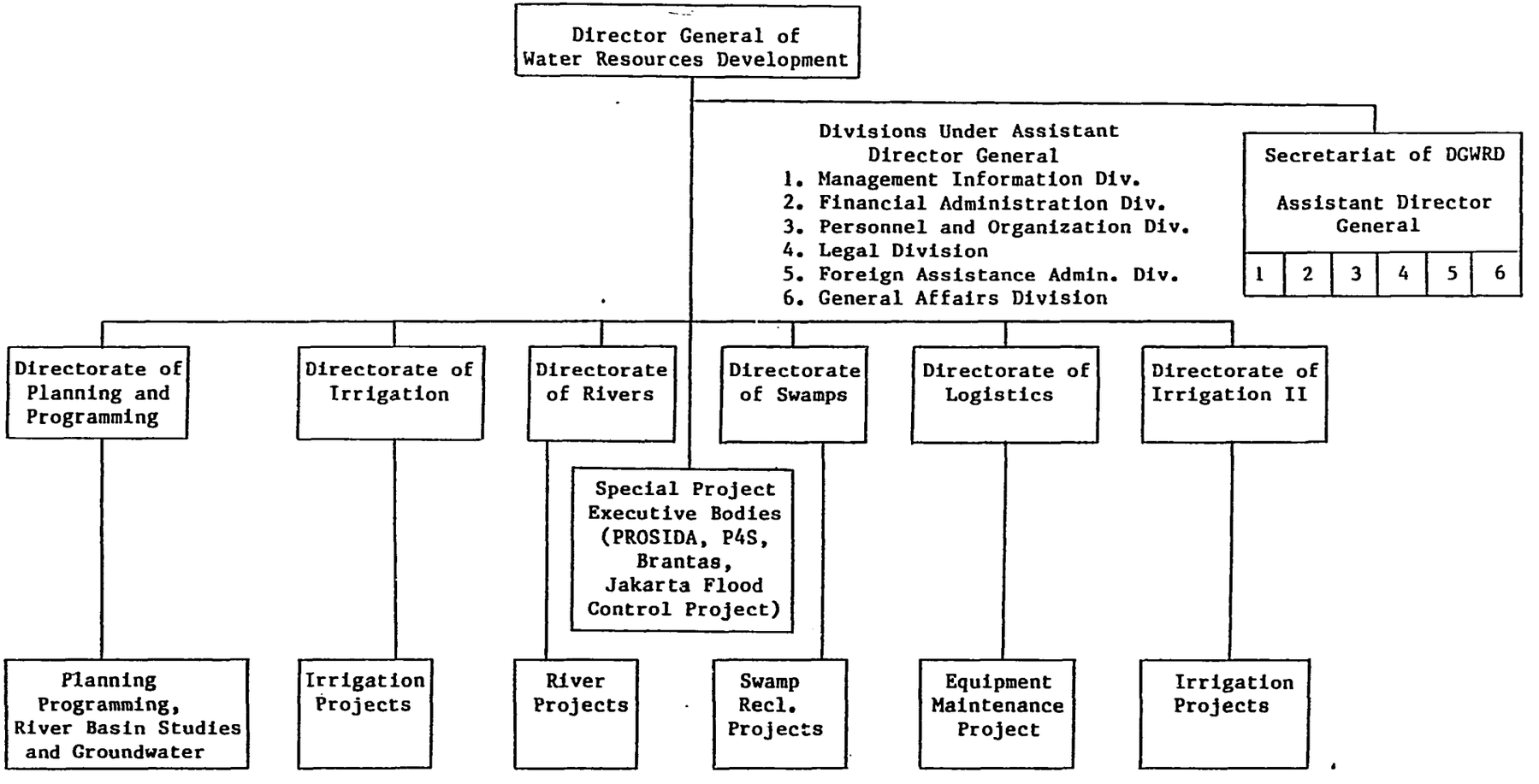


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Figure 5-1: Organization of the Directorate General of Water Resources Development



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new irrigation construction much of which has been financed by foreign aid agencies in the past decade. This has necessitated a large proportion of the total budget being provided by the central Ministry including for the Sederhana and Tertiary Development Program. In addition, many of the special centrally funded projects are directed from the center. There are separate project offices for the larger centrally funded projects which are often better equipped and include senior staff seconded by the center. Even the Provincial Government budget provided for minor rehabilitation and for O and M are largely funded by Central Government grants which often are earmarked for specific purposes.

There is no agency for irrigation administration at the Kabupaten level though most Kabupatens have Provincial Dinas PU offices attached to their secretariats. However, their legal responsibility is confined to roads, bridges and sanitation.

b. The Ministry of Agriculture

The Ministry of Agriculture's important responsibilities in irrigated agriculture include provision of extension advice on water management at the farm level; organization of farmers into water user associations (WUA) known as P3As; in some areas, physical organizational improvement of tertiaries; and, as mentioned above, participation in planning irrigated cropping patterns and seasonal water schedules through membership on the Kabupaten Irrigation Committees. The Ministry of Agriculture's extension field staff (PPL) are supposed to advise farmers on improved farm-level water management. They are members of the Provincial extension service and come under the supervision and training of a senior official at the sub-province level who is designated as a "subject matter specialist" in water management.[16] The program is funded through the general extension budget. Since the institution of the Tertiary Development Program, the PPLs have also been made responsible for the establishment of the P3As.

In the past, the Ministry of Agriculture had other functions in irrigation but these activities have been steadily reduced. For example, until 1979-80, the Ministry administered tertiary development of the Sederhana projects but this activity has now been taken over by the DPU. Before that, there was a Directorate of Rural Irrigation within the Ministry whose function was to provide technical assistance to communally managed systems, but this was closed in 1969.

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[16]The Ministry of Agriculture's sub-district offices do not correspond with those of the DPU.



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c. Local government

Although, theoretically, irrigation is a Provincial Government responsibility, the only formal linkage at the Kabupaten level is through the Bupati through his chairmanship of the Irrigation Committee.[17] In addition, some funds from Kabupaten budgets are used for minor irrigation investments on both DPU and communally managed systems. In at least one province, that of East Java, the Kabupaten dinas PU has responsibility for planning and supervising construction of minor irrigation works funded by Inpres Dati II.

2. Funding flows for irrigation in Indonesia

Approximately three-fourths of the funds for irrigation at the provincial level are provided by the Central Government and there is a complex relationship between the Central and Provincial Governments on financial matters. The flow of funds from the Central Government is shown in Figure 5-2, but it is important to remember that additional direct revenues are raised at the Provincial and Kabupaten levels.

The largest portion of irrigation financing is provided through the sectoral budget (APBN) of the DGWRD directly to the provincial public works agencies. Project proposals from the Provincial DPU are appraised and recommended by the provincial authorities but final selection is by the Central Government after a negotiation process. The main budgets are as follows:

- The Subsidi Daerah Otonom which is a routine budget for salaries and allowances of permanent civil servants employed by the Regional Government but paid by the Ministry of Home Affairs. This comprises 46 percent of total Regional Government revenue and 22 percent of the national routine budget;

- The Inpres Dati I or Provincial Development Grant is a multi-purpose grant provided by the center for development projects in the provinces. There are both fixed and discretionary components. Through DATI I, funds are available for irrigation rehabilitation and upgrading, and for O and M. Awards are made on the basis of weightings by population, size of cultivated area and length of existing roads in each province; and

- Dati II or the Inpres Kabupaten which is allocated on a per capita basis and is not earmarked, though most of it is spent on infrastructure development.

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[17]This Committee is composed of village administrative and irrigation officials who together decide cropping patterns. The two sets of authorities are generally separate.



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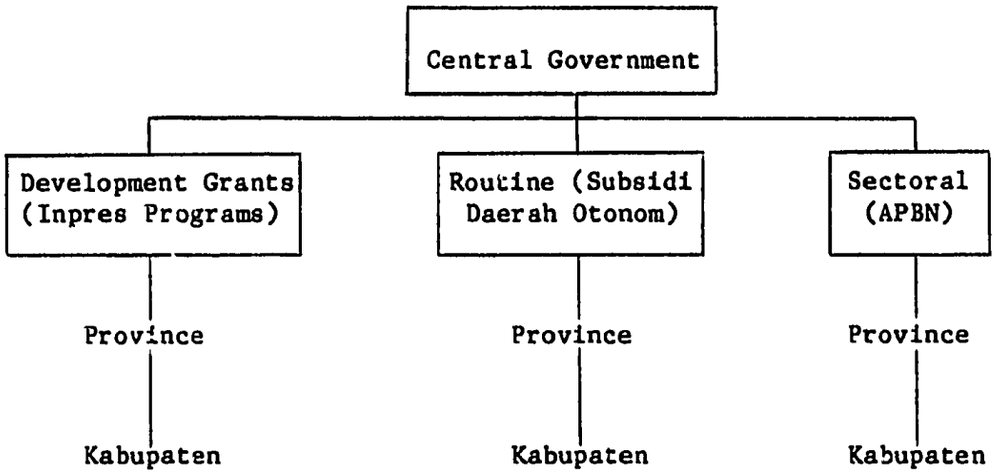


IRRIGATION PRICING AND MANAGEMENT: INDONESIA

Figure 5-2: Funding Flows from the Central Government to Province and Kabupaten Levels

The irrigation development budget for Fiscal Year 1980-81 is shown in Table 5-8. The APBN provided Rp. 200.3 billion of which Rp. 110.5 billion was earmarked for new construction, Rp. 69 billion for rehabilitation and Rp. 20.8 billion for swamp and tidal area development. In addition, Rp. 66.9 billion was budgeted for construction and rehabilitation from foreign aid sources. At the provincial level, total funds available from Central Government sources were Rp. 38.8 billion. Of this, Rp. 7.4 billion was Inpres Dati I earmarked for rehabilitation and Rp. 19.8 billion for O and M. Additionally, Rp. 8.2 billion represented Subsidi Daerah Otonom for salaries and other routine budget expenses. The main sources of funding at the Kabupaten level and below are the Inpres Dati II (Rp. 7.8 billion) and the Inpres Desa (about Rp. 4.9 billion). These funds are used for small construction and repairs.

Funding of irrigation from Kabupaten direct revenues is almost negligible and in 1980-81 amounted to Rp. 0.8 billion. For tertiary construction a special employment creation program provides funds through a special APBN to finance the cost of labor intensive channel construction complementing the DPU. This amounts to about Rp. 14 billion. In addition, the Agriculture Ministry provides an APBN allocation of Rp. 266 million to assist the formation of P3A under the national Tertiary Development Program.[18]

Examination of recent trends in financing show a significant increase in grant allocations to Provincial Governments for O and M. In the five years prior to 1980-81, they increased from Rp. 5.6 billion (about Rp. 1,500 per ha) to Rp. 19.8 billion (over Rp. 4,000 per ha). Allocations for rehabilitation have risen more slowly and there has been a decline in funding from other sources such as the Ministry of Agriculture and Inpres Dati II. This suggests a shift towards greater dependence upon Central Government funding.[19]

### 3. Irrigation policies and practice

#### a. Irrigation management

##### (1) Organization for O and M

###### (a) The Government's management structure

Responsibility for operating and maintaining irrigation systems in Indonesia is divided between the Government and local communities. The major irrigation systems, including intake structures, primary and secondary canals and related structures are the responsibility of the Provincial Government, although in practice as

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[18]Bottrall, Financing Irrigation, pp. 18-20.

[19]Ibid., p. 21.



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Table 5-8: Official Financing of Irrigation Development 1980-81

| Source of Funds | Purpose | Government Expenditure | Foreign Aid | Total |
|---|---|---|---|---|
| **Central Government** | | | | |
| Public Works | New construction | 110.5 | 34.3 | 144.8 |
| | Rehabilitation | 69.0 | 29.6 | 98.6 |
| | Swamp and tidal | 20.8 | 3.0 | 23.8 |
| Agriculture | Tertiary | 0.3 | | 0.3 |
| Manpower | Tertiary construction | 13.9[a] | | 13.9[a] |
| | and rehabilitation | 15.7 | | 15.7 |
| **Provincial Government** | | | | |
| Public Works | Rehabilitation | 7.4 | | 7.4 |
| | O and M | 19.8 | | 19.8 |
| | Dati I | 2.2[a] | | 2.2[a] |
| | Other | 9.4[a] | | 9.4[a] |
| Agriculture | | 0.5[a] | | 0.5[a] |
| **Kabupaten** | | | | |
| | Inpres | 7.8 | | 7.8 |
| | Local taxes | 0.8[a] | | 0.8[a] |
| **Desa** | | | | |
| | Inpres desa | 4.9[a] | | 4.9[a] |
| TOTAL | | 269.1 | 66.9 | 336.0 |

[a]Estimated.

Source: Anthony Bottrall, Financing Irrigation: Central-Local Financial Relation Review for the Government of Indonesia. Sectoral Study No. 3 (Birmingham: Development Administration Group, September 1981).





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noted in Section 1.a. above, the Central Government is also involved. System maintenance from the tertiary turnout to farm ditches is the responsibility of the farmers who are guided and supervised by government officials.

The organization of the typical irrigation district is based on a command area of 60,000-100,000 ha of irrigated land. Officials at this level are responsible for the design of minor rehabilitation works, construction supervision, assessment of O and M priorities and Section supervision. Below that level the Section or seksi usually comprises 20,000-40,000 ha under the charge of a section head (Kepala seksi) who is instrumental in planning, executing and monitoring day-to-day O and M activities. This is shown in Figure 5-3. Section staff provide the main contact with the Bupati who is the executive of the Kabupaten. At the 5,000 ha level the Sub-section Office provides administrative and operational support while ditch tenders or juris at the 700-1,000 ha level make direct contact with village level water officials. The juris are the most junior members of the DPU's field staff. Water distributors at the village level are known by a variety of names such as ulu-ulu, jogotirto, raja bondar, etc. Regular DPU staff above the juru level are classified as Central Government employees and their salaries come out of a routine budget at the center.

Since Section and district offices are organized on a hydrological basis their boundaries often do not correspond with the Kabupaten administration or with other administrative units at that level, such as the Agriculture Department. This is particularly true in Java. In Bali and Sumatra, the administrative areas of the DPU Section fall within single Kabupatens, while in South Sulawesi many Section Offices cover two or more Kabupatens with small irrigation systems and their boundaries coincide with those of the Kabupaten.

The main administrative difficulty that arises where Kabupaten and Section boundaries do not coincide is with the work of the interdepartmental Irrigation Committees that require cooperation between the DPU Section office, the Kabupaten administration and/or agriculture. The Committees meet twice a year prior to the wet and dry seasons to discuss planning for cropping patterns and water scheduling within the Section command area. The local Bupati chairs the meetings, the DPU's Section Head is the secretary and members include the head of the Agriculture Department in the Kabupaten level. Irrigation system performance monitoring is also effected by overlapping authorities for information on irrigated areas under each crop and yields are aggregated to the Kabupaten level which keeps data on both rainfed and irrigated agriculture. It is, therefore, extremely difficult to estimate irrigated production. Finally, water distribution activity that relies heavily on good communication between local government irrigation agencies, agricultural extension agencies and the final user is also hampered.



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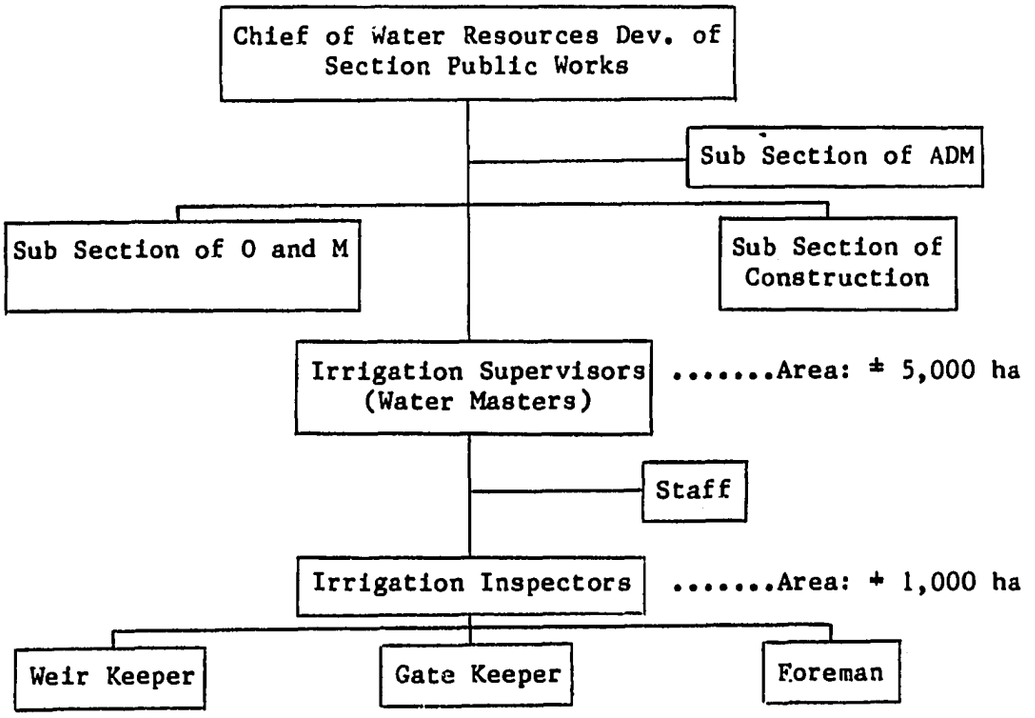


Figure 5-3: Organization of District Public Works for Irrigation Administration

Source: Directorate General of Water Resources Development, Ministry of Public Works, General Information on Irrigation Operation and Maintenance Activities in Indonesia (Jakarta, July 1984).



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(b) Farm level management

Water distribution and application at the farm level varies between the wet and dry seasons. During the rainy season, water is generally supplied through the tertiary and quartenary channels on a continuous basis and farmers take it at their own discretion. Institutional control is at a minimum. As supplies decline during the dry season, institutional control on the system is increased and farmers can no longer make unsupervised withdrawals. Water is then distributed among farmers under the supervision of the village irrigator helped by the WUA if one exists.

During the dry season, one of the methods used to match reduced irrigation water supplies to demand, is to reduce the amount of land planted to rice. Hence, cropping decisions are very important and are made at the village level by the village administration and the WUA. Water allocation to various groups of farmers are also made and the cropping decisions are implemented by the village irrigator.

Water distribution in rice paddies is by means of quartenary channels. Rice is grown in small submerged basins that are formed by bunds laid out parallel to the ground contours--the distance between bunds decreasing with increasing land slope. Superimposed on the paddy pattern are the property boundaries, generally normal to the slope and to the supply channel. To apply water to the land, farmers introduce water in the basin nearest to the intake point on the supply channel. Water then spills from the higher to the lower basins until the last basin within the property unit is irrigated. Farmers do not normally use field channels within individual property units.

Management at the tertiary level is legally specified as the responsibility of the desa (village). Village irrigation systems have historically been disaggregated into small management units of 10 ha. It is not uncommon to see a tertiary flanked by two quartenary channels running parallel over long distances. Such physical design helps clearly define a social group of farmers, their water rights and obligations to maintain channels. Since farmers get water only through the quartenary channels, farmer groups are responsible for maintenance of quartenary channels. The village administration maintains tertiary channels because water from them is used for domestic and agricultural purposes. Increasingly, formation of WUAs is being encouraged to obtain farmer participation in O and M on government irrigation as well as on the traditional village systems.

In Indonesia, there is a lengthy and well-documented tradition of irrigation systems managed by WUAs. The associations have different names in various parts of Indonesia, being known as Dharma Tirta in Central Java, Mitra Cai in West Java and Subaks in Bali. In Bali, the Subak is a social organization whose members help maintain canals and dams, distribute water and participate in religious ceremonies. The area of the Subak varies from 10 to 300 ha and the number of members from 50 to 600. Since the boundaries of the organization do not

correspond to the political boundaries of the villages, members of a Subak are not necessarily from the same village. The organization has its own rules and regulations that govern rice cultivation and crop rotations for rice and dry season crops, resolution of disputes among members and the performance of religious ceremonies.

Data on WUAs and their membership is difficult to obtain. In any case, membership most likely varies a great deal. However, information on WUAs in selected provinces is provided in Table 5-9. Even where there are no formal WUAs, farmers often organize themselves for voluntary labor (goyong rotong) to clean and maintain farm level canals and ditches. Although there is no formal charge for O and M, farmers make contributions in money, labor or in kind to the ulu-ulu who is responsible for village irrigation affairs. Sometimes these payments are quite substantial. Data on some payments for ulu-ulu services by farmers are provided in Table 5-10.

