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Organizational Change for Participatory Irrigation Management

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Report of the APO Seminar on Organizational Change for Participatory Irrigation Management
Philippines, 23–27 October 2000
(SEM-32-00)

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ORGANIZATIONAL CHANGE FOR PARTICIPATORY IRRIGATION MANAGEMENT

2002
Asian Productivity Organization
Tokyo

Report of the APO Seminar on Organizational Change for Participatory Irrigation Management held in the Philippines from 23 to 27 October 2000
(SEM-32-00)

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FOREWORD

The significant achievements in Asian agriculture during the past decades have been attributed in large part to the Green Revolution that occurred in the region in the 1960s and 1970s. The Green Revolution resulted in marked increases in yields which were brought about not only by the widespread use of new high-yielding varieties, mainly of rice and wheat, but also by the adoption of those varieties in conjunction with a comprehensive package of additional inputs which included fertilizers, pesticides, and adequate irrigation. Irrigation thus played a major role in the endeavors of developing countries to meet the food requirements of their growing populations.

The improvement of irrigation efficiency to sustain food production efforts became an overriding concern as water resources became increasingly scarce and costly. Large irrigation systems constructed by the public sector were often poorly managed. It was in this context that a more participatory approach to irrigation management was introduced in the 1970s and 1980s. Since then, the varied experiences of a number of developing countries have shown that participatory irrigation management generally contributes to reduced costs to government, better management, greater accountability, and improved sustainability of operations. Such benefits, however, can be gained only by ensuring that the shift to a participatory type of management is properly planned and managed. This requires all stakeholders to participate in, support, and commit to implementing the change on time and within the planned resource budget.

To assess recent developments in the implementation of participatory irrigation management in APO member countries and to discuss ways of more effectively managing the change to that type of management, the APO organized a Seminar on Organizational Change for Participatory Irrigation Management in October 2000 in the Philippines. This volume is a compilation of the papers and proceedings of the seminar. I hope that it will serve as a useful reference on the subject in APO member countries.

The APO is grateful to the Government of the Philippines for hosting the seminar, in particular to the Productivity and Development Center of the Development Academy of the Philippines, for implementing the program and to the resource speakers for their valuable contributions. Special thanks are due to Dr. C.M. Wijayaratna for editing the present volume.

TAKASHI TAJIMA
Secretary-General

Tokyo
December 2002

SUMMARY OF FINDINGS

INTRODUCTION

The Seminar on Organizational Change for Participatory Irrigation Management, which was organized by the Asian Productivity Organization (APO) and hosted by the Government of the Philippines, was held in Manila from 23 to 27 October 2000. The "Productivity and Development Center" of the Development Academy of the Philippines (PDC-DAP) implemented the program in cooperation with the Department of Agriculture. Sixteen participants from 13 member countries and five resource persons attended the seminar. Participants were from: Bangladesh, Republic of China, Fiji, India (2), Indonesia, Islamic Republic of Iran, Japan, Mongolia, Pakistan, the Philippines (2), Sri Lanka (2), Thailand and Vietnam and the resource persons were from: International Water Management Institute (IWMI); National Irrigation Administration, the Philippines; Food and Agriculture Organization (FAO), Bangkok; and New Zealand.

The objectives of the seminar were to: 1) assess recent developments in promoting participatory irrigation management and 2) discuss measures for more effectively managing organizational change for improved participatory irrigation management.

The seminar consisted of presentation and discussion of resource papers as well as country papers, and field visits to the Sta. Maria River Irrigation System and San Benito Communal Irrigation System in the Laguna Province. The topics covered by the resource papers were: 1) Recent Developments in Irrigation Management in Asia and the Pacific; 2) Improving the Irrigation Service to Farmers: A Key Issue in Participatory Irrigation Management; 3) Participatory Irrigation Management in the Philippines: Issues and Constraints; 4) Role of Water Users Associations for Sustainable Irrigation Management; and 5) Requisites of Organizational Change for Improved Participatory Irrigation Management. The country papers, on the other hand, focused on the current situation of irrigation development in each of the countries participated, present organizational setup of irrigation administration, recent developments in promoting participatory irrigation management (PIM), and future prospects for PIM in respective member countries. The participants had an opportunity also to undertake field studies during field visits and, in a workshop setting, they identified issues and specific measures to enhance participatory irrigation management. The highlights of the Seminar are presented below.