The growing emphasis on O and M improvements has been accompanied by efforts to establish WUAs under the assumption that where farmers are organized for the effort O and M will be improved. However, the process of establishing functioning WUAs is difficult for several reasons. Where construction and rehabilitation work have already been completed it is difficult to convince farmers that they must be responsible for maintaining a system that was constructed by the government. This has happened, for example, in the Tertiary Development Program which intended that farmers would assume responsibility for O and M once system rehabilitation or construction was completed. Farmer associations were formed for this purpose. These organizations sometimes replaced the traditional ones. However, they did not often obtain farmer support. The problem was that the program was directly funded by the Central Government whose objective was to speed up the process of rehabilitation in the interest of maximizing farmer benefits through improved efficiency and equity of water distribution at the farm level. Central Government expenditure in 1980-81 alone amounted to Rp. 49.3 billion. But there was a tradeoff involved, for farmers were reluctant to assume support for systems they did not regard as their own. A possible solution would be to slow down the process of tertiary construction and rehabilitation and attempt to get farmers involved by contributing whatever they can in the form of land and labor.[20] Other difficulties involved in establishing viable WUAs include the fact that irrigation boundaries do not correspond with political boundaries and there is sometimes conflict between the village administrative leader and the water leader elected by the farmers.

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[20]Interview with Mr. Peter Sun, World Bank.



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Table 5-9: Water User Associations in Selected Provinces, 1977-78

| Province | Name of the WUA | Total Number of WUA | Total Member Farmers | Total Area (ha) |
|---|---|---|---|---|
| Bali | Subak | 1,262a | NAb | 98,673 |
| Java Central | Dharma Tirta | 928 | 254,398 | 128,215 |
| East | NA | 1,358 | NA | NA |
| West | Mitra Cai | 2,568 | 138,081 | 171,460 |
| Sulawesi South | NA | 113 | NA | NA |

[a]The figure is for 1979.
[b]NA = Not available.

Source: A.J. Nyberg and Dibyo Prabowo, Status and Performance of Irrigation in Indonesia and the Prospects to 1990 and 2000, Working Paper, Southeast Asia Project, IFPRI, February 1982.



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Table 5-10: Farmers' Payments to Village Irrigation Officials--Some Examples

| Run-of-the-River | Average Seasonal Rate (per ha) | Crop Seasons | Total Annual Payments (RP./ha) (@ Rp. 100/kg rice) |
|---|---|---|---|
| 1. Bali: | | | |
| a. DPU system | 200 kg rice | 2 x rice | 4,000 |
| b. Communal system | 10 kg rice | 2 x rice | 2,000[a] |
| 2. Pekaten Sampean, E. Java - DPU system | 30-50 kg rice | 2 x rice or 1 x rice plus 1 x polowijo | 6,000-10,000 |
| 3. Sragen/Solo region, C. Java - Dharma Tirta communal system | 115 kg rice | 3 x rice | 34,500 |
| 4. Lake Toba region, N. Sumatra-communal system | 20 kg rice | 2 x rice | 4,000 |
| 5. Sidrap, S. Sulawesi, DPU system | 50 kg rice | 2 x rice | 10,000 |
| Pumps | | | |
| 6. Kediri-Nganjuk, E. Java, DPU Tubewells | hourly charges for fuel consumption and operator (Rp. 250-600/ha) | 2 x rice or 1 x rice plus 1 x polowijo | 25,000-40,000 |
| 7. Sedrap, S. Sulawesi, communal low-lift pumps | 100 kg rice | 2 x rice | 20,000 |

[a]Plus special contributions for major maintenance and repair when the need arises; may be up to Rp. 6,000/ha, but not every year.

Source: Anthony Bottrall, Financing Irrigation: Central-Local Financial Relation Review for the Government of Indonesia. Sectoral Study No. 3 (Birmingham: Development Administration Group, September 1981).



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(2) The cost of O and M

O and M costs are difficult to estimate, they vary with the type and status of irrigation systems. Thus, for example, O and M costs would differ between technical, semi-technical or simple systems. They would vary, as well, depending on whether or not rehabilitation had taken place, and contrary to expectation, O and M costs might even increase after rehabilitation depending upon the level of upgrading. A study conducted by the Gadjah Mada University Team concluded that current allocations were insufficient for efficient operation of systems or for attaining their useful life.[21] They proposed that main system O and M costs should be about Rp. 13,000 per ha annually and an additional Rp. 7,000 was required if tertiary systems were included. Most officials contacted by the present team estimated that main system O and M requirements were Rp. 15,000 per ha. In 1981-82, the Directorate of Irrigation issued guideline figures for provincial government use in proposing main system O and M budget requests. The total amount suggested was Rp. 13,145 which is equivalent to Rp. 15,000 in inflated 1983-84 prices.

Data from the Gadjah Mada University study showed that for the Pemali Comal Area of Central Java actual expenditure on O and M was as follows: 48 percent on salaries and wages and almost 39 percent on O and M of channels, hydraulic structures and inspection. At the tertiary level, farmers contributed additional amounts in cash and kind as well as contributing labor whose imputed value was Rp. 3,460 (see Table 5-11). In total, farmers provided about 18.6 percent of total O and M expenditure on the main and tertiary canals not including the imputed value of their required contribution of labor.

b. Cost recovery

(1) Types and levels of charges

(a) Direct charges

(i) Farmer payments

Although it is not recorded in official budgets, farmers in Indonesia make significant contributions towards the cost of O and M, especially for communal systems and for the tertiary sections of DPU systems. The subaks of Bali are self-financing and WUAs in Java and some of the Outer Islands are also quite active and successful in terms of cost recovery. Farmers

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[21]The Gadjah Mada University Team, Executive Summary: Study of Regional Capability to Finance the O and M Costs for Irrigation Systems in the Prosida Projects in the Pemali-Comal Area, Central Java and in the Bantimurung and Lanrae Project Areas, South Sulawesi, May 1982, pp. IV-21.



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Table 5-11: Comparison of Actual and Proposed O and M Costs of Gung Irrigation Section (Pemali-Comal Central Java) (Rp./ha)

| Cost Allocati | O and M Cost Actual | O and M Cost Proposed |
|---|---|---|
| Main Irrigation System | | |
| Wages and salaries | 4,442 | 5,027 |
| Transport | 149 | 395 |
| Office supplies | 276 | 221 |
| Routine O and M | | 393 |
| O and M[a] | 3,170 | 5,748 |
| Oth r | 1,037 | 850 |
| Subtotal | 9,074 | 12,634 |
| O and M Cost at Regional and Provincial Levels[b] | 1,815 | 2,520 |
| Tertiary Irrigation Level | | |
| O and M | | 4,750 |
| Ulu-Ulu and P3A salaries | — | 1,200 |
| Subtotal | 2,490 | 5,950[c] |
| TOTAL | 13,379 | 21,104 |

[a]Includes channels, hydraulic structures and inspection.
[b]Estimated at 20 percent of main system O and M cost.
[c]Includes actual farmer payments in cash and kind and imputed value (Rp. 3,460) of own-labor contribution required.

Source: The Gadjah Mada University Team, Executive Summary: Study of Regional Capability to Finance the O and M Costs for Irrigation Systems in the Prosida Projects in the Pemali Comol Area, Central Java and in the Bantimurung and Lanrae Project Areas, South Sulawesi, May 1982.



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generally make two types of payments. The first is a payment to the local irrigation official such as the ulu-ulu for water distribution services and the second is the labor contribution known as goyong-rotong for maintenance of irrigation and drainage channels. Since payments are usually made in kind there is a built-in protection against inflation. Bottrall suggests that farmer payments are considerable in some places and that this must be taken into account when considering potential increases in farmer contributions towards irrigation investment in the future.[22]

Reference has already been made to farmer payments in the Pemali Comal area that amounted to Rp. 2,450 per ha per year. Amounts of farmer contributions in other regions of Indonesia are shown in Table 5-10. Collections at the tertiary level are generally good because of community pressure and because they are made in kind. Table 5-10 shows considerable variation in the amount of payments made in different places. This is due to a variety of factors. In Bali, for example, the charges appear relatively low but they disguise the fact that in the first case, the official also receives payment in the form of subak land. On the second system, labor contributions are very high. Payments in Central Java are much higher because they include charges for capital costs of tertiary improvements in addition to regular O and M. On the pump irrigation systems, farmers are willing to pay the much higher costs arising from the high fuel charges because of the higher returns obtainable from use of this type of irrigation. On the basis of these data, Bottrall concluded that farmers are both willing and able to pay for irrigation when they are offered a service that they perceive is worthwhile because it results in a net profit to them.

(ii) IPEDA

The IPEDA is a land tax aimed at recovering some of the benefits resulting from improved productivity due to irrigation. Water users pay the IPEDA in addition to the payments made for O and M at the tertiary level. For the purposes of this tax, irrigated paddy land is classified into 15 productivity classes and non-paddy rural land into 17 classes. The land classification, along with rice prices and land values, are incorporated into the formula for calculating the IPEDA which is set at 5 percent of the value of net annual production from paddy land, or 5 percent of the annual rental value on nonproductive land.

Usually collections are made annually after the main harvest. Collectors in the rural areas (excluding estates) are desa government officials. After collection, deductions are made for the collector and for deposit at the provincial level and the remainder which amounts to 72 percent of the total is transferred to the kabupaten. IPEDA revenues are legally permitted to be used for infrastructure development for raising food production which includes irrigation,

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[22]Bottrall, Financing Irrigation, p. 27.



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transportation, flood control and energy distribution. The bupati or head of the kabupaten has considerable discretion over how the IPEDA is spent since there are no specific regulations governing spending allocations for different categories of development purposes. Field survey data from the Gadjah Mada University Study indicate that a very small percentage of the tax is spent on agricultural development and much less (possibly one percent) on irrigation development. (See Table 5-12.) The IPEDA is basically regarded as a development fund and not for O and M.

(b) Indirect cost recovery

Government policy with respect to subsidies on fertilizers and rice prices was discussed in Section A.1.b. Indirect cost recovery results from the incremental rice production being procured by the Government at a price lower than the import price as it effects a savings in foreign exchange. Improved irrigation is one of the factors contributing to increased production, and as such, this represents an indirect cost recovery mechanism. However, due to the complexity of the consumer and price subsidies, it is difficult to estimate the amount of the indirect cost recovery. It should be pointed out that it is not necessarily desirable to continue subsidies for the purposes of cost recovery because of the distortions that result. In fact, reduction of the fertilizer subsidy would increase net revenues to the Government, thereby making increased funds available for irrigation while reducing price distortions.

(2) Collection rates

From the point of view of improved O and M at the tertiary level, collection rates in the form of payments in kind and of contributions of voluntary labor are generally good, primarily because of the impact of community pressure. This is particularly true where there are traditional WUAs such as in Bali and Java. On the other hand, formation of WUAs is more difficult as is cost recovery on systems which farmers regard as being provided by the central government. Collection of the IPEDA, an alternate source of funding for irrigation development, is also not a problem. But such a small portion of this tax currently goes toward irrigation that it has not so far been of much importance. Even when a portion of the IPEDA is allocated for irrigation, it is not usually made available for O and M purposes. However, the IPEDA is a promising potential source of funds and changes could be made that would allow an increase in the tax to be used for main system O and M. Both USAID and the World Bank are examining the possibility of earmarking a portion of the IPEDA for O and M. Recently, the World Bank has succeeded in securing agreement to do this on the West Tarum Canal project near Jakarta.[23]

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[23]Mark Svendsen provided this information.



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Table 5-12: Utilization of IPEDA[a] in Two Regencies, 1978-79

| Type of Expenditure | Tegal Regency, Central Java | | Maros Regency, South Sulawesi | |
|---|---|---|---|---|
| | Amount (000s Rp.) | Percent | Amount (000s Rp.) | Percent |
| Agricultural infrastructure development[b] | 12,000 | 2.90 | 4,368 | 5.06 |
| Transportation infrastructure | 63,122 | 15.23 | 24,532 | 28.29 |
| Public utilities | 210,865 | 50.90 | 26,305 | 30.34 |
| Other | 128,287 | 30.97 | 31,490 | 36.31 |
| TOTAL | 414,274 | 100 | 86,715 | 100 |

[a]Land tax.
[b]Includes irrigation O and M, fish ponds, slaughter houses, etc.

Source: The Gadjah Mada University Team, Executive Summary: Study of Regional Capability to Finance The O and M Costs for Irrigation Systems in the Prosida Projects in the Pemali Comol Area, Central Java and in the Bantimurung and Lanrae Project Areas, South Sulawesi, May 1982.

## C. Irrigation Projects

### 1. Kali Progo Irrigation Project

#### a. Background

##### (1) Description

The Kali Progo Irrigation Project (KPIP) is a national project which provides year around irrigation to 35,259 ha of land located in the lower Progo Basin contiguous to the city of Yogyakarta in central Java. The project area surrounds the city and lies in the Special Province of Yogyakarta.

The project is the culmination of work started in 1970 when the United Kingdom Overseas Development Administration supported a study of the Progo Basin. The Progo Basin lies on the south slopes and adjacent coastal plain of the 3,000 meters high cone of Merapi, an active volcano. The basin has an area of 327,000 ha of which 103,000 ha is cultivated (sawah) and grows at least one crop of rice each year. The lower basin is essentially contiguous with the Special Province. The Upper basin skirts the volcano toward the west and lies in Central Java Province. Following the study's recommendations, designs and construction started in the lower basin under a national project created in 1973 by order of the Minister of Public Works. This work proceeded using local funds for construction with equipment and services supplied by UK until 1978 when the World Bank provided a US$ 52 million loan to support the US$ 70 million KPIP. Previous investments totaled Rp. 10,000 million by Indonesia with a UK contribution totaling L 1,080,000.[24]

Irrigation services are classified as technical, semi-technical and non-technical. Technical systems supplement streamfed areas with government-run intakes and major canals. Semi-technical systems are those in which the intake structures remain under government control but the canals come under the village. Non-technical systems are fully village controlled. Besides the 35,000 ha in the lower basin under technical irrigation, technical and semi-technical systems serve another 20,000 ha in the Upper Basin. About 37,000 ha have non-technical service and 11,000 ha are rainfed.

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[24]Sources of documentation for this report are DGWRD, "Kali Progo Irrigation Project Yogyakarta," undated 8 p. and "Project Presentation. Kali Progo Irrigation Project-Phase 2. Sermo Dam, Upper Areas and Basin Planning" Departmen Pekerjaan Umum, Directorat Jenderal Pengainan Directorate Irigasi II. Project Irrigasi Kali Progo. Yogyakarta. Undated. 15 p.



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Principal service under the KPIP is provided by the 31-km Mataram Main Canal which crosses 30 tributaries emanating from the slopes of the volcano. Some 220 pick-up weirs ranging in height from 1 to 7 meters divert water from tributary streams. On the western side, the 24-km Kalibawang canal conveys Progo water to some coastal areas and to about 1,600 ha along the west (right) bank of the river. This canal is located on steep slopes and crosses a number of deep valleys. The Directorate plans to improve service to the areas served by this canal with its proposed Sermo Dam which would provide 18 million cubic meters of reservoir storage. About 125 km of secondary canals and associated structures were rehabilitated. Water user organizations are being formed to manage the 1,080 tertiary units in the system.

(2) Agriculture in the project area

The Progo Basin has a population of 5 million. Most of the people are farmers and farm holdings are very small, about 0.15 to 0.3 ha. Three crops per year can be grown where water supply is available. Estimated cropping intensity for the project overall is 2.25. Annual yields anticipated after rehabilitation were 8.0 tons per ha dry paddy (14 percent moisture basis) up from 5.1 tons per ha before the project. From conversations with the President of one of the water user associations, who talked about seasonal yields of 9-10 tons per ha wet basis, using 140 kg nitrogen per ha, these targets are evidently being met or are surpassed in some areas. The acting Project Manager reported seasonal yields of 4 to 16 tons per ha, with 4 tons per ha minimal. Non-rice crops are raised for one season on a rotational basis after five to eight seasons in rice. These crops are principally sugarcane and vegetables. HYV rice is planted, although farmers are free--within limits--to choose varieties but the Agricultural Department may advise otherwise. Local rice varieties are subject to disease.

(3) Functioning of irrigation in the project area

The system seems to function very well and is in good condition but it has just been rehabilitated. Tertiary distribution channels are in reasonably good shape and fields are uniformly well watered.

b. Project management

(1) Administrative structure

The project is organized under the Directorate of Irrigation in Jakarta with a Project Manager in the Jogjakarta Headquarters assisted by various staff divisions including Planning and Design, Operations and Management, and Tertiary Development. There are ten separate systems under the project. The project has responsibility for management of the diversions main and secondary



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canals, and in some instances tertiary or quartenary channels although these normally are the farmer's responsibility. The management is arranged hierarchically with ditch tenders or jurus at tertiary levels.

(2) Farmer organization and participation

Responsibility for management of tertiary distribution and maintenance has traditionally been with village officials. Beginning in 1980, the KPIP initiated a program to develop water user associations based on hydraulic divisions. The responsibilities of farmers through the WUAs are described in an interview with the President of one of these associations. The Association was organized in January, 1984. The tertiary under this WUA has an area of 70 ha. It has 254 members, 35 of whom are women. Membership is open to whoever is on the land, owner or tenants, in this association, but in some cases, we were told, it may be limited to owners. Officers meet at five-week intervals and the whole association meets annually. Scheduling is worked out. The 70 ha is divided into five rotational blocks and water is rotated one day out of five.

The cropping pattern is discussed and worked out through the WUAs. The organization also maintains discipline and can invoke penalties which are taken in paddy. Deciding upon maintenance and work programs is also a responsibility, but this seemed still to be controlled in part by village officials. During the dry season, water is available for only 55 ha. The WUA decides who shall plant and this is rotated annually. Regarding conflict resolution, the President stated that this is done by the President at any time. There was some expression that in difficult situations the village officials become involved.

How successful formation of WUAs will be is still to be tested. The one examined seemed to be functioning well; however, on this same lateral, the other six tertiaries do not have functioning water user associations.

b. Cost recovery

For main and secondary channels, O and M is fully subsidized by the Central Government except that farmers contribute voluntary labor. The annual O and M allowance is Rp. 15,000 per ha. There seemed to be mixed opinions by the project officials on whether or not this was adequate.

Project officials stated that the charge to farmers for maintenance of tertiary systems was 25 kg of paddy per ha. Members of the association visited, pay Rp. 8,000 per ha annually according to the President. Fees may also be paid in cash or by labor at the rate of Rp. 400 per half day. The President stated that farmers do pay their fees.



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## 2. West Sumatra Sederhana Program

### a. Background

The Sederhana Irrigation Program was instituted by the Government of Indonesia in 1974 in order to develop small-scale (no more than 2,000 ha each) low-cost irrigation by rehabilitation or new construction outside Java. This was part of the overall objective of achieving rice self-sufficiency and simultaneously providing increased employment and earnings in the rural areas. It was also intended that at a later stage construction of new systems in more sparsely populated areas would encourage resettlement from Java. Originally, the target was to establish Sederhana schemes on just over a half million ha in a five-year period. By 1981, over 1,800 small-scale irrigation projects had either been rehabilitated or constructed throughout the country.

The United States Agency for International Development (AID) joined this effort in June 1975 with the contribution of a US$ 20 million loan. AID funds were designated for reimbursement of local construction costs, for technical assistance to project management and for training. In 1978, AID financed the Sederhana II project with a US$ 25 million loan and a US$ 4.5 million grant to continued and extend the work of Sederhana I. Some of the projects described in this section were funded by AID.

Despite technical and management problems encountered by the Sederhana program and the uneven development in different places, the program has many advantages. It has been a stimulus to the Provincial Public Works departments who are responsible for implementation. The low cost has enabled a great many farmers to have irrigation who would not otherwise have it. An AID evaluation[25] found that the program had improved water security, facilitated double or triple cropping and increased rice yields. However, some of the problems included poor quality of work that meant high annual maintenance costs and the likelihood of extensive rehabilitation of structures within a relatively short time. On the whole, though, a World Bank review concluded that the program was imaginative and "with the right management, has the potential for improving the welfare of farmers outside Java more quickly than some of the larger, technically more complete, but more expensive and time consuming, irrigation schemes."[26]

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[25] USAID, Sederhana: Indonesia Small-Scale Irrigation, AID Project Impact Evaluation Report No. 29, February 1982, p. 5.

[26] The World Bank, Irrigation Program Review, Annex 2, p. 5.



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(1) Description

(a) General

All Sederhana projects were designed and constructed in the simplest practical way. They are run-of-the-river gravity-fed systems consisting of a weir or diversion dam, a headworks canal structure, primary and secondary canals and tertiary and quartenary channels for on-farm water delivery. The size of completed systems varies from less than 50 ha to as much as 2,000 ha although most systems are smaller than 300 ha. Hydraulic design is often based on reconnaissance and topographic surveys with a minimum of detailed site information. This was apparent at some of the projects visited by the team in West Sumatra where the weirs were over-designed. The dams were much larger than was necessary given the water supply on the site. More specific descriptions of the project sites visited by the team follow.

In Sumatra, 95 percent of the irrigation consists of small-scale systems both because of the rugged topography and by virtue of the fact that many of the systems were built by the villagers themselves. The Sederhana program assisted in improving these systems by building more permanent structures. This enabled a cost savings because the traditional systems were temporary structures that were often washed away by annual floods and had to be reconstructed frequently. The program also built canals to improve distributional equity over the field-to-field irrigation practiced prior to the improvements.

(b) Guguk Landuk project

The Guguk Landuk project is located in Kabupaten Solok about 10 km south of Solok city. The system was newly constructed in 1981 at a cost of Rp. 105,980 and consists of the typical diversion weir with a lined canal 3.39 km long. About 25 ha on this scheme obtains water from another system as well. The design irrigation area is about 236 ha and actual irrigated area in the wet and dry seasons amounts to 190 ha. About 95 ha can be irrigated for a third crop. All the irrigated land is in one village with a population of 1,510 and about 400 families.