COUNTRY PAPERS

The country papers and the follow-up debates and discussions revealed that all the participating countries have taken initiatives in PIM. The effort as well as the success, however, varies across countries, representing mainly the country-specific socio-political, economic, cultural and historical aspects as well as the differences across countries in relation to such factors as the "stage" of economic and irrigation development, characteristics of the organizational structures established for irrigation management – especially the government

bureaucracies and farmer organizations (FOs) and the degree of external assistance. Hence, the following summary is organized in four parts: the current situation of irrigation development, organizational setup of irrigation administration, recent developments in PIM and future prospects.

Current Situation of Irrigation Development

Many countries in the region have had a long tradition of irrigation. And, in the recent past, water resources development has been assigned a significant priority in public investment strategies in many of the participating countries. Construction of large systems was the tradition in such efforts in many countries like Pakistan, India, Sri Lanka and Thailand. This trend was reversed in Thailand and in the recent years the focus has been shifted towards smaller systems. The irrigation potential of India has increased by four folds between 1947 and 1997. In Bangladesh, on the other hand, the recent developments were mainly in groundwater utilization, especially through shallow tube-wells. Despite such huge development efforts in recent years, however, there are problems such as inefficiencies in operation, cost and time overruns, waste of water, water-logging, groundwater pollution and overexploitation, problems associated with pricing of water and financial losses. In Vietnam, upgrading and rehabilitation of irrigation system have contributed to increased food production in the recent past.

In many countries, further expansion of area under irrigation is now constrained by several factors such as decline in donor funding, increased cost of new construction, and increased demand for meager budgets of governments of developing countries. In many countries in the region, the easiest and cheapest sources however already were exhausted. Consequently, the potential for expanding the area under irrigation has diminished rapidly. There are exceptions, however. For example, in the host country, Philippines, only 43 percent of the potential irrigable area is being used. In Iran too, only 7.8 million ha out of the potential irrigable area of 20 million ha has been developed. In India, it was reported that the potential created for surface water is about 75,853,000 ha whereas its utilization is only 43,897,000 ha.

In general, irrigation still plays a significant role in the economies of most of the countries. The exceptions are the more advanced economies such as Japan, the Republic of Korea and the Republic of China. In Japan, even though agriculture accounts for two-thirds of the total water use, the role of irrigation in the economy has declined. The techniques of wet rice had been adopted since third century BC, and by about 17 century AD, it had become the basis of the economy and finance. However, the food self-sufficiency ratio, area of agricultural activity as well as proportion of population involved in agriculture had continuously decreased in the past three decades. In these developed economies, a substantial effort has been taken to consolidate land, improve land and water-related infrastructure and the current tendency is to establish advanced land and water use methods and decision support systems to enhance the productivity of these two important natural resources. The paper from the Republic of China provided an excellent description of such an effort. Malaysia has now taken initiatives in land consolidation and improving canals and other structures.

Organizational Setup of Irrigation Administration

It was revealed that in many countries, several Ministries, divisions of Ministries as well as a large number of government institutions are involved in irrigation, directly or indirectly. In Thailand for example, it was reported that 32 institutions are involved. The number varies across countries. For example, seven major national level departments deal with irrigation in

Bangladesh and three Ministries; several national and provincial agencies are involved in Sri Lanka. However, decentralization or delegation of power has taken place in several countries such as Sri Lanka (through provincial governments) and Indonesia. In Indonesia, the Ministry of Public Works has the authority to administer irrigation. In India, water is a State subject and therefore, the role of the central government is essentially catalytic in nature. In Iran, two major Ministries are involved and there is a proposal to merge these two to enhance coordination and efficiency. In Fiji, the Land and Water Resources Management Division, which has been established recently (1972) within the Ministry of Agriculture, is responsible for irrigation.

Recent Developments in Participatory Irrigation Management

There is a growing concern on the need for Participatory Irrigation Management and Irrigation Management Transfer (PIM and IMT). This is due to many reasons. Most important ones are as follows: a) as new constructions involve heavy investments, and in the context of budgetary difficulties, the inefficiencies in existing systems need to be rectified; b) it has been evident that there is scope for improving management efficiency in existing systems; c) countries and/or irrigation systems which have adopted PIM and IMT have already demonstrated encouraging results; d) there is a "trend" in devolving and decentralizing responsibilities and even privatizing government-run business; and e) donor pressures. Many countries have attempted to generate Operation and Maintenance (O&M) financing from within systems, Participatory Modes of Management, IMT and strengthening management capacity etc.

In regard to the degree of development or the status of PIM, countries in the region, represents a "continuum". At one end of the continuum are the more advanced countries that have advanced organizations with more bargaining power and engaged in irrigated agricultural production using advanced techniques and technologies. Among the other countries, probably, the status of PIM in the Philippines is more advanced. However, according to presentations, it has faced with new constraints and challenges at present. Sri Lanka, which commenced PIM in early 1980s, has achieved a relatively higher level of success. Countries such as Pakistan are just embarked on PIM and several pilot projects are in progress. It was reported that in India, Water User Associations (WUAs) are in operation in several States and it is estimated that 862,563 ha are being managed by WUAs. Indonesia has been promoting PIM for sometime and, with the present efforts of decentralizations in the sector, PIM will be enhanced further. The paper from Indonesia reported, however, that the WUAs have not been "developed" as expected.

Thailand has developed an ambitious plan for the short term as well as for the long term. Vietnam, too is experimenting with novel models of PIM while Fiji is probably the latest addition to the adopters of the PIM.

Future Prospects

It has been reported that the PIM efforts in countries have achieved the following benefits: a) changing farmers' attitude of over dependence on external assistance; b) positive experience on new institutional arrangements that could be extended to other areas; c) improve irrigation management and crop production, timely maintenance of irrigation structures; d) collection of water fees; and e) promoting community activities. On the other hand, the presentations revealed certain constraints such as the following: inadequate knowledge (of

officials as well as farmers) about management transfer, limited coordination between FOs, inadequacies in government support and difficulties in "sharing power", inadequacies in legislation and regulatory mechanisms, lack of incentives for the (government agency) staff to effectively involved in PIM, price and market problems and resulting decline in farmer profits etc.

Participants perceived that the PIM could be enhanced further by facilitating the processes of strengthening FOs, WUAs and similar organizations, assisting in capacity building, supporting through other services such as timely supply of complementary inputs, regulating credit facilities, providing legal support, appropriate policy changes and political support etc. Further, some papers argued that in order to enhance and sustain the productivity of irrigation, a participatory and integrated management of natural resources – chiefly land and water in a watershed/basin basis is required.

Moreover, increasing cropping intensity by focusing on crop output and productivity per unit of water per unit of time and shifting to high value crops were also emphasized in several papers. This is prominent in more advanced economies. For example, the Republic of China and Japan are focusing more on demand-driven irrigation management systems.

Many countries, such as Malaysia are planning to further reduce government expenditure in irrigation management by promoting PIM. In addition, certain countries are developing institutional mechanisms to manage water resources in a river basin context. For example, in Sri Lanka, a new institutional arrangement and an organizational structure are being introduced for water management in river basins. Under this, a Water Resources Council and a Water Resources Secretariat have been set up as apex bodies.

RESOURCE PAPERS

Recent Developments in Irrigation Management in Asia and the Pacific
(Dr. Randolph Barker)

Overtime, irrigated agriculture has increased in importance in Asia as a source of food security, higher farm incomes, and increase in welfare for both rural and urban populations. The development of irrigation in the 20th century played an important role in generating food surpluses that have led to economic development, first in East Asia and more recently in South and Southeast Asia. Over 60 percent of the world's irrigation is in Asia and since 1965 the irrigated area has almost doubled. The region has moved beyond the period when food security was the major goal and construction of large dams and surface irrigation systems were seen, as the major investment needed to achieve that goal. It is now challenged to produce more food with less water, to enhance livelihoods and alleviate poverty in the rural areas, and to manage water to protect the environment and human health. This calls for a new approach to water management.