(b) Bandar Kuok project

The Bandar Kuok irrigation system is also located in Kabupaten Solok about 15 km south of Solok city. The system had been built originally in 1974 but it was rehabilitated in 1979-80 at a cost of Rp. 15,975 for the construction of a 1.5 km lined canal. Design irrigation area is 525 ha and only 70 percent of this is irrigated which amounts to a total of 367 ha for each of three seasons. More of the area could be irrigated if another canal was built. There is some dissatisfaction among the farmers who do not have



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irrigation and feel that they could improve dry season farming with increased water supplies. There are four villages in the irrigation area which has 1,445 families and a total population of 5,389.

(d) Guguk Rantau project

The Guguk Rantau project is located 6 km south of Solok city and just south of the Bandar Kuok irrigation project. The project consists of the usual weir and 7.17 km of lined canals and was constructed at a cost of Rp. 265,282. The design irrigation area is 416 ha while actual irrigated area is 319 ha in each of three cropping seasons, the rest being planted in perennials or having settlements.

(e) Punggung Kasiek project

The Punggung Kasiek irrigation scheme is located in a reclamation area. The system was built in 1978 and consists of an upstream weir. At the farm level of the main canal system is lined and consists of three laterals with gates, one of which was not working. The system could provide irrigation for 4,243 ha but only 1,800 ha are now being cultivated. Water availability is not a problem but getting farmers to cultivate reclaimed land is difficult, primarily because of the lack of availability of credit for inputs.

(f) Bulakkan project

The Bulakkan project which was built in 1980 derives its water from two sources--a river and a natural spring. During the dry season, water from the river is used to supplement the spring. There is a weir at the spring site and a lined canal 1.5 km long. This construction improved reliability of the water supply although it did not extend the irrigated area. If the water in the system is well managed, it allows harvesting of two rice crops.

(2) Agriculture in the project areas

As shown in Table 5-13, the size of an average plot on the irrigation projects in Kabupaten Soloh is less than 5 ha and ranges between 0.28-0.47 ha with families holding from five to ten plots. On the average, just over 60 percent of farmers were owners in their own right on two of the schemes while on the third, 51 percent owned their land. Average farm income was lowest on Guguk Rantau at Rp. 227,000 and highest on Bandar Kuok with Rp. 466,000, most of the income coming from farm revenues and very little from wage labor on and off the farm.

Rice is the predominant crop and extension of irrigation led to an even greater emphasis on rice production to the extent that rice replaced palawija crops wherever water availability made it possible. Data in Table 5-14 show that improved irrigation is associated with increased yields ranging from 7 to 22 percent. It is possible,



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Table 5-13: Farm Size, Ownership and Income on Selected Sederhana Irrigation Projects--West Sumatra

| Project Area | Average Farm Size (ha) | Average Number of Plots | Percent Owners | Average Farm Income (000s Rp.) | Total Farm[a] Income (000s Rp.) |
|---|---|---|---|---|---|
| Guguk Landuk | 0.41 | 4.79 | 51.16 | 206.47 | 261.47 |
| Bandar Kuok | 0.47 | 9.54 | 60.87 | 416.17 | 466.39 |
| Guguk Rantau | 0.28 | 9.77 | 60.42 | 168.27 | 227.02 |
| Punggung Kasiek | NA[b] | NA | NA | NA | NA |
| Bulakkan | NA | NA | NA | NA | NA |

[a]Included earnings from farm and non-farm labor.
[b]NA - Not available.

Source: The Sederhana Assessment Study (Bogor: P.T. Exsa, March 1985).



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Table 5-14: Before and After Project Rice Yields and Fertilizer Use on Selected Sederhana Projects--West Sumatra

| Project Area | Before Project Rice Yields[a] (kg/ha) | | After Project Rice Yields (kg/ha) | | Percent Change in Rice Yields | | Fertilizer Use (kg/ha) |
|---|---|---|---|---|---|---|---|
| | Wet Season | Dry Season | Wet Season | Dry Season | Wet Season | Dry Season | |
| Guguk Landuk | 2.6 | 2.6 | 3.2 | 3.1 | 23 | 19 | 188 |
| Bandar Kuok | 2.7 | 3.0 | 3.2 | 3.2[b] | 19 | 7 | 175 |
| Guguk Rantau | 2.7 | 2.7 | 3.3 | 3.3[c] | 22 | 22 | 200 |

[a]Paddy rice.
[b]In addition, a third crop of rice is harvested with a yield of 3.2/ha.
[c]In addition, a third crop of rice is harvested with a yield of 3.3/ha.

Source: The Sederhana Assessment Study, (Bogor: P.T. Exsa, March, 1985).



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however, that increased rice yields may be a function of factors other than irrigation including increased fertilizer use, so the statistics should be treated with caution. On the other hand, irrigation has directly increased overall rice production by making possible a third crop in some areas (Guguk Rantau and Bandary Kuok) and greater dry season production in all three sites.

Comparable agricultural data on the Bulakkan and Punggung Kasiek irrigation schemes were available.

(3) Functioning of irrigation in the project areas

On-site inspection of the irrigation systems indicated that all of them were functioning well technically. To the extent that the technical improvement had increased water availability and reliability, farmers in the area were very satisfied. On the Bandar Kuok project where irrigation availability was constrained by the lack of a canal, farmers who did not have irrigation were dissatisfied. The systems themselves were in good condition since most of them had been recently built. They were also fairly well-maintained.

b. Project management and farmer participation

Project management and farmer participation are jointly treated here because small-scale irrigation systems are intended to be wholly managed by the farmers themselves. However, this was not the case on at least four of the projects visited. While it was not possible to determine whether the Bulakkan scheme was officially managed, on each of the other schemes the team met with the official gate keepers. As on the larger irrigation schemes, the juru was responsible for care of the main permanent canal structures while farmers were expected to take care of the farm-level channels.

The Chief Engineer of Public Works (Sumbar) was greatly in favor of improved concrete channels for small-scale irrigation because it saved on land requirements and made it easier to maintain the channels.[27] O and M on the systems visited appeared to be good both on the main systems and the farmer-maintained tertiary and quartenary channels. The leader of the WUA at Punggung Kasiek felt it was difficult for him to secure cooperation of other farmers in weeding and maintaining channels.

[27] Interview with Mr. Sabri Kasim.



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The development of viable WUAs was an important element of the Sederhana program. As reported in an audit in 1979, of the 52 systems funded by AID until then, only 20 had organized WUAs.[28] As a supplement to this effort, the High Performance Sederhana Irrigation System (HPSIS) was added to test and refine the participatory approach to development of small-scale irrigation. Some of its motivation derived from the problems encountered by the Sederhana program with respect to destroyed or non-functioning structures, poor O and M and poor design which were attributed to lack of farmer participation in system design and construction. Early involvement of farmers was expected to facilitate farmer participation in O and M after construction. Research on HPSIS sites, while not conclusive, supports this hypothesis.[29]

On the sites visited by the team, there was little evidence that viable WUAs had been established. At Punggung Kasiek, an informal association had been organized with 30 members. Joint management was not a problem because of the adequate water supply and members cooperated on keeping the channels clean. An interview with the organizer indicated, however, that the organization was loose and unstructured and mainly held together by his leadership.

Additional evidence was obtained about a WUA at Bandak Kuok. The association consisted of 78 members and a complete set of officers. Members generally cooperated on cleaning the canals twice a year, but the leader felt he could obtain their cooperation on little else. Neither did the officers participate to an extent. The members did not make any financial contributions to the WUA. The leader of the WUA had attended a training session and felt that he could make improvements if he were given funds directly instead of having to obtain them from the village head. It also seemed that members who were not receiving water during the dry season had little incentive to participate in the WUA. However, the team was unable to find out what proportion of the members were not receiving irrigation water.

c. Cost recovery

The issue of cost recovery for improved O and M is of great concern in the Sederhana program and the formation of WUAs was regarded as a mechanism for ensuring both cost recovery and farmer involvement in O and M. Data were not available on the amount of farmer payments, if any. No payments were collected in the two established WUAs. However, systems were well maintained and farmers contributed their own labor for this purpose. There were no estimates available of the imputed value of these labor contributions. As

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[28]USAID, Evaluation Report, p. 10.

[29]David Robinson, "Farmer Participation in the High Performance Sederhana Irrigation Systems Project in Indonesia, USAID (Jakarta: December 1984).

suggested in Section B.3.b., such contributions can be considerable and farmer ability and willingness to pay is quite evident from more general evidence throughout the country.

## D. Summary and Conclusions: Study Issues

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

In Indonesia, cost recovery is focused on O and M costs and on the basis of the available data, the outlook is encouraging. At the farm level, payments are quite substantial in some places, the farmers making monetary and in-kind contributions and contributing voluntary labor. The WUA at the Kali Progo project was able to collect fees from its members in the amount of Rp. 8,000 per ha or voluntary labor in lieu thereof valued at Rp. 400 per half day of labor provided. On the Sederhana schemes visited, there was no clear evidence of the amounts of farmer payments but they had no difficulty with organizing labor groups for channel cleaning and maintenance several times per year.

Main system O and M in technical systems requires about Rp. 15,000 per ha for adequate maintenance but funds in that amount are not generally available from the central government for the purpose. Some attention is now being given to making increased IPEDA funds available for O and M although the funds are actually for a variety of development purposes and not for O and M. In addition, there are also plans to investigate the potential for raising IPEDA charges but this requires a major land reclassification effort before it can be done.

In Indonesia, direct charges at the farm level, wherever they exist, are an important source of funds for O and M for tertiary and quartenary structures. The indirect IPEDA tax is intended primarily for development purposes although currently some consideration is being given to use it for O and M as well.

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

Wherever farmers participate and feel they have control over the systems in Indonesia, cost recovery does not seem to be a problem. This is particularly the case with traditional systems. However, attempts to establish WUAs on government-funded systems have not been so successful because farmers feel that they should be maintained by the government who built them. Data on this subject were not available from the sites the team visited.

3. <u>To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?</u>

Evidence available from the Bandak Kuok Sederhana project suggested that the WUA was unable to collect dues from its members because they did not feel that they had an adequate and reliable water supply. On the other hand, farmer payments in other irrigation areas throughout the country indicate that farmers are both willing and able to pay for irrigation if they feel they have adequate water supplies to ensure good returns. We were unable to obtain information on whether improved water delivery and measurement technology results in improved cost recovery. While the existence of delivery technology makes possible the institution of sanctions against non-payers there is great reluctance to use this.

4. <u>Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water?</u>

The Gadjah Mada study indicated that current availability of funds for O and M for main systems on government projects is not adequate. Therefore, it is important that the government investigate possibilities for securing additional funding for O and M. There is some reluctance to instituting direct water charges as this may be politically difficult but the IPEDA is an alternate avenue for raising revenues. Whether this will be implemented is not clear. Thus, it is necessary to get additional revenues for O and M on government-managed systems but there is no way to tell yet whether this will be sufficient.

One avenue that is being tried to improve O and M is to encourage formation of WUAs below the tertiary level even on the large technical schemes. These have not generally been successful because the farmers are not accustomed yet to paying for O and M on these schemes. On the other hand, O and M on the smaller schemes is generally good and presumably farmers are able to raise sufficient financial and labor resources in various combinations to maintain their systems adequately.

Data were not available on the efficiency issue as related to water charges. But as water is scarce and essential to improved rice production farmers presumably use the water efficiently.

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

In general, the answer seems to be in the affirmative with the qualification that farmers have to feel that it is genuinely their system. This is easier to accomplish on irrigation systems that were built by farmers themselves but much harder to do on systems built or rehabilitated by the government. Farmers generally believe that O and M responsibility should lie with the government if it built or

rehabilitated a particular irrigation system. On the other hand, the government hopes that farmers can be persuaded through training and work with community organizers to accept responsibility for farm-level O and M on government constructed systems. Actually, the process involves changes in attitudes and methods both on the part of farmers and of PU officials.

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Pages 8-3 through 8-7 (Tables 8-1 and 8-2) of the Irrigation Pricing and Management Study should be replaced by the attached updated version.

Table 8-1: Classification of Irrigation Project Sites in Five Countries (continued)

| Project | Size: Large >10,000 ha | Size: Small <10,000 ha | Irrigation Type and Design: High Tech.[c] | Irrigation Type and Design: Low Tech. | Types of Charges: Direct | Types of Charges: Indirect | Cost Recovery: High | Cost Recovery: Low | Organization for O and M[a]: User Mgmt.[d] | Organization for O and M[a]: Admin.[b] Mgmt. | Effectiveness of O and M: Good | Effectiveness of O and M: Poor | Modern Measurement Technology: Yes | Modern Measurement Technology: No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E. DOMINICAN REPUBLIC | | | | | | | | | | | | | | |
| 1. Valle de Azua (Coastal) | X | | X | | X | | | X | | X | Variable | X | X (some) | |
| 2. La Vega (Plains) | X | | X | | X | X | | | - | X | X | | | X |
| 3. Alto Yaque del Norte | X | | X | | X | | | X | | Some | X | | | X |

[a]O and M = Operations and Maintenance.
[b]Admin. = Administration.
[c]Tech. = Technology.
[d]Mgmt. = Management.
[e]Could not be determined.

Table 8-2: Descriptions of Irrigation Project Site Classifications (Continued)

| Project | Irrigation Type and Design | Types of Charges | Cost Recovery | Organization for O and M | Effectiveness of O and M |
|---|---|---|---|---|---|
| C. PHILIPPINES | | | | | |
| 1. Upper Pampanga Project | High-Tech.: Dam and reservoir. | Direct: Water charges P152/ha[h]. | Variable: 21-65%. | Admin. Mgmt. User Mgmt. | Good. |
| 2. Communal System | Low-Tech.: Pumps. | Direct: | Low: 42%[j]. | User Mgmt.: Formal WUA's. | Could not be determined. |
| D. PERU | | | | | |
| 1. Cancay-Lanbayeque | High Tech.: a. Reservoir b. Lined canals some regulated. | Direct: Tariffs. Quotas. Sub-sector quotas. | Low: High (labor) | Admin./User Mgmt.: Technical Administrator, staff. Junta Comisiones Comites (some) | Adequate Inadequate water |
| 2. Tacna | High Tech.: a. Upstream pumps. b. Upstream diversions. c. Lined canals. | Direct: Tariff. Quota. | Low: | Admin/User Mgmt.: Technical Administrator. Junta Comisiones Traditional bonds. | Good: Scarce water. |
| 3. Plan MERIS II | High Tech.: a. Diversors. b. Lined canals. | Direct: Quota (minimal) | Unclear. | Admin. Mgmt.: With theoretical transfer to Users (Traditional institutions bypassed.) | Good: (some not even used) |

Table 8-2: Descriptions of Irrigation Project Site Classifications (Continued)

| Project | Irrigation Type and Design | Types of Charges | Cost Recovery | Organization for O and M[a] | Effectiveness of O and M |
|---|---|---|---|---|---|
| E. DOMINICAN REPUBLIC | | | | | |
| 1. Valle de Azua | High Tech.[b]: a. Upstream diversion and storage. b. Lined canals. | Direct: (indirect collection) Increasing % of O & M from 50% to 100% in four years. | Mixed. | Admin. Mgmt.[d]: | Mixed: Drainage inadequate. |
| 2. La Vega | High Tech.: a. Diversion b. Lined major canals | Direct: (indirect collection) Increasing % of O & M from 50% to 100% in four years. | High. | Admin. Mgmt.: | Good: Inadequate water. |
| 3. Alto Yaque del Norte | High Tech.: a. Diversion b. Lined canals | Direct: Increasing % of O & M from 50% to 100% in four years. | Improving. | Admin/User Mgmt.: | Adequate/mixed. Only part covered by new system. |

[a]O and M = Operation and Maintenance.
[b]Tech. = Technology.
[c]WUA = Water User Association.
[d]Mgmt. = Management.
[e]In 1980.
[f]In 1982.
[g]IC = Investment cost.
[h]In 1980.
[j]In 1981.

Table 8-2: Descriptions of Irrigation Project Site Classifications in Five Countries

| Project | Irrigation Type and Design | Types of Charges | Cost Recovery | Organization for O and M[a] | Effectiveness of O-and M |
|---|---|---|---|---|---|
| A. MOROCCO | | | | | |
| 1. Chichaoua | Low-Tech.[b]: a. Spring fed b. Gravity. | Direct: WUA's[c] service for O and M. Indirect: a. Incremental income tax. b. WUA investment charge. | Could not be determined. | User Mgmt.[d]: a. Nonformal traditional. b. WUAs planned. | Poor: At times of water scarcity. |
| 2. Doukkala I | High-Tech.: a. Reservoir b. Gravity c. Sprinklers. | Direct: a. Volumetric charge. b. Supplementary charge for pumping. Indirect: Land betterment levy. | High: a. 89% (O and M)[e] b. 14%[f] (IC)[g] | Admin. Mgmt.: WUAs planned (formal). | User Mgmt.: Undeveloped. Admin. Mgmt.: Good. |
| B. INDONESIA | | | | | |
| 1. Kaliprago Project | High-Tech.: Reservoir fed. | Indirect: Official land tax: 5% of net value of production. | Could not be determined. | Admin Mgmt. | Good |
| 2. Western Sumatra Sederhana Project | Low-Tech.: Diversion weir, canals, gravity fed. | Indirect: a. Official land tax: 5% of net value of production. b. Labor contributions by farmers. | Poor. | User Mgmt.: a. Non-formal traditional associations. b. Formal associations planned. | Variable |

IRRIGATION PRICING AND MANAGEMENT

ANNEX 6

Annotated Bibliography

Submitted to: Ms. Joan Atherton
Social Science Analyst
U.S. Agency for International Development
Office of Policy Development and Program Review
Bureau of Program and Policy Coordination

Submitted by: Ian D. Carruthers
N.S. Peabody, III
A.A. Bishop
A.D. LeBaron
Rekha Mehra
Ramchand Oad
Dean Peterson
Dennis H. Wood

DEVRES, INC.
2426 Ontario Road, N.W.
Washington, D.C. 20009
(202) 797-9610
Cable: DEVRES
Telex: 440184

Contract No.: OTR-0091-C-00-4466-00

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2. Valle de Azua . . . . . .

a. General discussion . . . . . .

b. Discussion of field visit . . . . . .

3. LaVega . . . . . .

a. General discussion . . . . . .

b. Discussion of field visit . . . . . .

C. Morocco . . . . . .

1. Doukkala I . . . . . .

a. General discussion . . . . . .

b. Discussion of field visit . . . . . .

2. Chichaoua . . . . . .

a. General discussion . . . . . .

b. Discussion of field visit . . . . . .

D. The Philippines . . . . . .

1. Upper Pampanga River Integrated Irrigation Project (UPRIIS) . . . . . .

a. General discussion . . . . . .

b. Discussion of field visit . . . . . .

2. Laur (Pinaburyuhan) Project . . . . . .

a. General discussion . . . . . .

b. Discussion of field visit . . . . . .

E. Indonesia . . . . . .

1. The Kali Progo Irrigation Project . . . . . .

2. West Sumatra Sederhana Program . . . . . .

IV. ISSUES AND ANALYSIS . . . . . .

A. Statement of Issues . . . . . .

B. Discussion and Analysis . . . . . .

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

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

3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology? . . . . . .

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water? . .

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

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V. CONCLUSIONS AND RECOMMENDATIONS . . . . . .

A. Overall Conclusions . . . . . .

B. Study Issues: Conclusions and Recommendations . .

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

a. Conclusions . . . . . .

b. Recommendations . . . . . .

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

a. Conclusions . . . . . .

b. Recommendations . . . . . .

3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology? . . . . .

a. Conclusions . . . . . .

b. Recommendations . . . . . .

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water? . .

a. Conclusions . . . . . .

b. Recommendations . . . . . .

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

a. Conclusions . . . . . .

b. Recommendations . . . . . .

ANNEX 6

Annotated Bibliography

ANNEX 6

Annotated Bibliography

Abbie, Leslie; Harrison, James W.; and Wall, John W. Economic Return to Investment in Irrigation in India. Staff Working Paper No. 536. Washington, D.C.: World Bank, 1982.

The report investigates the efficiency of investment in surface and groundwater and public and private irrigation in India. A brief history of irrigation development is provided as are expenditures and rates of return. In 1976-78, estimates show that only 34-45 percent of operating costs were recovered in government surface irrigation schemes. Rates of return on public surface projects are low compared to investment in groundwater development.

In examining the causes for low returns in surface irrigation, the authors compare the northern with the southern systems and find the former more successful than the latter. In the north, irrigation is by run-of-the-river, irrigation intensities are very low and only a fraction of the land can be irrigated. But the water is delivered on a fixed schedule through the warabundi system. The farmers have learned to stretch scarce water supplies and are aware of their rights (established through law and custom) and insist on their turns. In the south, irrigation intensities are high, water is stored in reservoirs, conveyed through elaborate mechanisms and discharge rates can be adjusted. However, efficiency is low and allocated water is used on one-half to three-quarters of the intended area at the upper reaches. Management problems below the outlet are an important factor in lower efficiency levels as is management of water between the reservoir and the outlet.