In the paper, a framework for examining the evolution of modern irrigation development in South and Southeast Asia was presented and four distinct phases were identified. Prior to World War II Asian irrigation consisted principally of run-of-river systems to provide supplemental irrigation to the wet season crop. Most of these systems were locally managed with a high degree of participation (Phase I). The 1960s and 1970s saw the construction of large dams and a rapid expansion of publicly managed irrigation systems (Phase II). Dissatisfaction with the performance of these systems and pressures to reduce government budgets has led to a period of irrigation management reform starting in the late 1970s and

carrying to the present (Phase III – participatory irrigation management). The growing scarcity and competition for water demands that in the future water be treated as a resource and economic good with a wide range of uses that can benefit various members and segments of society (Phase IV – integrated water resource management [IWRM]).

The paper then elaborates on the recent developments in irrigation management in Phases III and IV, and on the need to broaden the scope from the management of water for irrigation (PIM), to the management of water as a resource (IWRM).

Attention in Asia and in this conference is focused on PIM. However, inappropriate design limits the capacity of the canal systems to deliver water when needed by farmers even under good management. Declining cereal grain prices and the availability of low-cost pump and tube-well technologies has led to a rapid expansion in the area irrigated by groundwater. This has occurred often in canal areas with a lack of coordination in conjunctive use. Particularly in the semi-arid regions, overexploitation of groundwater is affecting both the quantity and quality of water available for agriculture, domestic use, and other purposes.

The growing scarcity and competition for water and the exploitation of groundwater are posing new management problems for governments:

- How to allocate water among competing users and uses;
- How to increase the productivity of water at farm, system, and basin level;
- How to manage ground and surface water for conjunctive use;
- How to control overexploitation of groundwater, which is affecting the quantity and quality of water used for irrigation and other purposes; and
- How to minimize the negative impacts of irrigation development on environment and human health.

IWRM will take on many forms depending on the location, the stage of development of water resources and institutions and in particular the degree of water scarcity. PIM can be seen as an integral component of IWRM. However, while PIM is designed to reduce government expenditures for irrigation, IWRM will require new management skills, the reform of old institutions and most certainly the creation of new institutions as we move from the management of water for irrigation to the management of water as a resource. Many Asian governments are already beginning to move toward IWRM. The task is monumental. Despite the urgency of the problem, it may take years or even decades to create the appropriate institutions. But both the needs to effectively manage water resources under scarcity and the direction to achieve this goal are clear.

Improving the Irrigation Service to Farmers: A Key Issue in Participatory Irrigation Management (Mr. Thierry Facon)

This paper argues that the notion of water delivery service and of generalized service-orientation of institutions in the irrigation sector, whether river basin agencies, reformed irrigation agencies, irrigation service providers, water users associations (WUAs) has become central in new concepts and definitions of participatory irrigation management and irrigation management transfer.

After a definition of the concept of irrigation service and how to evaluate it, the existing literature on the evaluation of impacts of ongoing participatory irrigation management and irrigation management transfer programs in terms of water service delivery, agricultural

productivity, and agricultural performance, which is one of the reasons for this evolution, is reviewed. The paper then reviews how the service orientation of irrigation water delivery is taken into account in physical works, monitoring and evaluation systems, and tools for design and preparation of operation and maintenance plans. The sustainability of the WUAs is seen to depend on their capacity to provide: a) an adequate water delivery service and control; and b) an improved service to allow the agricultural productivity to take place. In the context of Asia, diversification of rice crops is a major issue for increased income by farmers and improved agricultural and water productivity. This in turn is essential for the capacity of farmers to pay water and the WUAs to be financially viable. A more forward-looking strategy anticipating these future needs is therefore required. As a result, it is now recommended that strategies of gradual improvement of irrigation systems be adopted to support the transfer of water management responsibilities and associated rights.

The paper then reviews the implications of improved agricultural productivity and improved water productivity in terms of required quality of water service, particularly in the case of rice and diversification of rice-based farming systems.

The paper argues that concepts of irrigation management transfer/participatory irrigation management transfer and modernization of irrigation systems operation are therefore converging. However, there are still some substantial differences: the infra-structural physical improvements which must be supported must be designed with a view to improve equity and reliability of water delivery service and evolve towards increasing levels of flexibility. Operational and technical details become very significant. Environmental considerations need to be better taken into account in a perspective of IWRM.

Recent visioning processes in the water sector provide a good condition for strategically panning organizational and technical changes in participatory and irrigation management. The paper therefore presents trends and evolutions towards IWRM as well as concrete examples of water visions and their implications in terms of transformation of the irrigation sector. However, there is a general lack of knowledge of modern service-oriented design and operation concept at all technical levels in the irrigation sector in the region. The paper presents modernization design and operation concepts as well as possible modernization strategies.

Intensified and ongoing training programs for both professionals in the reformed irrigation agencies, consulting firms who will provide advisory services to WUAs and to the managers of WUAs and the technical staff that they may employ for O&M of their irrigation schemes are understood as one of the conditions for sustained success of the transfer programs.

It is therefore essential that these programs introduce and provide knowledge on ways and means to design and operate irrigation systems cheaply for good performance and adequate service to farmers as they evolve toward more commercial forms of agriculture. An appraisal of initial conditions and performance of the systems to be transfer would allow both a better design and strategic planning of physical improvements together with a definition of the service to be provided both by the irrigation service provider to WUAs and by WUAs to their members, with indications on ways and means to achieve these service goals and improve them in the future.

It is suggested that the Rapid Appraisal Process developed and used in the evaluation of modernization programs of IPTRID could be used for this purpose at program appraisal stage and for individual irrigation systems. The use of internal process indicators would be useful in M&E systems. A pilot training program on modernization concepts and application of the Rapid Appraisal Procedure which builds on the knowledge synthesis acquired in recent years

on modern design principles and PIM shows promising results. Its application to a system in Thailand by staff of the Royal Irrigation Department is presented.

A concept for a more ambitious re-training program based on the same concepts and tools has been developed and could be supported in the context of efforts to improve the performance of programs to transfer the management of irrigation systems to the users (Burt and Facon, 1999). The paper also concludes that a second condition for the sustained success of participatory irrigation management is the availability of financial instruments that allow farmers to invest in the upgrading of their irrigation systems. Another condition for the sustainability of the reforms is the development of a suitable service to assist farmers in increasing the productivity of agriculture.

Participatory Irrigation Management in the Philippines: Issues and Constraints
(Mr. Avelino M. Mejia)

The long-term vision of the National Irrigation Administration (NIA) of the Philippines is "*dynamic and functional NIA-IA relationship working in partnership to accelerate irrigation development and provide efficient levels of irrigation services*". The achievement of this vision lies heavily on NIA's capability in providing assistance and guidance to beneficiary farmers in the establishment of the IAs so that they can effectively participate in an organized manner in all aspects of irrigation management. One of the major accomplishments of NIA in strengthening the organizational capability and linkages among IAs was the establishment of IA federations at various levels (system, provincial and regional). These efforts resulted to the holding of the first national IA congress wherein the National Confederation of Irrigators Associations (NCIA) was established in June 1997.

NIA established System Management Committees (SMCs) as well. SMCs are primarily at the irrigation system level and serve as the formal forum and meeting platform between NIA field managers and the farmers. Additionally, SMCs serve as a coordinating mechanism with various related agencies and with local government units.

As of December 1999, 2,078 and 3,018 IAs have been organized in National Irrigation Systems (NIS) and Communal Irrigation Systems (CIS), respectively. These IAs cover an aggregate area of 1.01 million ha. The key parameters of IA functionality are: cropping intensity, financial viability, implementation of O&M plans, organizational viability and resource mobilization. Based on surveys, annual assessments are being made and the results are used to reward outstanding IAs. The IA functionality results also used as the basis for the field and regional offices in identifying appropriate strategies and means for enhancing the IAs capabilities in handling O&M and in improving the management of the organizations.