The authors suggest that the problem of water wastage is difficult to solve without mechanisms to enforce more efficient use. Rates of return can be increased through design improvements combined with clear-cut legal water rights, efficient and timely water delivery and improved management by trained professional cadres. Imposing water scarcity on all users will be a powerful incentive to water use efficiency. Design that incorporates greater flexibility of water delivery is also useful, as are smaller areas to be served by each outlet and greater portions of the system being lined. These developments would require a greater government role. Improved operating procedures will require efficient water scheduling and equitable water allocation and the ability to overcome resistance to reallocation of water by farmers now benefitting disproportionately. Cooperation among farmers can be enhanced through controlled and reliable water supplies to outlets.



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The main factors limiting returns to groundwater investment include geologic conditions, energy availability (especially power shortages) and lack of adequate technical advice. Private wells function more efficiently than do public wells because individual control enables water application in a timely and flexible manner. Returns from groundwater irrigation can be increased through improved supply of complementary factors (electricity, credit availability, etc.) and land consolidation.

Abu-Zeid, Mahmoud. "On-Farm Water Management Programs in Egypt." 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.

Alwis, J. "An Overview of State Intervention in Irrigation Development in Sri Lanka." Presented at the Conference on Organization as a Strategic Resource in Irrigation Development. Manila, November 15-19, 1982.

This paper reviews the history of state involvement in irrigation systems in Sri Lanka. Traditionally, farmer participation in irrigation systems was based on equity and productivity and a strong, self-reliant management organization developed around the village tank. Initially, the British promoted local participation in irrigation management with local leadership, local enforcement of rules and codification of local irrigation rules. But the government's policy changed with a shift in emphasis to large schemes. Management became more centralized and institutionalized, and as traditional systems were neglected, farmers became alienated.

The Special Program of the 1960's utilized intensive management to provide a coordinated supply of inputs to farmers but since it neglected to focus on farmer participation, farmers' problems and long-term management plans, the program was unsuccessful. It has provoked changes in the irrigation system which now utilizes farmer organizations and resources in conjunction with government funding for rehabilitation of minor irrigation systems. Small scale projects which promote farmer participation are encouraged and channel-based user organizations have been formed and institutionalized.

"An Analysis of the Philippine Economic Crisis--A Workshop Report". Quezon City: University of the Philippines, School of Economics, nd.

Anderson, B. et al. Project Paper: On-Farm Water Management Project. Draft. Prepared for USAID/DR with support of Science and Technology Bureau sponsored WMSII Project. Santo Domingo: US Agency for International Development, 1983.



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Anderson, D.C. Irrigation Institutions and Water Users in Ecuador. Washington, D.C.: US Agency for International Development, 1977.

Public irrigation schemes have higher costs than private schemes, but are worthwhile in directing benefits to poor communities. Public scheme users pay higher fees than those in private schemes, but charges do not cover costs. Much of the difference in costs is attributed to large overheads and administrative costs in public schemes, and better use of voluntary services for O and M in private schemes.

Angeles, Honorato L.; Gavino, Romeo B.; and Cubos, Arturo T. Community Managed Irrigation System. Nueva Ecija, Philippines: Central Luzon State University, 1983.

This paper describes the operation of the San Roque Communal Irrigation System (SRNIA) in allocating water, managing O and M and resolving problems encountered during operation. The SRNIA strives to help farmers develop systems which are more responsive to their needs using a participatory approach. Methods for comparing and improving Water-Use Efficiency (WUE) are discussed as are the effects on WUE of changes in the system.

The SRNIA employs continuous flow irrigation at times of frequent rainfall and rotational irrigation when water is scarce. The rotation system is based on equal time allotments to each farmer.

The organization of the SRNIA has shifted from a centralized to a decentralized structure, enabling expeditious conflict resolution, improved fee collection, and greater farmer participation. Conflicts have been minimal within the organization, but they have occurred among leaders as a result of local politics and among farmers over water rights. Conflicts among farmers have been resolved by a third party. The most serious ongoing dispute is with a non-member over the use of water. The legal costs of this dispute have increased user fees greatly. Recently, fees have been regularly collected at harvest time. Previously, collections were made only when the need arose. Several other changes such as giving commissions to collectors and collection on a per hectare basis are being considered in an effort to improve the collection capability.

Ansari, Nasim. Economics of Irrigation Rates: A Study in Punjab and Uttar Pradesh. Delhi: Agricultural Economics Research Centre, 1968.

This study examines the different factors involved in irrigation pricing with special reference to the conditions in Punjab and Uttar Pradesh. It describes the evolution of the structure of irrigation rates in the two states and the theoretical issues associated with irrigation pricing, as well as



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two case studies and an analysis of a field survey. Theories that would have the state subsidize irrigation are dispensed with and methods for calculating higher interest rates are discussed. Costs of new irrigation systems are estimated and yields of revenue required for irrigation are compared with currently obtained revenue.

It was found that the rate of demand for water depends more on the degree of agricultural development than on the rate structure. Therefore, it is necessary to maximize irrigation potential by increasing availability of inputs in order to raise production and the farmers' ability to pay higher rates.

Arruda, Zenith Joao. "Pricing System for Irrigation Water as an Incentive to Conservation." (Xerox) California: The Central Valley Project, April 15, 1980.

Asian Development Bank. Irrigation Development and Management Proceedings of the ADB Regional Seminar on Irrigation Development and Management. Manila, Philippines: Asian Development Bank, 1980.

The seminar proceedings provide a useful summary of the Bank's experience in a range of countries. The conclusions have recommendations convening management and financing of irrigation projects.

Asopa, V.N., et al. Irrigation System On-Farm Development and Extension Service in Chambal Project, Rajasthan. Ahmedabad, India: Indian Institute of Management, 1978.

This study examines the Chambal Valley Development Program in the Kata and Bundi districts of Rajasthan and the state of Madhya Pradesh in India with respect to the on-farm development of physical structures. Water scheduling, pricing, and delivery policies are examined in reference to a new agricultural extension program in the region. The authors recommend a new water management approach that improves upon the transportation and communication facilities, and the education and training of village extension workers. A close interaction with state irrigation offices is also recommended.

The article describes a four-part strategy for developing water user associations and catalogues some of the problems encountered in each case. The first strategy is to give construction help to local associations with costs financed on a loan basis. This is necessitated by the temporariness of farmer constructed diversions which often do not survive the rains and result in inefficiencies and crop losses. Problems with established institutions include poor member participation, passive and/or corrupt leadership, divergent desires regarding government aid and repayment of construction costs. Good



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technical help and construction of durable structures are necessary conditions for solving or preventing some of the organizational problems.

The second strategy is for preconstruction development of the skills and viability of the associations by encouraging cooperation, active participation of all members and development of effective management skills. Group dynamic seminars can be employed for this purpose. The third strategy of fostering farmer participation in all key decisions and activities is based on several assumptions about the beneficial effects of this on institutional development. The problems include the fact that agency management systems are often designed for centralized planning and implementation; the pressures upon engineers to finish construction on time causes conflicts because the participatory approach may take longer to implement; and hiring and procurement are often done by outside agencies though farmers would like to do it themselves.

The fourth strategy is to maintain the independence of the associations by putting accountability at the local level. The first three strategies can help accomplish this but assistance is also needed after the construction phase for helping to develop farmer capacity for routine managerial tasks including record keeping, financial management, water management, etc.

Bagadion, Benjamin V. and Korten, Frances F. "Developing Irrigators Organizations: A Learning Process Approach to a Participatory Irrigation Program." Draft for inclusion in Michael Correa, ed., Putting People First to be published by the World Bank.

. "Developing Viable Irrigators' Associations: Lessons from Small-Scale Irrigation Development in the Philippines." Agricultural Administration 7 (1980).

Bayo, Jose Luis. "Sondeo Descriptivo Sobre Irrigacion en el Peru." Lima Peru: Mimeograph, September, 1982.

Bhuiyan, Sadiqul I. Irrigation System Management Research and Selected Methodological Issues. IRRI Research Paper Series No. 81. Los Baños, Philippines: The International Rice Research Institute, 1982.

Recent field research findings indicate there is great potential to improve performance of existing irrigation systems in Asian rice growing regions. Crop yield, water use efficiency, irrigation efficiency, water adequacy, relative water supply, and water distribution equity criteria can be used to assess irrigation system performance. These criteria for areas with crop planning (zoning) should consider net returns for all farmers, as well as soil suitability. Equity issues may be complicated by water rights questions. Once the equity criteria are determined,



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it is possible to assess water distribution equity. Methodological options available for evaluating field research on irrigation system management improvement are analyzed. Also discussed are applicability requirements and field considerations of practical alternatives for measuring critical hydrologic and hydraulic factors which enable the determination of water-related criteria for irrigation system performance evaluation.

Blankstein, E. and Cadman, J., "Report of Evaluative Rural Savings Mobilization Project (517-0179)." Mimeo Report. Santo Domingo: US Agency for International Development, February 1985.

Bottrall, Anthony F. Comments on Management Structures for Irrigation. Irrigation Management Network Paper 106, London: Overseas Development Institute, 1984.

A discussion of different organizational structures and their effectiveness in relation to the method of management and accountability.

_____. Comparative Study of the Management and Organization of Irrigation Projects. Staff Working Paper No. 458. Washington: The World Bank, 1981.

This paper presents an analytical framework for monitoring and evaluating administration of irrigation projects in developing countries. A review of four field studies in South and East Asia is included, which focuses on the organizational procedures affecting tail-end farmers. The appendix summarizing "Guidelines for Analysis Using a Checklist Format" is particularly useful for monitoring and evaluating irrigation projects.

_____. "Evaluating the Organization and Management of Irrigated Agriculture." Paper presented to Commonwealth Secretariat Workshop in Irrigation Management. Hyderabad, India, 1978.

Evaluation of irrigation projects tend to be limited to technical and economic performance. The processes of management require increased attention in evaluation. Paper includes a checklist for evaluating performance and returns to irrigation projects.

_____. Financing Irrigation: Central-Local Financial Relations Review for the Government of Indonesia. Sectoral Study No. 3. Birmingham: Development Administration Group, September, 1981.

An analysis of conflicts for technical, organizational and financial responsibility for post construction works and O and M in Indonesian irrigation systems. Report includes recommendations for financing, budgeting and administration of irrigation operation. The report highlights the common problem of



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administrative (Government) and irrigation management geographic boundaries not being coincidental.

_____. "Technology and Management in Irrigated Agriculture." Overseas Development Institute Review, II (1978): pp. 22-50.

The study draws attention to the debate over whether the poor performance of established irrigation systems is due to inadequate technology and/or inadequate management. Areas of management, technology and policy are examined focusing on the characteristics and problems of large and small surface schemes, and groundwater schemes. Criteria for good management are discussed using case studies in Taiwan, Kenya, and South and South East Asia. The criteria include farmer participation, communication between local irrigation users and officials and government attention to local needs. Authoritarian schemes where all aspects of irrigation are government-run may work initially but institutions become ossified. Management of small surface schemes sometimes suffers because of the lack of clarity of defined duties between officials and farmers.

Bromley, Daniel W. Improving Irrigated Agriculture: Institutional Reform and the Small Farmer. Staff Working Paper No. 531. Washington: The World Bank, 1982.

The paper focuses on the need and offers recommendations for developing institutions which better protect the needs of the farmer on the tailend of a watercourse and the small farmer (often the same person fits into both categories). Three themes emerged: 1) Farmers along a watercourse are physically interdependent. Therefore, independent activity is inefficient and unequal. Also downstreamers are especially subject to the actions of those upstream. Institutional provisions were seen as a way to correct these inequalities; 2) Uneven water supply causes institutional uncertainty. Often the cause is that farmers ignore many rules and conventions for water allocation; and 3) Small farmers tend to be cautious optimizers. Based on uneven water supply and other uncertainties, they will choose safe routes of production, at the expense of maximizing yield.

Several case studies were cited to corporate these facts in Mexico, Sudan, India, Malaysia, Philippines and Taiwan. Especially in Taiwan, it was noted that an increase in farmer water control resulted in a decrease in overall water requirements.



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The author concluded that intensification, or structuring the needs of the small farmer into an institutional system, was correlated to good water management and to higher crop yields. Two ways to assure intensification are:

-- lowering an individual farmer's costs of making mistakes; and

-- making institutions predictable and dependable--i.e., not constantly changing the "rules".

Bromley, Daniel W.; Taylor, Donald C.; and Parker, Donald E. "Water Reform and Economic Development: Institutional Aspects of Water Management in the Developing Countries." Economic Development and Cultural Change, Vol. XXVIII (2) (1980): pp. 365-387

This article addresses the effect of water security (quantity and timeliness of water supply) and water reform (institutional modifications which alter current water allocations) on irrigation farmers, particularly the less advantaged. Water security has a direct bearing on production as unreliable water supply causes farmers to take less risks or put less effort into their production activities. Water security depends on the physical characteristics of the system (water supply, losses due to transport, drainage and seepage, and distance to and number of irrigators) as well as the management of the supply (scheduling, allocation, maintenance and enforcement procedures). Farmers who are poorer, less politically influential and/or more distant from the water source are more vulnerable to water security issues.

The authors emphasize the need for a workable association to monitor and maintain water security and the need to protect the interests of the least advantaged so that water equity can be assured. The Philippine Irrigation Service Association is cited as a positive example of a working institution. Association members participate actively in the formation of the association and in the decisions which ultimately affect their access to water. In turn, their responsibilities to the association range from obeyance of rules and regulations established by the association, to payment of dues and fees, to contributions to construction and maintenance of the irrigation system.

The success of the association lies in its formalized structure and functions which require full involvement by its members, and in the cultural compatibility of the institution to the traditional structure of the society.

The authors conclude that policy changes are needed to address associations with operational or organizational problems or in situations where no associations exist. They advocate continued research into user organizations as a means of making more effective irrigated agriculture.



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Cabanilla, Liborio. Study of Operation and Maintenance Problems in Irrigation: The Philippine Case. Manila: USAID, November 1984.

California Department of Water Resources. The California State Water Project--1978 Activities and Future Management Plans. Bulletin 132-79, November, 1979.

Caponera, Dante A. "Institutional and Organizational Requirements for Water Development and Management." Farm Water Management Seminar--Manila. Rome: Food and Agriculture Organization, 1972.

Carruthers, Ian. Irrigation Development: Implications of Recent Experience for Aid Policy. Paris: Organization for Economic Cooperation and Development, 1982.

"...The greatest potential for increased agricultural production lies in reorganizing, rehabilitating, modernizing and improving management of the existing irrigation network." This conclusion by the author is supported by a review of cost/benefit issues in several areas, including the opportunity cost of irrigation, equity of water allocation, pre-planning needs, investment in local financing and recurrent costs, and improved design of construction and O and M.

Competition for resources is not necessarily between irrigation and rainfed farming, but between irrigating new land versus supplying existing developed land. Great care must be taken in the planning stages to avoid mistakes since water has such a high opportunity cost. Applied research of scientific and social factors affecting irrigation (such as plant/water/soil interactions and farmer water allocation patterns) should be a necessary prerequisite to planning for irrigation. Steps should be taken by donors to support schemes for giving the poorer farmer a larger share than what is traditionally considered "equitable" (i.e., a greater share than proportionate to amount of land owned).

Recurrent costs, which are largely local costs for operation and maintenance, have often been the most productive use of donor finances; however, donor support for O and M is "relatively rare." Table 2 (page 18) considers several aid options for O and M. The author supports greater aid for local financing and recurrent costs. He also advocates better design of O and M sections of an irrigation plan, including utilization of existing organizations versus establishment of new ones, development of manuals and maintenance workshops, provision of machinery and equipment, and financing such as water charges, land taxes, and sales or value-added taxes. He urges consideration of lower discount rates for projects, and increased support of drainage projects, small-scale irrigation, private irrigation development, groundwater development, and most importantly, modernization of



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existing irrigation systems instead of building new, costly systems.

_____. "Neglect of O and M in Irrigation--The Need for New Sources and Forms of Support." Irrigation Development: Implications of Recent Experience for Aid Policy. Annex II. Paris: Organization for Economic Cooperation and Development, 1982.

The objective of this paper is to determine the validity and implications of the hypothesis that potential performance in the O and M phase of irrigation projects is not realized because of shortages of recurrent financial resources and neglect of O and M. It is asserted that inadequate O and M adversely impacts agricultural productivity, adds costs to the irrigation agency, leads to substandard working order, decreases yield, worsens social conditions, and negatively impacts projects in other sectors.

Because planning is an ex ante procedure, planners typically "expect the worst and plan for the best." Often, appraisals focus on technical, economic and financial aspects of a plan, but not on organizational, managerial, and operational aspects, and village-level analysis. Constant feedback of data from those in charge of O and M to project planners and more attention to lessons learned from past mistakes is needed. Problems cited are poor construction standards, unfinished projects, poor financing and training of personnel, failure of water rate collections to raise sufficient funds, corruption, and various problems unique to each irrigation management system. Solutions and future strategies include government consideration of devices related to extending credit on loans, (sub)sector lending with agreed O and M amounts, more input from aid donors in protecting O and M services, contract clauses making new investment contingent upon satisfactory O and M of original project, more careful planning of recurrent costs, external audits of the budgeting system, and assessments of farmer capability to pay for adequate O and M.

_____. Aid for the Development of Irrigation. Report on the Development Assistance Committee Workshop on "Irrigation Assistance," Paris, September 29-30, 1982. Paris: Organization for Economic Cooperation and Development, 1983.

Carruthers, Ian and Clark, C. The Economics of Irrigation. Liverpool, United Kingdom: Liverpool University Press, 1983.

Centro de Estudios para el Desarrollo y la Participacion (CEDEP), Diagnostico Técnico-Económico de la Actividad Agropecuaria del Valle de Chancay-Lambayeque. Lima, Peru: CEDEP, 1984.

Chambers, Robert. In Search of a Water Revolution: Questions for Managing Canal Irrigation in the 1980's. Brighton: Institute of Development Studies, University of Sussex, 1980.



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_____. Irrigation Management: Ends, Means and Opportunities. Paper for Workshop on Productivity and Equity in Irrigation Systems in India. Lucknow, India: Giri Institute of Development Studies, September 21-23, 1982.

Views differ about objectives and criteria for irrigation and irrigation management - between individuals, groups, disciplines, professionals and departments; according to whether one or several objectives and criteria are considered; according to who is meant to benefit; and according to where objectives and criteria are located on long causal chains. As a practical framework, five focal objectives and criteria are proposed: productivity, especially of water; equity, especially in its distribution; long-term stability, both environmental and through maintenance of works; carrying capacity (livelihood-intensity), reflecting the size of population supported at a decent and secure level; and well-being, including health, amenity, nutrition and psychological factors. Measures to optimize achievement of these objectives include decisions about the size and location of area to be irrigated; changes in farm size; the scheduling and delivery of water; choice of cropping system and crop zoning; the frequency with which different zones receive irrigation; the staggering of cultivation; and the spatial and temporal spread of cultivation rights. Bringing this repertoire to bear, there appear to be rather few serious conflicts between the objectives. Perhaps the main one is between productivity and equity where high transmission losses reduce the productivity of system water distributed to tailends, but this is often offset by the highly productive use of groundwater supplied by seepage losses. In contrast, complementarities are very strong, especially with redistribution of water from head to tail which can at once be more productive, more equitable, reduce waterlogging, support more livelihoods, and enhance well-being. Many constraints on optimizing are linked with who gains and who loses from current practices, and who would gain and who would lose from changes. Facing these questions, the approach of practical political economy seeks realistic opportunities by asking how all can gain, or how losers can be reconciled to their losses. Three major problems and opportunities are presented by, first, the professional training and incentives of irrigation managers, second, the search for ways in which headreach farmers can gain while receiving less water, and third, the purchase and distribution of land to landless and very small farmers at the time when irrigation comes. To proceed further, four next steps are proposed.



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Chaudhary, Muhammed Ali. "Determination of Cost of Tubewell Water and Estimation of Economic Rent in Canal Irrigation." Pakistan Development Review, XVII (2) (1978): pp. 139-168.

Economic rent is defined in this paper as the "...residual of the value of surface irrigation at its market price..." and computed as the "...value of tubewell water cost less water rates..." Of the various types of irrigation systems in Pakistan, canal irrigation generates the highest economic rent. The author suggests that to remove economic rent, especially for segments of the irrigation system disadvantaged by canal position, water rates have to be revised in accordance with net income from crop production. Furthermore, to justify increases in water rates, the increments from revenue must be channeled to improvements in water delivery efficiency. Detailed estimates of selected irrigation systems in Pakistan are included in the paper.

Cheng, S.C., et al. A Study on Area's Agricultural Productivity for Farmers' Capability for Membership Fee for Irrigation Association. Chungli, Taiwan: Agricultural Engineering Research Center, 1980.

Farmers find the irrigation association membership fee a heavy burden because of low income, rather than because of the level of the fee. The study examines agricultural productivity and farmers' ability to pay the irrigation fee. It is argued that the government should continue to subsidize irrigation and try to increase agricultural productivity and farm families' revenue. In the long run, a soundly organized, self-governed irrigation association is desirable.

Chin, L.T. "Management, Operation and Maintenance of a Completed Project." Farm Water Management Seminar--Manila. Rome: Food and Agriculture Organization, 1972.

_____. "Irrigation Associations." Farm Water Management Seminar--Manila. Rome: Food and Agriculture Organization, 1972.

Clyma, W. and Ley, T.W. "Furrow Irrigation Practices in Northern Colorado." Water Use and Management Project. Vol. IV: Appendix C: Technical Articles by Egyptian and American Teams. Cairo and Ft. Collins, Colorado: September, 1980.

Clyma, W.; Lowdermilk, M.K.; and Lattimore, Dan. "On-Farm Water Management for Rural Development." Agricultural Engineering, (February, 1981).

This article outlines a three-phase water management development model that the authors have found, through field studies, increases food production and has significant positive effects on energy use and the environment in developing countries. The three phases are problem identification,

development and assessment of solutions, and implementation of solutions in a development program at the farm level.

An interdisciplinary team of specialists which includes agricultural engineers, agronomists, sociologists, and economists then applies this model so that a variety of factors and solutions are considered and evaluated. For example, in Pakistan the technologically best solution to the irrigation problems might have been to install concrete-lined watercourses to the farmers' fields, but economic conditions did not permit this. So, a program was developed to restore existing watercourses. This reaped many positive results, including for some a doubling of water supply, a steadier and more dependable supply, more land areas for farming, and improved yields. Indirect benefits included more efficient energy use in pumping water and less water logging and salinity.

Commonwealth Secretariat. Proceedings of Commonwealth Workshop on Irrigation Management. Hyderabad, India, 1978.

Effective water pricing will only be achieved with timely and reliable water supplies which are allocated fairly. High water charges were recommended to encourage efficiency, increase Government revenue, and as a means of taking the privileged users of irrigation.

Coward, E. Walter, Jr. "Institutional and Social Organizational Factors Affecting Irrigation: Their Application to a Specific Case." Water Management in Philippine Irrigation Systems: Research and Operations. Los Baños, Philippines: The International Rice Research Institute, 1973.

This paper examines the institutional and organizational influences on water-use behavior. The author analyzes the nature of interaction between Philippine farmers and the administration and organization of three gravity irrigation systems by focusing on the role played by the government-employed ditch tenders. The nature of this interaction is analyzed by looking at three specific factors: 1) the scale of the interaction; 2) the form of the interaction; and 3) the content of the interaction.

The scope, form, and content of interaction between ditch tenders and water users shows a pattern of integration that is authoritarian, minimal in farmer participation and is coincidental with high levels of uncertainty and frustration. As long as the water user is inhibited from being more directly involved in water distribution decisions, the system will lack feedback information for improvement and development. Greater farmer participation is urged so that the system can be developed and improved in the areas of efficiency and equitable distribution. It is noted that frequent contact between the ditch tender and the water user places the ditch tender in the role as a potential source for the



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farmers for information regarding technical innovations--a role the ditch tender is not now filling.

_____. Irrigation and Agricultural Development in Asia. Ithaca, N.Y.: Cornell University Press, 1980.

Coward, E. Walter and Ahmed, Badaruddin. "Bangladesh: A Case Study of a Successful Decentralized Village Irrigation Organization." Mimeo: Condensation of original paper. Ithaca, N.Y.: Cornell University, 1977.

The key to a successfully operated program of irrigation development and water distribution is an effective collaboration between local cooperative water users and government regulatory agencies. The following are significant aspects from the example of Comilla, Bangladesh which contribute toward its success:

The use of small-scale, village-based pump systems enable the local government and village level to exercise more control of O and M and water distribution.

Bangladesh's local government system operates a great deal at the thana (or country) level, enabling flexible collaboration. The Bangladesh Agricultural Development Corporation (BADC) allows for a good deal of variation, to enable villages to adapt their procedures to local needs. Three examples of this adaptability are taken from an example in Nabagram: 1) the village hired a water distributor, who was selected by village coop members each season; 2) the village coop set different rates for coop member users, non-coop village users and non-village water users. Since coop members attended weekly meetings and contributed labor, they received the lowest rate. Non-coop villagers contributed labor for irrigation system cleaning and repair, so received the next lowest rate. Non-villagers paid the highest rate since they contributed no time or labor; and 3) villagers hired their own mechanic instead of relying on the BADC mechanic. Although the cost was much higher, they preferred the local control and accountability this arrangement afforded.

The paper emphasized the importance of close collaboration between the local government agency (in this case BADC) and the village to ensure timely distribution of irrigated water. It also noted that irrigation management institutions are often not effective because they are too removed from the on-farm level.

Tables included rainfall patterns, landholdings and water use categories for payments.



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Coward, E.W., Koppel, B. and Siy, R. Organization as a Strategy Resource in Irrigation Development. Report of Conference, East-West Center, Honolulu, Hawaii: Asian Institute of Management, 1982.

The conference reviewed the role of management and organization for water delivery, utilization and system maintenance. Existing irrigation users may provide a major area for investment to improve resource mobilization and improve returns, in preference to investment in new schemes.

Crespo, M. Costos de producción de arroz por tarea. Santiago, Republica Dominicana: 6 de Marzo de 1985.

Crosson, Pierre R., Ronald G. Cummings, and Kenneth D. Frederick, eds. Selected Water Management Issues in Latin American Agriculture. Baltimore, Maryland: The John Hopkins University Press, 1978.

This book addresses the questions of how current government policies in Latin America must change in order to meet the rising demand for water in addition to other questions concerning agriculture water management in Argentina, Colombia, Mexico and Peru.

Using the case-study approach, the authors deal with several of the more important emerging water issues, such as competition between agricultural and non-agricultural uses, pricing to encourage more efficient and equitable allocation, optimal uses for crop production and control of salinity, and the effectiveness of multipurpose flood-control projects.

Two principal responses to water management were identified: construction of additional control facilities or more efficient use of water in existing systems.

The authors challenge the traditional view-widely held in Latin America and elsewhere--that water is not like other economic resources and that therefore its management must be highly centralized, with economic criteria having little effect on its allocation. This traditional view has resulted in water management institutions which generally are rigid and slow to respond to changing technological, economic and social realities affecting water demand and supply.

In the case of Peru, the authors note a conflict between water laws, prescriptions of economists and real world management and division of resources by farmers. The law specifies full cost recovery, economist recommend special pricing schemes, and in practice, irrigated water is highly subsidized with fees bearing little relationship to the amount of water used. Neither laws, nor the recommendations of economist, seem to have taken into account important real world factors such as the seasonal nature



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of rainfall or the many political, social and cultural practices of water users.

Cruz, M.C.; Briones, N.D.; and Mufschmidt, M.N. "Water Resources Management in Asia: A Selective Bibliography with Introduction Essays." Working Paper 505. Honolulu, Hawaii: East-West Center, 1984.

A comprehensive bibliography with annotations, covering many related issues in management, pricing and resource use in irrigation.

Cruz, M.C. and Siy, R. "Issues in Irrigation Water Management in the Philippines." Agricultural Policy Working Group Mini-Workshop on Rice Policy. Los Baños, Philippines: University of the Philippines, January 3-4, 1985.

de Jesus, Ed C. Bureaucratic Reorientation at the National Irrigation Administration: A Philippine Case Study. Manila, Philippines: Asian Institute of Management, 1982.

This document is a case study on the NIA communal project done recently by de Jesus of the Asian Institute of Management. Its focus is not on the work of the famous Community Organizers, but on the changes in attitude and policy within NIA which were necessary first to initiate the program and then to accommodate it.

The critical shift in NIA objectives from expansion of irrigated area to the development of functioning irrigation systems was reinforced by a presidential mandate to recover, partially, the costs of construction of new communal systems. Support at the center for an innovative approach involving farmer participation in design and construction had to be converted to support by regional and provincial NIA field offices. This involved both changing attitudes toward the new objectives and strategy through training courses and workshops, and also changing structures and procedures by which NIA operated. These changes included significant modifications in NIA planning, budgeting, and accounting procedures and changes in the criteria by which the performance of Provincial Irrigation Engineers is evaluated.

Not treated here is the critical role played throughout this process by the Communals Irrigation Committee, a group of engineers, anthropology planners, and management specialists who helped to chart the course taken, set the strategy, and develop the tools and mechanisms that allowed continuous monitoring of activities and which guided the unfolding of the entire effort.

de Los Reyes, R.P. Managing Communally Gravity Systems. Farmers Approaches and Implications for Program Planning. Manila, Philippines: Institute of Philippine Culture, 1980.

The study analyzes variations in communal system organization, approaches to management, and the water rights status for commercial irrigators groups.

. "Managing Through Persuasion: Experiences in a Philippine Community Irrigation System." Paper prepared for the Joint International Conference of the Canadian Council for Southeast Asian Studies and the Institute of Southeast Asian Studies. Singapore: International Development Center, June 21-24, 1982.

This article analyzes the institutional aspects of existing irrigation systems in the Philippines and the organizational principles relating to managerial reform programs. Emphasis is placed on development and improvement of human support structures which increase irrigation efficiency and, in turn, increase yield per ha of riceland area. A strengthening of the indigenous organizational structures is seen as most effective in terms of water management. The major focus is on a specific community-managed system (HMT) in the province of Camarines Sur where management is by local farmers. Community systems comprise approximately 50 percent of irrigated cropland in the Philippines and 25 percent of irrigated land in Indonesia.

Examination of community systems reveals socio-organizational challenges such as: capacity to maintain facilities; equitable allocation of water among users; resolution of farmer conflict; and mobilization of resources for O and M. Specifically, system maintenance is critical as damage and deterioration caused by monsoons and high levels of humidity necessitate effective labor mobilization for maintenance. Farmers' perceptions of water use benefits affect motivation levels and reinforce importance of mobilizing both upstream and downstream users. Difficulty in securing farmer contributions and the need for social organization in resolving allocation disputes among farmers is also addressed.

Among findings of HMT mechanisms for O and M are: (1) culture-specific mechanisms pertaining to those employed in mobilizing labor, cash resources and conflict resolution; and (2) cross-cultural "mini-unit" structures which disperse leadership geographically throughout the system. Social stratification within HMT serves to mobilize resources for system O and M, thereby reinforcing the author's assertion that the most effective forms of irrigation can be achieved once planners and implementors gain knowledge of existing social and cultural conditions.



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_____. "Stereotypes and Facts in Irrigation Management: Preliminary Findings from a Case Study of a Philippine Communal Gravity System." In Irrigation Policy and Management in Southeast Asia (Ed.). Los Baños, Philippines: The International Rice Research Institute, 1978.

Direction General de Agua Suelos e Irrigaciones (DGASI), Estudio de Tarifas de Agua Proyecto Tinajones. Lima, Peru: DGASI, 1982.

Directorate General of Water Resources Development, Ministry of Public Works. General Information on Irrigation Operation and Maintenance Activities in Indonesia. Jakarta, Indonesia, July 1984.

Directorate General of Water Resources Development, Ministry of Public Works. "Kaliprogo Irrigation Project Yogjakarta." nd

Doherty, Victor S.; Miranda, S.M.; and Kampen, J. Social Organization and Small Watershed Development. Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 1981.

This paper discusses the findings of a multidisciplinary investigation potential for cooperation by small groups of farmers in semi-arid tropical southern India. This investigation was undertaken as part of an overall assessment of the prospects for the development of small agricultural watersheds in the region.

Two types of cooperative behavior amongst the farmers are identified by the authors: 1) rule-based behavior, which is predominantly passive, can persist over the long term, and can be carried out by individuals, small groups. or large groups alike; and 2) decision-based behavior, which is situational, requires management judgments, and can be carried out effectively only by individuals or small groups formed only for the short-term, decision-making task at hand.

The authors found that the system of cooperation followed by farmers who share rights to wells is rule-based, and that decision-based interaction was excluded by custom. They then conclude that the farmers would prefer small sources of irrigation water--such as runoff collection points on small watersheds--to be individually owned unless simple rules for the distribution of water could be enacted. The farmers' aim is to minimize interaction and common decision-making among owners.

Doppler, W. "Determining and Levying of Water Charges on Irrigation Schemes." Workshop on Choices in Immigration Management, University of Kent, 1976.



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_____. Towards a General Guideline of Irrigation Water Policy. Agricultural Adminstration. No. 4, 1978.

A phased approach to developing water charge would initially use indirect charges with close attention to administrative control to encourage adoption. The second stage would combine a basic charge and water pricing as farmers gain experience. In most developing countries equilibrium price based charges should used in conjunction with basic charges. This approach would encompass a number of objectives and by orientation to the farm reduce risks of project failure.

Duane, Paul. A Policy Framework for Irrigation Water Charges. Staff Working Paper No. 218. Washington, D.C.: The World Bank, 1975.

The Bank's policy has been to require a recovery of at least the public sector's O and M costs, and up to 100 percent of all direct public costs of any irrigation project, with revenues and costs in future years suitably discounted and adjusted for general inflation and with costs measured at domestic market prices. In practice, negotiated recovery rates in Bank projects have indeed exceeded O and M costs, but have fallen well short of total costs. According to a survey of 17 Bank irrigation projects, anticipated recoveries averaged only 30 percent of total costs. The policy has therefore allowed wide discretion in setting the level of charges, at least in relation to public costs. Justifications of proposed charges have referred mainly to the need to help users, especially the poorer ones and, occasionally, the need to preserve user incentives. Unfortunately, the absence of a sound framework for incorporating distributional and other objectives into the assessment of charges has led to rather simplistic and vague rules for setting their level; and these rules may have contributed to the poor record of estimated recoveries. This paper is intended to assist decisions on cost recovery by providing an appropriate framework for determining the desirable means and degree of cost recovery.

Recommendations for improved cost recovery are through efficiency pricing and through discriminatory benefit taxes, for example, a land betterment tax. The betterment tax should accurately reflect size of the potential rent. The requirements necessary for instituting market prices for water are: measured deliveries; auctioning of water to highest bidders; blocs of buyers; and capability to deliver water to buyers and withhold it from non-buyers. The desirable characteristics for any cost recovery instrument include: 1) capacity to discriminate between water users and non-users; 2) ability to guide efficient allocation of resources; 3) at least one instrument with the capacity for progressive rates; and 4) fair rates in the sense that they are linked to service provided in terms of timing and amounts of water delivery. The author clarifies that market clearing prices for water would have no relation to accounting



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costs such as O and M; use of crop rates could distort cropping patterns and there is no opportunity to apply progressivity; and indirect production taxes may cause resource misallocation if they discourage use of taxed factors.

Easter, K. William. Capturing the Economic Surplus Created by Irrigation. Staff Paper P80-114. St. Paul: University of Minnesota, Department of Agriculture and Applied Economics, 1980.

The economic basis for determining water charges will vary with project type and objectives. To better capture a share of the economic rent through water charges, planners should be flexible at project design stage, so the project can accommodate different allocation procedures and water charges. Flexible fees and price rationing may improve efficiency, and allow fee increases with inflation, with less farmer protest than attempts to alter a fixed fee system.

_____. "Neglected Opportunities in Irrigation." Economic and Political Weekly, IX (14) (April 6, 1974); pp. 557-64.

This article discusses two different kinds of programs in Eastern India designed to improve water use and management by installing field channels in order to give farmers better control over the water in each field. The two programs represent the two ends of the cost spectrum, one being capital intensive and costly and the other involving the introduction of a simple system of village field channels at minimum cost.

The article reports on the internal rates of return from these projects and highlights the importance of technically trained people and alternative project designs in making the project viable. The author concludes that new institutional arrangements are necessary within the villages for the maintenance of the new irrigation systems, and also finds that improved means of water allocation are needed.

The author advocates pricing water on the basis of the volume used--perhaps measured at the village level rather than at individual farms--plus better policing of actual water use, as means for improving the efficiency of on-farm water use. In addition, for the minimum cost projects, farmers should pay the full cost of installing the simple small unlined channels because their increased returns cover costs in the first year.

Easter, K. William and Ellingson, D. 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.



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Easter, K. W. and Martin, Lee R. Water Resource Problems in Developing Countries. Bulletin No. 3. St. Paul, Minnesota: University of Minnesota, Economic Center, July 1977.

This paper focuses on pricing, economic and management issues. Important issues were (a) the inefficiency of resource use for irrigation, (b) conflicts for scarce water use, particularly between irrigation and hydropower, (c) the increasing tradeoffs between agricultural and environmental issues, and d) effect of irrigation projects on already shared wealth distribution.

Easter, K. William and Welsch, Delane E. Socioeconomic Issues in Irrigation Development and Distribution. St. Paul, Minnesota: Department of Agricultural and Applied Economics, University of Minnesota, 1983.

In this article, the authors address the issue of the socioeconomic problems facing irrigation managers and how these problems impact upon overall failures in reaching expected levels and distribution of output and income. Three topics are examined: 1) water allocation procedures and policies; 2) institutional arrangements for irrigation management; and 3) irrigation investment alternatives. They summarize the findings of many earlier studies and then raise their own questions about key issues for the future.

Farmer participation in the form of users' organizations is discussed in the Institutional Arrangements for Irrigation Management portion of the article. The authors find in their survey of the literature that farmers' organizations clearly facilitate farmer cooperation in the areas of operations and maintenance, distribution, management, and sometimes even in the financing of the project. The key question left unanswered, however, is how to establish effective users' organizations to meet the project objectives and at the same time be adaptable to local conditions. Other areas of concern include the disparity in land ownership and the underlying local power structure and how these factors often determine who derives the benefits from the projects, and also the need for institutional changes in order to achieve the objectives of equity and efficiency. The authors believe more must be done to develop incentives, training programs and institutions which will make better use of management talent available among farmers.

The authors also briefly discuss water pricing in the section on institutional arrangements, noting how rules and procedures for water pricing affect both the distribution of water and benefits. Conflicts over the equitable distribution of water, efficiency of distribution, and means for meeting government objectives including cost recovery and influencing allocation are all influenced by water pricing policies.



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Echevarría, Jose Francisco Niño and Ramos, Alfonso Quiroz. Aplicación de un modelo de programación matemática para determinar el plan de cultivo en función del recurso agua en el subdistrito de riego regulado: Chancay-Lambayeque. Tesis, Ingeniero Agriola, Lambayeque, Peru: Universidad Nacional Pedro Ruiz Gallo, 1984.

El Kady, Mona; Clyma, Wayne; and Abu-Zeid, Mahmoud. "On-Farm Irrigation Practices in Mansouria District, Egypt." 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.

Elumalai, G. Farmers' Organizations for Efficient Water Use in Irrigated Agriculture: A Case Study in Tamil Nadu. Workshop Paper. Madras, India: Madras Institute of Management, 1980.

Espaillat A., L.S. and Melo A.H.M. "Funcion de Producción del Agua in Interacción con Nitrogeno en el Cultivo del Tomato Industrial (lycopersicum sculentum): Azua, Republica Dominicana." Thesis No. 21 papa Ingeniero Agronomico, Santo Domingo, Republica Dominicana, Facultad de Ciencias Agronomicas y Veterinaries, Universidad Autonoma de Santo Domingo, 1984.

Estudio: "Establecimiento de Tasas de Utilización de Agua y Cargas por este Concepto en el Distrito de Riego Chili." Lima, Peru: Ministerio de Agricultura, 1983.

Evangelista, D.L.; Faigmane, M.M.; and Torres, R.D., "The Economics of Groundwater Irrigation". Water Management in Philippine Irrigation Systems: Research and Operations. Los Baños, Philippines: The International Rice Research Institute, 1973.

The Philippine government, in an attempt to increase crop production, has distributed thousands of pumps to tap the country's groundwater resources. The authors conducted a survey to determine the effects of this distribution, especially on the pumps' performance and their effects on farmer economic status. Surveys were conducted in the Batangas and Quezon provinces; the sample consisted of 52 pumps serving 65 farms. Results were tabulated on farm characteristics, cropping patterns, pump characteristics, pump investment, pump performance, costs and returns for pump irrigated rice fields, reasons given for irrigation charges, satisfaction of irrigation charges, and problems regarding pump use.

Flexible arrangements in water distribution resulted in a strong spirit of cooperation, since each farmer was guaranteed enough water to meet their farm needs. Although the survey revealed that there was no sound or systematic basis for charging irrigation fees, most of the pump users seemed content with the fee arrangements. However, the authors believe that, since

farmers are so dependent on pumps for their irrigation needs, they do not want to protest the fees. Problem areas cited included lack of cash for pump repairs (aggravated by difficulty in securing spare parts), lack of skilled mechanics to repair pumps, and (less frequently cited) poor quality of repair services.

Farmers' Participation in Tank Irrigation Management. Vol. I. Bangalore, India: Indian Institute of Management, February 1982.

This paper is a feasibility study for the establishment of farmer organizations in tank irrigated areas of Karnataka. Current practice is for the farmers to maintain their own channels below the outlet and maintenance is often unsatisfactory.

From questionnaires administered to farmers and officials, it was found that water distribution was decided by the Taluk Tank Irrigation Committee, but below the outlet farmers were responsible for distribution. Farmers also maintained field channels, although they expected the government to maintain the main channel. Communication between Department officials and farmers was not good and interactions were mainly through the soudi (operator) and the Maistry (engineer) who were Irrigation Department officials. They were generally well perceived by the farmers and they had no conflicts with the farmers. There was conflict between farmers over water distribution. Resolution was generally by villagers themselves though sometimes officials were called in for mediation.