While it is apparent that NIA has achieved substantial accomplishments in the establishment of IAs and in handing over the management responsibilities to these IAs, there are still some issues and constraints to the further development of these organizations. These include: accelerated deterioration of irrigation infrastructure, lack of production capital, stringent bank lending procedures, lack of police power to IAs, absence of attractive retirement package for NIA officials whose services would become redundant after the full transfer of O&M responsibilities of irrigation systems, dwindling of morale of program supervisors and implementers due to the recent streamlining proposals prepared by NIA in compliance with the directives of the national government and policy changes due to political interventions. NIA, however, envisions that in the future the IAs would become dynamic and self-reliant organizations of farmers with capabilities to respond effectively the challenges posed by its environment.

Role of Water Users Associations for Sustainable Irrigation Management
(Mr. Benjamin U. Bagadion, Sr.)

As the economic, social and political conditions vary from one country to another, it is to be expected that the factors that affect the role of WUAs would also vary across countries. In general, however, the factors identified are:

i) Laws and policies of the country and its irrigation agency;
ii) Size and complexity of the irrigation systems;
iii) Physical condition of the irrigation systems;
iv) Size of irrigated farm holdings;
v) Farmers' net income;
vi) Capability of irrigation agency and its staff;
vii) Capability and organizational arrangements of the WUA;
viii) Local politics;
ix) Local social customs and practices;
x) Frequency of natural disasters; and
xi) Environmental problems.

Depending on the mix of the above factors in a given situation, the role of the WUAs and NIA in irrigation management in the Philippines would be any of the following as may be agreed upon between NIA and the farmers:

i) The responsibility of the farmers is only at the terminal level;
ii) NIA responsible for the entire irrigation system and deliver water in the turnout;
iii) Farmers are expected to construct and maintain farm ditches and drainage ditches, distribute water among themselves and pay the irrigation fees as prescribed by the government;
iv) Farmers are organized into informal groups; and
v) Irrigation fees are collected from the water users by NIA irrigation fee collectors.

NIA and WUAs enter into two types of contracts, Type I and Type II:

Type 1: The WUA undertakes canal maintenance which does not require heavy equipment such as clearing desilting, embankment repair for which NIA pays the WUA an agreed amount per kilometer of canal on a monthly basis.
Type 2: The WUA assists in delivering water to the various turnouts, prepare the list of irrigated and planted areas, distribute Irrigation Service Fee (ISF) bills prepared by NIA, collect payments of ISF from farmers and remit the collection to NIA. For this activity they are entitled to a share of the amount collected, based on the following formula:

Percentage Collected	WUA Share (percent)
50-60 percent of billings	2
Above 60-70 percent of billings	5
Above 70-90 percent of billings	10
Above 90 percent of billings	15

Each WUA in a given irrigation system enters into an agreement with NIA for O&M of a lateral canal and the sub-laterals that irrigate the area of the WUA. NIA remains responsible for the O&M of the main canal and the head works and delivers water to each WUA at the head gate of each lateral canal. ISF bills to farmers are prepared by NIA from the list of irrigated and planted areas prepared by the WUA and verified by NIA staff. ISF is collected by the WUA and the collections are shared between NIA and the WUA in accordance with a formula designed to cover the O&M expenses of NIA. The agency provides incentives for increased collection by the WUA. The WUA is responsible for O&M and financial management of the entire irrigation system in accordance with an agreement on irrigation management transfer that stipulates the responsibilities of the WUA and the NIA for attaining sustainability of the irrigation system.

Having generally outlined the various roles, which may have in irrigation system management as experienced in the Philippines, the question becomes which of these roles would enable sustainable irrigation management.

Requisites of Organizational Change for Improved Participatory Irrigation Management (Dr. C. M. Wijayaratna)

In many countries, agriculture sector in general and irrigated agriculture in particular, has now entered a new phase of development. In the 1970s and 1980s, there was a shift in focus towards rehabilitation and improving management of existing systems rather than the earlier emphasis on constructing of new irrigation systems. This interest gathered momentum due to the diminishing land and water resources available for, and the increasing cost of developing new irrigated production systems; demonstrated under-performance of the existing systems and comparative advantage of undertaking rehabilitation programs over new construction activities. At present, most of the countries face with new challenges of structural adjustments towards liberalized markets. This implies that the agriculture sector has to face with local demands such as achieving food security, poverty alleviation, environmental concerns, income and employment generation, and at the same time, compete in export markets (and in the local market with imported products), based on comparative advantage. In this context, this paper proposes that irrigation organizations and institutional arrangements should be restructured to cater "market-oriented" production. Moreover, the expected improvements in irrigation management alone may not generate adequate incremental benefits for WUAs/irrigation organizations to be financially viable.