Water rates were levied in some areas and collected by the village accountant. A wide divergence of opinion existed among farmers about the level of the charge and their willingness to participate in O and M on an organized basis. Maintenance of the physical structure was important to the farmers and they expressed willingness to participate if the government assisted in maintenance. Since rotational water distribution was needed to ensure greater equity, greater farmer participation would be required for new tank schemes. The study concluded that establishment of farmers' organizations was feasible for water distribution and conflict management and for maintaining the system below the outlets. However, the presence of the government in the form of the soudi was necessary for effective functioning of the organization.

Fell, A.M. "An Overview of Irrigation Strategy and Results in the Sahel." In Aid for the Development of Irrigation. Edited by Ian Carruthers. Paris, France: Organization for Economic Cooperation and Development, 1983.



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Finney, C.E. "Least-Cost Analysis of the O and M Problem." Water Resources Development. Vol. 2, No. 1. 1984.

Inadequate O and M are analyzed in terms of shortages in public funds and foreign exchange. The author sûggests use of varying discount rates for different expenditures in a project to better account for opportunity costs. If O and M costs are valued at higher opportunity costs than construction, the result is likely to be a higher, but perhaps more appropriate net present cost than using a sing discount rate for the whole project.

Food and Agriculture Organization (FAO) and United Nations Development Program (UNDP). Estudio para el mejoramiento de los Sistemas de Riego Existentes: Republica Dominicana: Resultados y Recommendaciones del proyecto: Informe Tècnico AG: DP/DOM/81/012. Prepared for the Government of the Dominican Republic. Rome: FAO and UNDP, 1984.

Frias, M.C. Methodologia EMESIRE. Informe Tècnico No. 1, preparando para el Gobierno de la Republica Dominicana: AG: DP/DOM/81/012. Rome: FAO and UNDP, 1984.

_____. Resultados-Diagnostica-Jerarquizaciòn de los Proyectos. Informe Tècnico No. 2, preparado para el Gobierno de la Republica Dominicana: AG: DO/DOM/81/012. Rome: FAO and UNDP, 1984.

The Gadjah Mada University Team. Executive Summary: Study of Regional Capability to Finance the O and M Costs for Irrigation Systems in the Prosida Projects in the Pemali-Comal Area, Central Java and in the Bantimurung and Lanrae Project Areas, South Sulawesi. Gadjah Mada University: May 1982.

Gardner, B. Delworth; Coppock, R.H.; Lynn, C.D.; Rains, D.W.; Loomis, R.S.; and Snyder, J.H. Background Paper No. 1 for Conference on Competition for California's Water: Alternative Resolutions Agriculture. Draft, October 17, 1981.

Geller, Sheldon. Planning, Management, and Participatory Development Issues in Irrigation Projects: A Selected Annotated Bibliography. Prepared for the Club du Sahel/CILSS, 1981.

Gomex Teofilo. Organizaciòn de Usuarios/Reuniòn con German Pichardo." (Mimeo of an interview concerning organizational history of users on the new INDRHI canals). Santo Domingo: INDRHI Central Files, 1985.

Gustafson, Eric W., and Reidinger, R.B. "Delivery of Canal Water in North India and West Pakistan." Economic and Political Weekly, VI (52) 1971, pp. 157-62.



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In most of the canal systems in north India and west Pakistan, the principal problem affecting water delivery is the lack of predictability, certainty, and controllability of canal water supplies. The practice of water trading and sale is viewed as a way in which water deliveries can be controlled, especially if a water users' association is organized to negotiate with government agencies or with large landowners.

Hafid, Anwar; and Hayami, Y. "Mobilising Local Resources for Irrigation Development: The Subsidy Case of Indonesia." In Irrigation Policy and the Management of Irrigation Systems in South-East Asia, edited by Taylor, D.C. and Wickham, T.H. ADC, Bangkok, Thailand: 1979.

With adequate local leadership and attention to technical detail, government subsidy to mobilize local, low opportunity cost labor resources for irrigation rehabilitation produced high rates of return. A similar study in the Philippines showed similar results, with a relatively greater share of benefits to farm laborers than owners.

Hagan, Robert M.; Houston, C.E.; and Allison, S.V. Successful Irrigation. Rome, Italy: Food and Agriculture Organization, 1968.

This general discussion of irrigation includes the issues of financing and repayment, organization, operation and maintenance and appropriate water use management. The authors state that charges for water service should be established on a basis which will encourage the undertaking of irrigated farming in new projects and also discourage the misuse of water. Also, repayment of project costs can be realized by special taxes on the lands benefitted and by charges for the use of water, power, and other services. The authors also believe that the organization, operation and maintenance of irrigation projects are as important to their success as are the original design and construction, and that experiences with irrigation enterprises throughout the world suggest that local control of final water distribution is often desirable. But, the selection of the method and necessary preparations should not be left to the farmer.

Hancock, Karl; Anderson, Craig; Daines, Samuel; Buttars, Randle; and Daines, David. Small Farm Irrigation Improvement in Salcedo Ecuador: Technical, Economic and Institutional Feasibility. Quito, Ecuador: US Agency for International Development, 1980.

Hartshorn, G., et al. Dominican Republic Country Environmental Profile. AID Contract AID/SOD/PDC-C-0247. McLean, VA: JRB Associates, July 1981.



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Holloran, Susan; Corey, G.L.; and Mahoney, T. Sederhana: Indonesia Small-Scale Irrigation. AID Project Impact Evaluation Report No. 29. Washington, D.C.: US Agency for International Development, 1982.

Hondale, George. Farmer Organization for Irrigation Water Management: Organization, Design and Implementation in Bula and Libmanan. A Report to the USAID and the Bicol River Basin Development Program. Washington, D.C.: Development Alternatives, Inc., 1978.

Hotes, Frederick L. "World Bank Irrigation Experience." Prepared for DAC/OECD Meeting, September 29-30, 1982, on Lessons of AID-Financed Agricultural Water Projects. Washington, D.C.: The World Bank, 1982.

The costly nature of irrigation projects suggests that better preparation should be undertaken to adequately plan project costs, management and O and M. Cost recovery on World Bank project varies greatly, and the fiscal viability of both Government and farmer need to be better assessed.

_____. "The Experience of the World Bank," In Aid for the Development of Irrigation. Edited by Ian Carruthers. Paris, France: Organization for Cooperation and Development, 1983.

Howes, Mick. Alternative Approaches to Small-Scale Irrigation: The Implications for Production Distribution and Social Organization. Brighton, England: Institute of Development Studies, University of Sussex, 1981.

Howitt, R.E. "Agricultural Water Pricing is a Means to Water Conservation." Paper presented to Agriculture Water Conservation Conference, University of California, 1976.

Hunt, Robert C. and Hunt, Eva. "Canal Irrigation and Local Social Organization." Current Anthropology, XVII (3) 1976: pp. 389-411.

Hunt, R.C. "The Local Social Organization of Immigration System Policy--Implications of its Relationship to Production and Distribution." Brandeis University for US Agency for International Development, 1978.

The paper analyzes relationships between social, production and distributional organization of irrigation systems in a number of Asian country studies. Adjusting organizational and financial procedures may improve productivity and distribution of benefits and costs.

Huszar, Paul C., Radosevich, G.E.; Skogerboe, G.V., and Vlachos, E.C. "Consolidaton of Irrigation Systems: Phase II Engineering, Economic, Legal, and Sociological Requirements." Washington, DC: US Department of the Interior, 1980.

Idrus, Rachmatiah, Ohorella, M.G.; Kristanto, K.; Wattimena, R.A.; Nazaruddin, L.; Ruru, F.H.; Lihawa, T.; Ukkas, M.Y.; and Linggojwo. Impact Evaluation of Bone-Bone Irrigation System in Luwu, South Sulawesi, Indonesia. Husanuddin University, 1981.

This study explored the impact of the rehabilitated Bone-Bone irrigation system on the production, productivity, income and employment of farmers affected by the system. The study examined a village before and after irrigation and then compared this same village to a non-irrigated village.

The authors found that the effects of irrigation create such an abundance in yield that a labor shortage results on the farms. Irrigation also generated many off-farm jobs but the labor shortage during harvest time prevented farmers from benefitting from these jobs. Human and animal labor, chemical inputs and land taxes increased faster than increased in gross farm income. As a result, farmers' incomes are distributed to a greater extent among village cooperative groups, hired labor, livestock owners and government revenue.

Based on these observations the author made five recommendations for more effective irrigation systems: 1) Relieve farmers from losses due to pests by reducing pesticide cost; 2) Reduce labor cost through uniform planting times; 3) create water user organizations to control water management; 4) Provide facilities for reducing post harvest losses; and 5) Provide selective mechanization in farming and increased animal labor.

Indonesia--Second, Third and Fourth Irrigation Rehabilitation Projects (Credits 195, 220 and 289-IND) Project Performance Audit Report, #3269. Prepared by Operations Evaluation Department. Washington, D.C.: The World Bank, December 31, 1980.

Instituto Nacional de Recursos Hidràulicos (INDRHI). "Analysis Tarifa de Agua del Año 1985." Santiago: INDRHI Irrigation District Files, 1983.

_____. "Cuadro Sinóptico de los Porcentajes de Inversion de las Zonas con Relación a los Distritos de Riego en al año 1984. Santo Domingo: INDRHI Central Files, 1985.

_____. "Determinacion de factor de Pago por zona para Usuarios." Santo Domingo: INDRHI Central Files, 1985.



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_____. "Estadisticas de Distribución de Usuarios por Zonas." Santo Domingo: INDRHI Central Files, 1985.

_____. "Recaudaciones por Concepto de Tarifas de Aguas Recibidas por los de Riego en al año 1984." Santo Domingo: INDRHI Central Files, 1985.

_____. "Recaudaciones por Concepto de Usuarios en el Periodo 1966-84." Santo Domingo: INDRHI Central Files, 1985.

_____. "Recaudaciones por zonas en 1980, 1981, 1982, 1983, 1984, and 1985." Santiago: INDRHI Irrigation District Files, 1985.

_____. "Registro Asignaciones RD al Distrito/mes-1980-1985." Santiago: INDRHI Irrigation District Files, 1983.

_____. "Relacion de los Deudos de los Usuarios de los Distritos y Zonas de Riego por Concepto del Uso de las Aguas Publicas." Santo Domingo: INDRHI Central Files, 1985.

_____. "Resumen de Entrevistas Realizadas a Usuarios de Agua." (Mimeo results of a survey of Water User in Santiago Zone). Santo Domingo: INDRHI Central Files, 1985.

_____. "Resumen Presupuesto 1984 por Objectos." Santiago, Dominican Republic: INDRHI Irrigation District Files, 1985. (Mimeo.)

_____. "Resumen Proyecto de Presupuesto de operacion, mantenimiento y administracion para el año 1985." Santiago: INDRHI Irrigation District Files, 1983.

Inter-American Development Bank. "Dominican Republic Reformulation of Loan 570/SF-DR." Mimeo Document PR-915-Z. Memo to Board of Directors from the Secretary. Washington, DC: Inter-American Development Bank, 26 July 1984.

International Commission on Irrigation and Drainage. Specificities of the Moroccan Hydroagricultural Equipment. 30th Executive Council, May 1979.

International Rice Research Institute. "Irrigation Policy and Management in Southeast Asia. Los Baños, Philippines: International Rice Research Institute, 1978.

Institutional Framework for Improved On-Farm Water Management in Pakistan. Special Technical Report for the US Agency for International Development Mission to Pakistan. Fort Collins, Colorado: Colorado State University, January 1976.

The report defines some of the major irrigation water management problems in Pakistan and the technologies for correcting them, providing a strong basis for undertaking a program of improved on-farm water management even though there is still a need for additional field data to further identify and define problems. The most important components of a water management program for Pakistan are: 1) watercourse rehabilitation; 2) precision land leveling; 3) small tubewells; 4) effective agricultural and water management technical assistance and extension; and 5) development of local institutions to insure the effectiveness of the program. The more difficult problems are to define the appropriate processes for implementing such technologies.

One recommendation is to promote institutional development at three levels: 1) at the farm level by creating water user associations; 2) at the government agency level; and 3) at the legal regulatory level. Currently, Pakistan has no user associations and the first steps must be to introduce the concepts, use a bottom-up approach that will foster initiative among farmers, and provide them with incentives for improved water use by arranging for loans, giving technical assistance, etc. A Water Management Advisory Service is needed for liaison between farmer groups and government agencies, whose role must be to facilitate the development of associations by giving help in water allocation and management (especially in technical aspects), and by providing training.

Irrigation Assistance to Developing Countries Should Require Stronger Commitments to Operation and Maintenance. Washington, D.C.: US General Accounting Office, 1983.

The report outlines the rapid deterioration of many donor funded irrigation systems in Indonesia, Sri Lanka and Thailand, primarily because there is a shortage of funds for regular O and M (recurrent costs). This results in most developing country systems operating at less than 50 percent efficiency which reduces acreage and yields and enhances tension among farmers. Often early rehabilitation of systems becomes necessary and is done at tremendous expense. An example is the Luwu Project in Indonesia where routine maintenance was so poor that canals were eroded even though they were only constructed in 1979. The failure of each of the three countries to fully meet O and M funding expectations is detailed. In Indonesia, O and M needs greatly exceed government allocations and delivery of subsidies. Monitoring is also difficult because there are no consolidated figures for funds used in O and M. Eleven different government agencies are involved in funding and there is no single source of accountability.



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The report recommends that AID: 1) require a recurrent cost plan that identifies operation and maintenance requirements and funding sources for each project; 2) adopt stronger project design and construction criteria to reduce recurrent costs; and 3) require that water user associations be established before financing on-farm construction.

Irrigation Policy and Management in Southeast Asia. Los Baños, Philippines: The International Rice Research Institute, 1978.

Irrigation Water Management: Report of a Planning Workshop. Los Baños, Philippines: The International Rice Research Institute, 1980.

Isles, Carlos and Collado, Manuel L. "Farmer Participation in Communal Irrigation Development: Lessons from Laur." MS prepared for publication in Philippine Agricultural Engineering Journal, nd.

Jayaraman, Pushpa and Jayaraman, Tiru K. "Attitudes of the Irrigation Bureaucracy in India to Scientific Water Management Tasks in Irrigated Agriculture: A Case Study from Gujarat State, India," Quarterly Journal of International Agriculture, XX (3) July - September, 1981: pp. 279-392.

The purpose of this paper is to analyze the attitudes of irrigation engineers in the Indian irrigation bureaucracy, and specifically these engineers' attitudes toward working in the area of water management/O and M versus working in the construction and designing wing of the irrigation department. In turn, the author looks at how these attitudes affect the current inadequacy in the discharge of water management functions. The study was based on two irrigation projects in Gujarat State involving 289 engineers.

In concluding that the engineers find work in the C and D wing of the irrigation bureaucracy to be far superior in both professional growth potential and in prestige than in the O and M wing, the authors argue that specific tasks must be undertaken to raise the status of O and M personnel and to engender in them a sense of self-esteem and commitment. One such specific task identified is to let O and M personnel see that problems encountered in O and M are challenging and interesting, and worthy of specialization and investigation. One problem mentioned is that of considering farmer participation in the O and M scheme.

Jayaraman, T.K. "A Case for Professionalization of Water Management in Irrigation Projects in India." Public Adminstration and Development, Vol. 1, 1981.



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This paper addresses the lack of professionalism in the water management area of the Indian irrigation administration and the negative effects this has had on many irrigation projects, particularly in the delivery of water to farmers' lands in an adequate, timely, and reliable manner. The author suggests several ways that the self-esteem and sense of professionalism can be boosted among water management personnel.

Experimental rotational water supply (RWS) schemes have been welcomed by farmers. Irrigation and water management personnel have, in turn, responded positively to the farmers' reactions to RWS. This mutual confidence between irrigation personnel and farmers leads to an atmosphere that is favorable for the development of new institutions such as farmers' organizations designed to help regulate supplies below the outlets, to solve disputes among irrigators, and to monitor field channels and drains.

_____. "Farmers' Organizations in Surface Irrigation Projects: Two Empirical Studies for Gujarat." Economic and Political Weekly, XVI (89): pp. A89-A98.

Two empirical case studies from Gujarat state demonstrate the following conditions for successful farmer group-operated irrigation: certainties of water supply, relatively egalitarian community structure based on size of land holding and leadership by a person or group with proven ability, and a commitment to egalitarianism. The organizational form in both cases was a central committee of a small number of farmers with delegated authority for limited functions such as maintenance of water courses and community assets and liaison with the irrigation bureaucracy. In one case, the organization had the power to collect fees in lieu of labor, and in the second, the organization collected fees towards labor charges. The simple organizational form of the committees was adequate for the limited functions assigned, but more extensive functions such as water allocation and distribution and conflict resolution would require more formal organizational structures.

_____. "Irrigators' Organizations for Better Water Management: A Case Study of Attitudes of Irrigators from Gujarat State, India," Agricultural Administration, X (1982): pp. 289-212.

_____. "Water Use Efficiency and Rotational Water Supply at the Farm Level: Certain Results from an Experimental Pilot Project in Gujarat State, India." Water Supply and Management, V (6) 1981: pp. 391-399.

This paper assesses the water use efficiency at a 0.5 million acres irrigation project in Gujarat State, India, where rotational water supply at the farm level is used. One of the conclusions drawn by the author is that greater water use efficiency would



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result if farmers came forward on their own to maintain the watercourses (earthen field channels), because this would increase the conveyance efficiency and reduce water losses in transmission. The author also asserts, however, that farmers will only come forward to do this if they can be assured of the availability of water supplies at scheduled intervals in adequate quantities in a reliable manner.

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 system, 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; Smith, Bryant; Aitken, Percy; LeBaron, Allen; Meyer, Ray; Walter, Michael; and Wolf, James. Peru: Irrigation Development Options and Investment Strategies for the 1980s. USAID Water Management Synthesis II Project, Report No. 14. Logan, Utah: Utah State University, 1984.



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

This summary report reviews the status of irrigation projects in India prior to 1980, describing the extent of irrigated hectares, relative utilization, objectives of the Government of India and USAID in developing irrigation projects and the obstacles or constraints to efficient and effective utilization of current and potential projects. The authors conclude that the primary cause of underutilization is due to inefficient management and estimate that efficiency could increase 25 percent via improved on-farm delivery systems. They observe that the political objective to provide irrigation resources equitably to all sectors and regions of the country has resulted in thinly spread resources--too many new projects have been started with insufficient resources to complete and fully utilize available water resources. The effective range of irrigated water use varies from 10 percent to 100 percent with private wells achieving highest effective utilization and major and medium projects averaging 50 percent utilization. The disappointing record of the CADAs (Command Area Development Authorities) is noted with support given to reorganization of the government agencies overseeing irrigation projects to provide improved coordination.

The authors note that incomplete utilization of surface water does not necessarily represent a net loss. Seepage helps to develop ground water reservoirs and fill aquifers which provide long term benefits to farmers by establishing efficient reserves for dry seasons, ensuring availability of water in drought years and enabling higher distribution efficiency through private tube wells.

It was observed that AID's policy of limiting support of irrigation projects to areas greater than 40 ha often excluded smallholders who sometimes lacked the technical and organizational capacity to deliver water to their fields. Credit and technical support to fully develop irrigated potential was identified as a potential solution rather than a change in AID policy.

Keller, Andrew A. "Unit Command Area Response to Water Delivery by the Main System." PhD Thesis, Logan, Utah: 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: Colorado State University, 1979.



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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 over irrigate 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. World Bank Staff Working Paper No. 528. Washington, D.C.: The World Bank, 1982.

Over a five-year period the National Irrigation Administration (NIA) of the Philippines has been building its capacity to develop water users' associations for small scale irrigation systems. The NIA approach is to develop a water users' association prior to construction of the physical system and then to involve association members fully in the planning and construction of the system. Implementing this participatory approach has required a wide variety of changes in the agency's policies, procedures, and personnel to become an enabler rather than simply a provider of services.

Based on data acquired from pilot projects involving farmers in the preconstruction and construction process, the lessons learned for developing user associations were the following: 1) farmers developed a sense of ownership in the system and concern for O and M after construction; 2) farmers could contribute knowledge that helped system design and layout; 3) the NIA as the implementing agency realized the difficulties of integrating social and technical dimensions because of the conflicting goals and approaches of engineers and community organizers and lack of awareness of their reciprocal needs.

In the O and M stage, user associations provided for water allocation and system maintenance by hiring full-time water tenders who were responsible for opening and closing outlets and mobilized members for routine maintenance. Tenders resolved conflicts at the sector level and collected fees immediately after the harvest. The fees accounted to $25/ha/year (150 kg) of unhusked rice--half for amortization costs and half for association expenses. The involvement of farmers in the stages of preconstruction study and construction increased the probability of good O and M later.

Kosters, M. Price Control Policy in the Dominican Republic. Santo Domingo: US Agency for International Development, 1984.



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Kuhns, J., et al. "Pre-Investment Project-Feasbility Study and Final Designs of the Area of Influence of the Sabona Yegua Dam." Mimeo Document PK-855-A. Washington, DC: Inter-American Development Bank, 5 December 1977.

Larbon, D.W. "The Effect of Price and Credit Policies on Dominican Republic Agriculture." Consultant Report (Mimeo). Santo Domingo: US Agency for International Development. September 1984.

Leindo Gil, Nancy. "Marco Historico-Económico del Aprovechamiento del Agua de la Agricultura del Valle Viejo de Tacna." MA Thesis, Lima, Peru: Universidad Particular Ricardo Palma, 1976.

Levine, Gilbert. "Perspectives on Integrating Findings from Research on Irrigation Systems in Southeast Asia." Teaching and Research Forum, (26) (1982): pp. 9-15.

_____. "The Relationship of Design, Operation and Management." In Irrigation and Agricultural Development in Asia. Edited by E.W. Coward, Jr. Ithaca, N.Y.: Cornell University Press, 1980. Pp. 51-62.

Levine, Gilbert and Hart, Henry C. Mobilizing Local Resources for Irrigation. Interpretive Summary of a Seminar by the Agricultural Development Council, Colombo, Sri Lanka, August 11-15, 1980. ADB Report No. 22, N.Y.: Agricultural Development Council, 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: 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.

Lowdermilk, Max K.; Early, Alan C.; and Freeman, David M. Farm Irrigation Constraints and Farmers' Responses: Comprehensive Field Survey in Pakistan. Water Management Technical Report No. 48-A. Volume I. Fort Collins, Colorado: September, 1978.

McCawley, Peter. "Survey of Recent Developments." Bulletin of Indonesian Economic Studies, April 1985.



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Margolis, Julius. "Welfare Criteria, Pricing and Decentralization of a Public Service." Quarterly Journal of Economics. LXXI (August 1957): pp. 448-463.

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

This paper describes the extent to which farmers in the project area participated in the planning, construction, and implementation of the rehabilitation project. The various government institutions and farmer organizations are examined, with emphasis on the potential for liaison and closer cooperation among them. The author indicates that the technical and construction agencies failed to adequately tap the vast experience and knowledge of the farmers concerning effective water management. The government depended heavily on their technical advisors who used mainly mathematical calculations, rather than consulting the farmers at the preliminary, pre-construction, construction and O and M stages to ascertain feasible methods of achieving maximum cost recovery and increased irrigation benefits.

Although the farmers were comfortable in forming liaisons with some government institutions, they felt that their expertise and practical knowledge could have been sought to a greater extent, thereby increasing the number of beneficiaries and avoiding misuse of precious financial and human resources, and time.

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, nd

This study explores the reasons why many villages in Pakistan cannot successfully organize water users in order to make effective improvements in farm water management and maintain these improved watercourses. The author identifies a cultural phenomena known as izzat (honor, reputation) as the major cause of local level water management failure and then proposes three ways in which officials and farmers can work within Pakistan's culture toward successful farm water management.

A water management improvement project was examined in a small village dominated by a few powerful brotherhoods or clans known as biraderis. The government provided the supplies and technicians for the improvement project while the farmers in the biraderis provided the labor and, after construction, maintained the system. The system deteriorated and became ineffective for three major reasons: 1) upon completion of the project, farmers

illegally cut into the main branch near the headwaters, thus shortchanging those near the tail; 2) powerful biraderis sabotaged efforts to irrigate farmers other than themselves in order to gain more izzat in the eyes of the community; and 3) these biraderis did not wish to organize and cooperate because small farmers would gain izzat and cause them to lose power and influence in the community.

Other problems concerning izzat included land disputes, pressure placed on engineers by powerful biraderis and the superior attitude of many Western officials toward the villagers in this type of extension project.

The author concludes that this village's inability to organize and cooperate typifies many villages in Pakistan. The most successful efforts occur among small shareholders near the tail of the watercourse. These farmers perform the labor and maintenance themselves, unlike the larger landholders.

The author suggests three ways in which the project can provide for more effective water management. The project needs to provide: 1) legal mechanisms which facilitate the existence of water user organizations; 2) sufficient on-going rewards which make it desirable to organize and cooperate even after project completion; and 3) effective sanctions applied by external authority from local communities. Izzat thus becomes a positive factor in encouraging organization and cooperation and discouraging factionalism.

Millar, Agustin A. Proyecto Piloto de Administración, Operación y Mantenimiento de un Proyecto de Riego Yoque del Norte. (Proposed convenio IICA/INDRH for Bid financing under loan 570/SF-DR). Santo Domingo: IICA, December 1984.

Ministry of Agriculture and Irrigation. "Irrigation Rates and Betterment Levy--A Critical Study." New Delhi, India: Directorate of Statistics, Central Water Commission, Ministry of Agriculture and Irrigation, 1975.

Mirza, Ashfaq Hussain. A Study of Village Organizational Factors Affecting Water Management Decision Making in Pakistan. Water Management Technical Report No. 34. Fort Collins, Colorado: Colorado State University, 1975.

Montalvo, Modesto A.M. and Lluen, Carlos A.Q. "Optimización del Recurso Hidrico en el Proyecto Especial de Irrigación Tinajones a Través de la Aplicación de Modelos Matemáticos." Tesis, Ingeniero Agricola, Labayaque, Peru: Universidad Nacional Pedro Ruiz Gallo, 1984.



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Moorti, T.V. "A Comparative Study of Well Irrigation in Aligark District, India." Cornell International Agricultural Development Bulletin 19, May 1971.

Moore, M.P. Approaches to Improving Water Management on Large-Scale Irrigation Schemes in Sri Lanka. Colombo, Sri Lanka: Agrarian Research and Training Institute, 1980.

_____. "The Management of Irrigation Systems in Sri Lanka: A Study in Practical Sociology." Sri Lanka Journal of Social Sciences. 22 pages, nd.

Murthy, Y. R. "Experiences of O and M of Some of Our Irrigation Systems." Proceeding O and M of Canal Systems, Vol. 1, New Delhi, India: 1980.

The paper assesses the need to increase the use of water charges based on volume.

Neghassi, Habte Mariam and Seagraves, James A. "Efficiency in the Use of Water for Irrigation: The Role of Prices and Regulations." Natural Resources Forum 3 (1978): pp. 53-72.

Efficiency in the use of water for irrigation is normally defined in a physical sense - engineering and agronomic; and it is often assumed that higher efficiency is desirable. However, in an economic sense, there is an optimum range in the level of physical efficiency. Normally it can be said 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, and to design systems of pricing and regulations that will promote optimal allocation and efficient use. However, the value of water is often extremely low, in which case there may be little economic incentive to improve physical efficiency unless forced by physical factors that affect production and productivity such as soil characteristics, water-logging or nutrient leaching.

The combination of regulations and prices that are used to allocate irrigation water reflect the conflicting goals of redistribution of income in favor of agriculture and needs to encourage efficient use of water. Regulations and pricing systems also depend on the value of water, the dependability of supplies, systems of delivery and the extent to which flows can be regulated.

Using examples and case studies, this paper discusses physical and economic efficiencies and their interrelationships. It emphasizes the role of pricing and regulations and provides general guidelines.

Nelson, G. and Taleston F. "Why Irrigation Projects May Become Educing Monuments to Failure." Focus, 1977.

Much of the widespread failure of irrigation projects may be attributable to imposition of complex management and charging to previously traditional economies with limited experience in cash transactions.

Ng, Ronald and Lethem, Frances. Monitoring Systems and Irrigation Management: An Experience from the Philippines. Washington, D.C.: The World Bank, 1982.

The study is an evaluation of the Upper Pampanga River Integrated Irrigation Project (UPRIIS) whose goals were to improve rice yields in the project area based on efficient irrigation water supply through the rotational method. Since this method required cooperation between farmers and officials and among farmers themselves, the organization of irrigator groups was given priority by the National Irrigation Administration (NIA) which also made available water management technicians to ensure technical efficiency. In order to make the system self-financing for O and M, water charges were established at the rate of 125 kg of paddy/ha and 175 kg of paddy/ha of wet and dry season harvest respectively. Fees based on quantities of paddy have the advantage of protection against inflation and price fluctuations.

Evaluation after five years showed that though farmers have joined irrigation groups, their functional performance is rudimentary and they have not helped officials improve water discipline. The targeted water charge collection rate of 85 percent has not been achieved. For the future, continued production increases will depend on strategies to improve water discipline and collection rates. This must be based on improved understanding of farmer motivation and behavior that can be used to strengthen the irrin rates. This must be based on improved understanding of farmer motivation and behavior that can be used to strengthen the irrigation associations, for farmers must feel as if they are partners in the development process. Some ground has been lost because getting farmers accustomed to payment for irrigation at an early stage is crucial. As time passes they come to expect irrigation as a right and hence become less willing to pay.

NIA Corporate Planning Staff. The Agricultural Input Loan: Irrigation Study. Manila, Philippines: National Irrigation Administration, November 1984.

Nickerson, J.E. Irrigation Management in China: A Review of the Literature. World Bank, Staff Working Paper No. 545, Washington, D.C.: The World Bank, 1982.



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A review of organization and management of irrigation in China. Case studies are used to develop some generally applicable hypotheses about specific aspects of management. The desirability of volumetric charging for water must be weighed against the additional costs, and do not reduce the need for good organizational management.

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.

In this comprehensive analysis of Indonesia's irrigation system, one central conclusion is that lack of attention given to O and M of existing irrigation structures has had an overall detrimental effect on the system. The O and M of the entire canal system has not developed well enough to assure that capital invested in the canals will return projected benefits, and greater emphasis should be placed on routine maintenance activities to avoid or delay the need for rehabilitation. The current need for rehabilitation of the canals is greater than it should be due to inadequate O and M and initial rehabilitation activities.

The authors conclude that although the economic benefits of appropriate O and M and the effects of water users associations on the O and M management infrastructure are difficult to measure, they nonetheless probably have higher economic payoffs than any other form of investment. In order to consolidate the gains from irrigation investment, it is imperative that water management, organization, operation and maintenance become effective.

Oficina Nacional de Estadisticas (ONE), VII Censo Nacional agropecuario 1981: Cifros Preliminaris. Santo Domingo: Oficina Nacional de Estadisticas, July 1983.

Ortiz, A. Incentives and Comparative Advantages to the Dominican Republic Dairy Industry. Published MS Thesis. Columbus, Ohio: Ohio State University, 1983.

Ongkingco, P.S. "Organization and Operation of 15 Communal Irrigation Systems in the Philippines." Water Management in Philippine Irrigation Systems: Research and Operations. Los Baños, Philippines: The International Rice Research Institute, 1973.

Overseas Development Institute. "Introduction to Discussion of Water Rates." IMN Network Paper No. 10F, 001. London, England: Overseas Development Institute, 1984.

Discussion and comments on cost recovery in relation to water pricing and organizational structures.



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_____. "Developing the Role of Farmers Associations in Sri Lanka and Northern Thailand." Case studies by Widaranpathirana, A.S., Jayawardere, J., and Kathpalia, G.N., IMN Network Paper No. 8, 001, London, England: Overseas Development Institute, 1983.

These case studies provide the basis for a discussion on the development of farmers groups and their effect on improving water management, O and M, and cost recovery. Where groups have operated successfully, benefits have accrued to both the irrigation system and community.

Ozal, Korkut. The Problem of Repayment. Ankara: Middle East Technical University, 1964.

Pant, Niranjan. Some Aspects of Irrigation Administration (A Case Study of Kosi Project). Calcutta, India: Arunima-Print Works, 1983.

_____. "Utilization of Canal Water Below Outlet in Kosi Irrigation Project: Administrative and Community-Level Solutions." Economic and Political Weekly. (September, 1981): pp. 78-88.

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

This article discusses the formation of cooperative user's irrigation societies, known as a chaks, and their effects in the Sone Command region of India. The authors examine the structure, characteristics, and composition of chak societies and analyze the role these societies play in the areas of local farmer participation, water distribution and repair and maintenance of irrigation infrastructure, conflict resolution, social justice, and interaction with the government and other institutions. They then evaluate the utility of these chak societies in terms of productivity and socioeconomic groupings of the beneficiaries. Three specific chak societies are used as case studies in this evaluation.

The authors explain that the ultimate goal of the chak is that it "...may be of help in the maximum utilization of irrigation potential..." Several purposes of the chak are identified: 1) to maintain common irrigation and drainage works; 2) to own or hire appliances, water pumps, and plants; 3) to maintain the irrigation structures; and 4) to regulate and supervise the supply of water and its fair distribution. The capital for the formation of these societies was raised by share payments made by the local landowners/farmers becoming members.



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The authors conclude that chaks have been effective in irrigation management as well as in the areas of O and M, distribution of water and conflict resolution at the local level. The evaluation also finds increased productivity in terms of yield and intensity of cropping in chak areas as compared to areas outside of the chaks. The authors state that "...as regard(s) the utilization of these organizations in the effective implementation of various policy decisions, there is hardly any doubt about their ability." They also conclude that in two of the three chak societies examined, sections of the village also received some benefits, despite the fact that benefits resulting from the chak generally went to the dominant sections of the villages.

Pazos, I. and Reynoso, G. "Situación del Riego en Republica Dominicana." Documents B-5 presented at VII Seminario Latinoamericano de Irrigación, Santiago de Chile, 28 November-2 December 1983.

Peterson, Dean F. "Systems and Technology for Improved Irrigation Water Management." Adapted from a paper prepared for Agricultural and Rural Development Training Workshop, Washington, D.C., June 18-22, 1984.

This paper is concerned with the goals and objectives of irrigation water management. The author identifies human well-being as the overriding goal, and then incorporates this generalized goal into the discipline of irrigation management by stating that the one purpose uniquely served by an irrigation system is to increase production by enhancing the water available for crops.

The author then proceeds to analyze the irrigation water management systems, in part by addressing what he identifies as five "system management considerations": 1) the total system; 2) the farmer as the ultimate manager; 3) the type of system; 4) design and development limitations; and 5) improving management on constrained systems. He views the farmer as the ultimate manager because the farmer, and not the salaried bureaucrat, makes the ultimate production decisions and takes the risks. The author asserts that all functions of the irrigation system should be focused toward the objective of improving the farmer's production environment. Means of improvement include the need for reliable irrigation supplies, enhancement of the farmer's technical and economic information base, and addressing the farmers' perceptions of their production environment.

Peterson, Dean F.; Walker, James L.; and Coward, E. Walter. Evaluation of the On-Farm Water Management Research Project. Prepared for US Agency for International Development. Fort Collins, Colorado: Colorado State University, September, 1979.



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This report is focused on the improvements in water management of existing irrigation systems in Pakistan and evaluating the success of the 10+ year Colorado State University (CSU) irrigation project in Pakistan in comparison to other centrally-funded research projects.

The authors conclude that the major project achievement was maintenance of project focus over a ten year period and the success of the interdisciplinary approach employed by the project team. They attribute these successes to: the essential design of the project and the focus on on-farm water management; the emphasis on field work together with a flexible work plan which allowed the project to respond to real world problems rather than rely on pre-planned work plan; the conceptualization of the water course as a dynamic unit; the interdisciplinary approach employed by the CSU team; and the recruitment of staff who possessed not only excellent technical skills, but also the requisite attitudinal and interpersonal skills to successfully integrate the various project goals.

The team determined that full farmer participation was essential to project success, with farmers willing to contribute not only labor, but also some financing. Although the project was not focused on institutional and human resource development, training and development of institutional capacities were essential parts of each step in the process. The multiple-contact strategy employed, which required the team to interact with various government ministries and organizations, was deemed to be a success in that it: maintained an active overall strategy, avoiding the usual lulls; eliminated dependence on the project team by individual institutions; and allowed for more facets of irrigation management problems to regularly appear as agenda items on the various institutions involved.

Modification of current Pakistani law was suggested if water user associations were to be granted meaningful legal rights. Little action has been taken on this front with the result of less formal irrigation user groups. The authors suggested that more attention should have been given to traditional user groups, especially in Baluchistan and the Northwest Frontier Province, where peculiar ecological and cultural settings exist, in order to suggest new social organizations and provide actual examples for policy-makers of the possibilities of local-level organizations. Case studies of local irrigation organizations would have been useful supplements to the general discussion. Real world experiments provide a useful source of data.

Pomaredo, Carlos. "Some Considerations for Agricultural Price Policy in Peru." Lima, Peru: INIFA, June 25, 1984.



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"Project Presentation. Kaliprogo Irrigation Project--Phase 2. Sermo Dam. Upper Areas and Basin Planning." Department Pekayaan Umum, Directorat Jenderal Pingainan Directorate Irigasi II. Project Irrigasi Kaliprogo. Yogjakarta, Indonesia: nd

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.

Radosevich, George E. Water User Organizations for Improving Irrigated Agriculture: Applicability to Pakistan. Water Management Technical Report No. 44. Fort Collins, Colorado: Colorado State University, 1975.

The water laws of Pakistan, although providing no impediment to water user associations, do not encourage cooperative efforts among water users at the farm level, and Pakistan has no formalized pattern of local associations designed to promote the effective distribution and use of water. Such local associations should be developed, for they would support improved irrigation, increased employment, and greater agricultural productivity. Such organizations could involve farmers in local decision-making, resolve disputes, and constitute a legal contact point between the government and water users. The organizations would need to be simply structured and tailored to the religious, social, political, economic, and legal systems of Pakistan. Such organizations function well in other countries studies. The Tribunal of Waters in Valencia, Spain, is a good model of the type of organization that would be effective in Pakistan, especially since it has some Islamic roots. The authors offer 28 recommendations concerning the proposed functions of water user associations in the Indus Basin and means of developing it. These deal with a charter, bylaws, objectives, functions, formulation of rules and regulations, assessments, sanctions, jurisdictions, separation from politics, member representation, member obligations and rights, cost sharing, water course maintenance, extension and training activities, interfaces with government, and other aspects of such organizations.

Rao, P. K. "Comments on Cost Recovery and Irrigation Water Pricing." IMN Network Paper No. 10F, London, England: Overseas Development Institute, 1984.

Operational difficulties in cost recovery include inflated cost estimates and wasteful O and M where farmers are not involved in the work programme. More consideration needs to be given to the overall pricing and subsidy issue.

Rao, T.H. Analysis of Water Rates, Lift and Flow Irrigation Schemes in Anihra Pradesh, India. Hyderabad, India: Andhra Pradesh State Irrigation Development Corporation Ltd., 1979.

Lift schemes are financially more beneficial to the Government, but high water rates relative to those for flow schemes are discouraging development. Despite this there is a large hidden subsidy as charges do not increase with costs.

Ray, A.; Bruce, C., and Hotes, F.L. Cost Recovery Policies for Irrigation Projects, Informal Guidelines. World Bank Staff Paper. Washington, D.C.: The World Bank, 1976.

Cost recovery is assessed in terms of economic efficiency, income distribution and public savings. There is a useful discussion on cost recovery and economic rent. A range of rent recovery indices are recommended to distinguish between different income classes. The procedures for, and extent of cost recovery will vary, with projects directed to low income areas accepting a low cost recovery. The recovery in relation to O and M may be a poor measure of the adequacy of water charges and benefit terms.

Recharte, Jorge. "Ethnography of Irrigations in Peru with Special Reference to the Coast," 1983.

Reidinger, Richard B. Institutional Rationing of Canal Water in North India. Davis, California: University of California, Department of Agricultural Economics, 1971.

Based on the premise that institutional rules rather than market forces determine canal water rationing, the author defines three levels of rationing: water release into the canal system at the administrative unit level, rotation among channels within administrative units and the farm level where there are turns among farmers (warabundi). The uncertainties of the system increase farmer risk causing low utilization and poor system performance. Problems include lack of supply flexibility and control by farmers and operators, predetermined schedules for water delivery, shares of water based on amount of land ownership, a fixed water levy per irrigated acre unrelated to the quantity of water applied or its marginal value, and high seepage losses from unlined canals. The difference in rotations between the warabundi and the channel enhances farmer uncertainty. Farmers are certain of receiving water twice a month but they never know when during the month they will receive it, which makes precise crop and water management difficult and restricts adoption of new crop varieties. Farmers expressed a desire to supplement available irrigation with tube wells. Recommendations for improved rationing include putting the levy on a volumetric basis, allocating more water to small farmers in the interest of equity,



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replacement of the warabundi system with a more flexible one that allows water trading, and the development of water user associations that give greater control to farmers.

Robinson, David M. "Farmer Participation in the High Performance Sederhana Irrigation Systems Project in Indonesia." Jakarta: US Agency for International Development, December 1984.

_____. "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 Baños, Philippines: The International Rice Research Institute, 1973.

A study of the establishment of an irrigation association in the Catanduanes province, Philippines, and the effects of a project to improve production and promote land reform, revealed several factors which demanded attention. The association's president played too large a role in the association's funding and daily operations, which served to delay the irrigation systems' smooth functioning at times (since he alone knew O and M, repair and key financial matters) and also distanced him from the other members (he was accused of favoritism and too much control, while he claimed he did all the work and used his own money for things the association should have financed). Irrigation fees indeed were insufficient, due to low production, faulty collection techniques and lack of strong identification with the association.

Land tenure and land reform became a major focus. The project made credit, technical and other assistance contingent upon a 70/30 arrangement between tenants and owners in distribution of harvest proceeds, rather than the traditional 50/50 arrangement. A questionnaire was distributed, the results of which were to convince the landowners of the profitability of the new arrangement. The questionnaire served to calculate a net break-even point (i.e., minimum yield required so that landowners would receive the same share of proceeds under the new arrangement as under the previous) and a gross break-even point (i.e., yield required to entirely repay production loans and to have savings for costs of the succeeding crop). Complicating factors were that tenants were often relatives of owners, and may have had difficulty voicing complaints. Also, mortgaging and re-mortgaging of lots made it difficult to discern the usufructuary.

The president agreed to more equally distribute functions of the association, and by-laws, constitution and financial records were made more readily available. The paper was written only one season after the project was implemented, and yields were not yet up to expectations. However, the provincial governor tentatively agreed to start a similar program in another area. It was hoped



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that success in irrigation cooperation would spur farmers to cooperate in other areas, such as fertilizer purchase, marketing and conflict resolution between tenants and landlords.

Rydzewski, J.R. "Determination of the Operation and Maintenance Costs of Irrigation Projects." ICID Bulletin, January, 1984.

The paper reviews the nature and extent of O and M costs in irrigation. A methodology for collecting recurrent costs is proposed for use in policy and project management.

Sagardoy, J.A. "The Role of Water Pricing and Metering in Promoting Efficient Irrigation Water Use." Seminar on Economic Instruments for National Utilization of Water Resources. Water/Sem/7R9. Geneva, Switzerland: United Nations, E.C.E., 1973.

_____. Water Charges for Agriculture in Some Selected Countries." Rome, Italy: Food and Agriculture Organization, 1973.

In Mexico, recovery of irrigation costs through water pricing is based on farmers' ability to pay. The result is a highly subsidized system with complex management.

Sagardoy, J.A.; Bottrall, A.F.; and Uittinlogaard, G.O. Organization, Operation and Maintenance of Irrigation Schemes. Irrigation and Drainage Paper No. 40. Rome, Italy: Food and Agriculture Organization, 1982.

A study of organizational and management issues in irrigation, with a discussion of the usefulness of a range of alternative procedures for operation and charging for water.

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.

Sanchez Velez, Roger. "Resumen del Informe de Peru." Santiago, Chile: Document prepared for VII Seminario Latinoamericano de Irrigacion, 1983.

Sarria Remy, Carlos. Análisis de los Mecanismos Institucionales y Económicos Para Optimizar el Uso de Agua Agrícola. Lima, Peru: Grupo de Análisis de Politica Agraria (GAPA), 1984.

_____. "Documento Base Para el Análisis de Políticas de Aguas e Irrigaciónes." Lima, Peru: Inter-American Development Bank, June 1984.



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Seagraves, J.A. "Using the Residual Method to Estimate Values of Irrigation Water and Land." Draft of Paper.

The author provides a means of organizing data and estimating the values of each resource for purposes of investment decisions on water and land use. Net income per hectare is separated into estimated values of land and water, and ratios of water to land are used to help decide which of these resources would have the most elastic supply. A marginal supply price is then budgeted for that input and the residual income is attributed to the other fixed resource.

The article also notes that prices charged for water use cannot always be an accurate indicator of value or estimated value, because irrigation water is often a loosely-defined water right that is purchased along with the land, and the water fees are not high enough to ration the limited quantity of water among potential buyers. However, where water rights are transferred apart from the land (within canal user associations or cooperatives, for example) some studies contend that within such cooperatives effective allocation of water to its highest-valued use does take place.

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

Alternative combinations of water pricing and regulations are possible in allocating irrigation water. The best combination will depend on the value of water, ability to control deliveries, desire to subsidize agriculture, ownership traditions, crops grown, return flows, drainage problems, staff training, ability to collect fees, the number of farmers involved, etc. Marginal cost pricing is just one possible alternative and it is more a way of thinking about prices rather than a set system. The possibilities for achieving an equitable and efficient distribution of water are improved if some form of marginal cost pricing is included in the system of water charges.

Secretaria del Estado de Agropecuario. Costos de Producción por Entrevista. Santo Domingo: Secretaria del Estado de Agropecuario. Departamento de Estadisticas y la Departamento de Planificación, 1980.

The Sederhana Assessment Study. Bogor: P.T. Exsa, March 1985.

Sensuar, B., Green D., and Roe, T. "An Analysis of Foodgrain and Nature Policy in the Dominican Republic." Report under University of Minnesota/USDA, Office of International Crops and Development Research Agreement, No. 58-319R-1-220 (Mimeo). Santo Domingo: University of Minnesota/USDA, October 1982.

Siy, Jr., Robert Y. Irrigation and Water Management Policies in the Philippines. Manila, Philippines: Asian Institute of Management, 1983.

Small, Leslie. "Investment Decisions for the Development and Utilization of Irrigation Resources in Southeast Asia." Teaching and Research Forum 26 (1982): pp. 1-9.

Steinberg, David I. Irrigation and AID's Experience: A Consideration Based on Evaluations. Draft. Washington, D.C.: 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, D.C.: US Agency for International Development, 1980.

Summary of Ex-Post Evaluations of Small- and Medium-Scale Irrigation Projects Partially Financed with IDB Loans. Prepared by Operations Evaluation Office, Washington, D.C.: Inter-American Development Bank, May, 1982.

Svedsen, Mark. Irrigator Collective Behavior in Three Philippine Irrigation Systems. Presented at "Investment Decisions to Further Develop and Make Use of Southeast Asia's Irrigation Resources." Bangkok, Thailand: Agricultural Development Council, August 7-21, 1981.

Svedsen, Mark; Merrey, Douglas; and Fitzgerald, Worth. "Meeting the Challenge for Better Irrigation Management." Horizons, March, 1983, pp. 17-25.

After noting the massive investments in irrigation over the last decades, the continued investment and attention to irrigated agriculture, and the shifting focus from building new systems to improving the performance of existing systems--the authors review the major requirement to increase food production via irrigated agriculture: improved irrigation management. Improved water management, or irrigation management, is defined as a complex set of factors going beyond the purely technical system and reaching to issues of long-term sustainability, as well as management of people, funds, equipment, information, and political relationships. They note that, without an interdisciplinary approach or without examining all levels of the irrigation system and subsystems, symptoms tend to be confused with causes and technological fixes are proposed which cure only the symptoms of a larger problem.

The authors note that USAID has responded well to these issues over the last decade. Water Management Synthesis II, a joint project of the Asia and Science and Technology Bureaus, is designed to develop the knowledge necessary to overcome these



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problems and transfer the lessons learned to the appropriate government institutions in developing countries, which are responsible for the planning, design, implementation, operation, maintenance, monitoring and evaluation of irrigation institutions. This institution-strengthening strategy focuses on management, farmer participation, an interdisciplinary approach, and two-way communication between irrigation subsystems. It is the focus of USAID irrigation efforts in the '80s.

Tagarino, R.N. Economic and Financial Policy Issues in Philippine Irrigation Systems. Los Baños, Philippines: University of the Philippines at Los Baños Continuing Education Center, 1976.

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.

Tagarino, R.N. and Torres, R.D. "The Pricing of Irrigation Water: A Case Study of the Philippines Upper Pampanga River Project." In Irrigation Policy and the Management of Irrigation Systems in South East Asia. Edited by Taylor, D.C. and Wickham, T.M., Bangkok: ADC, 1979.

The irrigation water rates policy resulted in a fee which was too high in relation to incomes and too low to cover O and M costs. Alternatives for charging should consider change in production, and prices received by farmers. Benefits to non-project participants, competing objectives for efficient water use, revenue generation and income distribution must all be taken into account to determine appropriate charges.

Takase, K. "NIA-ADB Water Management Project." Farm Water Management Seminar, Manila. Rome, Italy: Food and Agriculture Organization, 1972.

Taylor, Donald C. "Agricultural Development Through Group Action to Improve the Distribution of Water in Asian Gravity-Flow Irrigation Systems." Teaching and Research Forum. No. 1, The Agricultural Development Council, Inc. Singapore: Singapore University Press, 1976.

_____. "Financing Irrigation Services in the Pekalen Sampean Irrigation Project, East Java, Indonesia." Irrigation Policy and Management in Southeast Asia. Los Baños, Philippines: The International Rice Research Institute, 1978. pp. 111-22.



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Farmers are already paying more for irrigation water than the amount being spent on O and M in the project. With substantial external benefits to Government, agro-industry and consumers caution is required in approaching the possibility of increased charges. A number of methods for cost recovery are evaluated.

Taylor, Donald C. and Wickham, Thomas H. eds. Irrigation Policy and the Management of Irrigation Systems in Southeast Asia. Bangkok: The Agricultural Development Council, Inc., 1979.

Torres, R.D. "Pricing Irrigation Water." Water Management in Philippine Irrigation Systems: Research and Operations. Los Baños, Philippines: The International Rice Research Institute, 1973.

United Nations. Efficiency and Distributional Equity in the Use and Treatment of Water: Guidelines for Pricing and Regulations. Natural Resources/Water Series No. 8. New York: United Nations, 1980.

Unson, Delia Cecelia Ochoa. Social Development and the Communal Irrigation System in Laur, Nueva Ecija: Baseline and Selected Interim Monitoring Results, Final Report. Quezon City: Institute of Philippine Culture, 1978.

Uphoff, Norman. "Contrasting Legal and Organizational Approaches to Water Management Development in Sri Lanka." Ithaca, N.Y.: Department of Government, Cornell University, 1982.

UPRIIS, Operation and Maintenance Manual. Cabanatuan City: UPRIIS, 1985.

_____. Organization and Development of Farmers Irrigators Associations (Zone Team Approach) Completion Report. Cabanatuan City: UPRIIS, January, 1985.

US Agency for International Development. Approaches to the Policy Dialogue. AID Policy Paper. Prepared by Bureau for Program and Policy Coordination. Washington, D.C.: US Agency for International Development, 1982.

_____. Food and Agriculture Development. AID Policy Paper. Prepared by Bureau for Program and Policy Coordination. Washington, D.C.: US Agency for International Development, 1982.

_____. Institutional Development. AID Policy Paper. Prepared by Bureau for Program and Policy Coordination. Washington, D.C.: US Agency for International Development, 1983.



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_____. Irrigation Development Options and Investment Strategies for the 1980's. WMS-II Project Report No. 14. Logan, Utah: Utah State University, 1984.

The report urges USAID to concentrate on development of small scale community irrigation in the Sierras with the emphasis on maximizing social benefits per unit of capital input. This should be supported by incentive policies for agricultural development.

The prevailing system of water allocation is based on cropping patterns. Water ownership rights are held by the state and farmers are required to submit to the irrigation district a cultivation plan for the season projecting anticipated irrigated crops and areas. Based on these submissions the district allocates water. Water distribution is enforced at the farm level by sectoristas who are government personnel. Shortage of funds and personnel results in sectoristas being appointed only for management and control of systems where conflicts are common as a result of water scarcity. The system's weakness is its emphasis on determining allocation rather than enforcing distribution.

User participation in irrigation is relatively high in Peru and the organizational structure is defined by law. The primary motivating force in participation is the need for regulation in order to protect individual interests. Organizations are particularly active where conflicts are common but there are shortcomings in that the presidents of the user organizations cannot handle allocation abuses and therefore equity suffers. The possibility for establishing successful user organizations in the Sierras is great because of the Indian population which tends to be communally organized.

By law, Peruvian irrigation users are required to pay a tariff and a quota. The purpose is threefold: to recover capital costs; to recover O and M costs; and to increase efficiency of water use. The current tariff varies from district to district and is based on farmer ability to pay. It is collected by the government for the public fund. The quota is collected by user groups for their own use. The rates of the tariff and quotas are, however, so low as to be almost inconsequential. Collection costs are sometimes higher than generated revenues.

Prescriptions to use pricing as a means for getting farmers to use water more efficiently will not work where water is scarce because it may aggravate an already difficult situation. Although some studies have suggested that there is considerable wastage of water, pricing may not be the solution for inefficient use. Other factors may be involved, such as inefficiencies in the main system which are related to the local system, and over which users have no control and cannot effect by improved management. In setting fees, it is important to take into consideration that a variety of objectives may be involved and it is necessary to relate the tariffs to the paramount objective.

Cost recovery and management issues in Peru are greatly affected by macroeconomic conditions. A clear relation was found in this study between good on-farm water management and cases where farmers were faced with strong market prices, whether real or subsidized. In these cases, a minimum of governmental support was needed.


_____. Local Organizations in Development. AID Policy Paper. Prepared by Bureau for Program and Policy Coordination. Washington, D.C.: US Agency for International Development, 1984.

_____. The On-Farm Water Management Project in Pakistan. AID Project Impact Evaluation Report No. 35. Washington, D.C.: US Agency for International Development, June 1982.

_____. Pricing, Subsidies, and Related Policies in Food and Agriculture. AID Policy Paper. Prepared by Bureau for Program and Policy Coordination. Washington, D.C.: US Agency for International Development, 1982.

_____. Project Paper: Agricultural Policy Analysis. Prepared by University of Minnesota in Dominican Republic. Washington, D.C.: US Agency for International Development, 1984.

_____. Project Paper: Dominican Republic Rural Savings Mobilization. AID/LAC/P-163; Loan #517-0179. Washington, D.C.: US Agency for International Development, August 18, 1983.

_____. Project Paper: India - Hill Areas Land and Water Development. No. (386-0489), New Delhi: USAID/India, July 27, 1984.

_____. Project Paper: India - Maharashtra Minor Irrigation. No. (386-0490), New Delhi: USAID/India, May 1984.

_____. Recurrent Costs--Problems in Less Developed Countries. AID Policy Paper. Prepared by Bureau for Program and Policy Coordination. Washington, D.C.: US Agency for International Development, 1982.

_____. Sederhana: Indonesia Small-Scale Irrigation. AID Project Impact Evaluation Report No. 29. February 1982.

_____. Study of Recurrent Cost Problems in Irrigation Systems. Colombo, Sri Lanka: Engineering Consultants Limited, 1984.

Veeman, Terence S. "Water Policy and Water Institutions in Northern India: The Case of Groundwater Rights." Natural Resources Journal VIII (3): pp. 569-88.




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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.

Venugopal, K.; Kumar, P.N.; Pal, S.P.; and Agarwal, S.C. Techno-Economic Study of the Recovery of Water Related Charges in the World Bank Assisted Haryana Irrigation Project. India: National Council of Applied Economic Research, 1982.

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.

The experience of the National Irrigation Administration (NIA) of Philippines' with irrigation design and implementation led to a greater respect for and inclusion of existing traditional structures of farmer organization (called zanjeras), in terms of farmer participation in planning and implementation as well as optimal utilization of existing irrigation networks. The zanjera is a communal irrigation system operated by a very cohesive group with values of fair and equal distribution of labor, money and other resources. In its initial stages, the Palsiguan River Multi-Purpose Project (PRMP) did not utilize the zanjeras' existing system of canals. Also, farmers were suspicious of NIA's motives as well as resistant to signing right-of-way waivers and paying irrigation fees. A re-assessment of the project led to a strategy which involved farmers from the beginning in planning for the project, after taking zanjeras leaders on a field trip to observe the benefits of a similar project. A survey of the zanjeras canals showed that 85 percent of the existing canals could be utilized in the project. The remaining canals and ditches to be constructed were jointly planned by the zanjeras and NIA. NIA also provided opportunities for strengthening the zanjeras through federations, registering them with the Securities and Exchange Commission, and providing training in O and M. Thus, the zanjeras could assume full responsibility for the new system. The authors concluded that project success is highly dependent on farmer participation in the project at the planning stages and throughout the construction and turnover process.

Wade, Robert. "Collective Responsibility in Construction and Management of Irrigation Canals: Case of Italy." Economic and Political Weekly, December, 1979, pp. 155-160.

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

This article treats the subject of canal irrigation and the management thereof in a case study of the southern Indian district of Andhra Pradesh. Specific attention focuses on the relationship between the degree of corporate organization and the scarcity and uncertainty of water supply. In India an estimated 40-50 percent of food grain production comes from irrigated areas; of this area, one-half is supplied by canals. The functioning of these canals at the local level has not attracted the appropriate attention of social scientists, in that the specific district studied exemplifies a system with a low degree of organization where the land owner is the primary manager of the land. The comparison is made to a village with a higher degree of organization which contains committees designed to settle irrigation and cultivation questions and which nominates the members on an annual basis. Among the functions of the committee are: 1) appointment of water guards; 2) establishment of harvesting dates for sorghum; and 3) collection and management of village funds. The author therefore asserts that to employ common irrigators is of sociological significance in that the establishment of common irrigators results in cultivators relinquishing management of irrigated land and their individual claim to control water usage. A corporate approach to irrigation as a response to water scarcity is evident in nearly all cases studied. Where water is problematic for virtually all irrigators, users tend to form a corporate body to deal with problems of users' rights, allocation, fees, and equitable distribution of the resource. These pressures, then, are likely to be institutionalized in the formation of an association or committee concerned with management problems. Finally, as described in the Indian villages studied, which lack a formalized management structure, the organizational response is likely to be most strongly shaped by the immediate environmental pressures such as water scarcity and its impact on water regulation.

_____. "Water to the Fields: Institutional Innovation in India's CAD Programme." South Asian Review VIII (1975): pp. 301-321.

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, realignment of 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.

_____. "The System of Administrative and Political Corruption: Canal Irrigation in South India." Journal of Development Studies XVIII (3) (1982): pp. 288-327.

Wade, Robert and Chambers, Robert. Managing the Main System: Canal Irrigation's Blind Spot. Brighton, England: Institute of Development Studies, University of Sussex, 1980.

The authors argue that current evaluation and professional writing concerning canal irrigation systems is severely biased by ignoring or screening out a set of causes for inefficient irrigation management. They identify the following three implicit false assumptions prevading current discussion: 1) problems are 'technical' rather than 'institutional' in nature; 2) problems are 'below' rather than 'above' the outlet, i.e., at the farm and village level; and 3) inasmuch as problems are institutional in nature, they are problems with farmer institutions.

Effective and efficient management of the main system, or even realization of problems with the main systems, are hampered by several 'blind spots': 1) village level and on-farm management difficiencies are more visible than system distribution problems; 2) no professional discipline exists to identify and provide solutions for main system management as exists for the physical, economic, social and agronomic elements of the systems; 3) prejudicial blame is given to farmers as ignorant and therefore of water as a scarce resource in the analysis of problems and potential solutions; 5) solutions are treated as zero-sum games when in fact benefits can accrue to all participants in the system by improved management of the main system; and 6) little incentive exists for canal operators to allocate water efficiently, rather allocation is to minimize conflict to the operator.

The authors propose that changes in both cognitive and diagnostic procedures are needed to overcome these problems. Increased focus must be paid to main system management, especially to overcome the bias and blind spots identified.

Water Management in Bank-Supported Irrigation Project Systems: An Analysis of Past Experience. Prepared by Operations Evaluation Department. Washington, D.C.: The World Bank, April 1981.

Watson, William D.; Nuckton, Carole Frank; and Howitt, Richard E. Crop Production and Water Supply Characteristics of Kern County. Davis, California: University of California, 1980.

Wattanavitukul, Somluckrat and Cruz, 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. Two major types of organizational arrangements are identified: 1) direct state management where no village organization exists; and 2) state coordination with existing local, village administration.

Wells, John Craig and Norman, William Ray. Sahelian Irrigated Agriculture: A Review of French Literature Sources. Water Management Synthesis II Project. Ithaca, New York: Cornell University.

Wickham, Gekee Y. "Farmer Attitudes Towards Irrigation and Farmer Potential for Cooperation." Water Management in Philippine Irrigation Systems: Research and Operations. Los Baños, Philippines: The International Rice Research Institute, 1973.

In this study, the author finds that farmers in areas of assured water adequacy tend to be less cooperative with water management personnel because they already have free access to water, whereas farmers in water-short areas exhibit a greater degree of cooperation in hope that it will improve their water supply. Cooperation between farmers themselves also seemed to be preferred on an informal basis rather than through formal means such as irrigators associations. In addition, farmers were generally interested in working individually rather than as a group, pump use being the only preferred group activity recognized by a majority of the farmers in the study group.

One traditional notion of noncooperation in the area of water fee payments is challenged by the author. The traditional explanation of inadequacy of water resulting in non-payment is not born out in this study, nonpayment remains a problem despite 71 percent of the farmers in the study group acknowledging they have at least adequate water supply.

The study also notes that farmers generally have good relations and communication with the government-employed ditch tender. This relationship was mostly social, however, so irrigation was seldom the topic of discussion. The author therefore advocates the need for either increased communication between higher-level irrigation personnel and the farmers or an upgrading of the ditch tenders' responsibilities, in the areas of water distribution or collection of fees for example.

Wickham, T.H. Water Management in the Humid Tropics: A Farm Level Analysis. PhD Dissertation. Ithaca: Cornell University, 1971.

Young, Robert A. Notes on the Allocation, Pricing and Valuation of Irrigation Water. Paper prepared for seminar on "Economics of Water Uses for Irrigation in Egypt." Cairo, Egypt: Department of Hudraulic Engineering Cairo University, and Water Research Center, Ministry of Irrigation, December 6, 1983.