A better alternative would be to strengthen the established organizations and enhance their scope of work to adopt a holistic approach. In this, the farmers' organizations will have to deal with the organized private sector, in a business mode. They would be engaged in, not only in irrigation management tasks, but also in production, collection, storage, quality control, value-added production and marketing etc. While the countries are increasingly embracing open market policies, Farmer Companies (FCs), cooperatives or other forms of federated Farmer Organizations (FOs), would be the most appropriate organizations for small farmers to reach economies of scale and enhance the bargaining power.

The matured organizations/institutions may federate upwards and expand their scope, for instance, by expanding their area of work to cover main irrigation system, or the watershed/river basin as well, and most importantly, enter in to other economic activities. Thus, new activities, roles and functions will be added and new skills will be required. Then the organizational structure should be adjusted for efficient handling of these new tasks and

roles: it may be diversified and division of management and labor may be necessary to undertake special functions. One alternative may be to form task-based groups within a single organization to handle different tasks. FCs or similar (multi-functional business) organizations, once they gain economic strength and management capacities, would become the appropriate organizations for "self-managing" irrigation systems. They could take the responsibility of managing the total "agricultural production system" and within a "multi-function" organization they may create an "arm" for irrigation management.

The major functions of the irrigation "arm" of a federated organization/company would include: deploying mechanisms to ensure active and productive participation of water users; planing and conducting O&M and Rehabilitation and Modernization (R&M); administer water rights; resolution of conflicts, and implementation of regulatory and control mechanisms; ISF/revenue collection, budgeting, and financial management; providing/ coordinating irrigation and agriculture-related services; and managing information, Monitoring and Evaluation (M&E) and, at advanced stages, research. It is important that the leaders/farmer representatives as well as the members of organizations have a clear understanding on such aspects as: the need and basis for collective action in irrigation management (including division of O&M-related responsibility within the organization), rules governing collective action, obligations in regard to contributions/irrigation fees/rates, mechanisms for conflict management in relation to O&M and the "Reward-Punishment" mechanisms. In addition, they should be aware of water supply/delivery mechanisms; water requirements for planned cropping patterns at different places of the command area and at different times etc. Further, the modes of ordinary farmers' participation in decision-making at different levels and procedures ensuring accountability of higher level decision-making to ordinary farmers should be clear and transparent.

The proposed process (in sequence) may be summarized as follows:

1. Strengthen the managerial capacity of FOs or WUAs;
2. Facilitate the establishment of multi-functional business organizations like FCs, with irrigation management as an integral part of the overall business;
3. "Full transfer" of responsibility (and authority to "rehabilitate, own and operate");
4. Financial support, technical assistance and skill development; and
5. Assist initially in feedback and self-correcting mechanisms, establishing transparency through the establishment of a people-centered M&E system based on a set of objectively verifiable indicators.

Providing an "Institutional Home" for farmer organizations, especially at their initial stages of development could facilitate such a process. A relevant State institution or a capable NGO may perform such a role and provide catalytic services and technical assistance, arrange for policy (including legal) and financial support and assist in the institutionalization of self-correcting mechanisms and information systems.

Different combinations of stakeholders, primarily FOs, government agencies and the organized private sector (private firms), may undertake R&M and post R&M activities at different levels of intensity using different levels of technology (related to water use and crop production, for example). It is suggested that, in general, different models for participatory irrigation management (including rehabilitation) can be specified on the basis of three variables namely: a) level of water use (mainly the level of technology or irrigation method); b) type of

production process including crops, cropping patterns and methods of production; and c) the degree of participation by different "actors" or the stakeholders in "a" and "b". Obviously, the type and number of functions undertaken by any organization as well as the scale of operation would directly related to its organizational strength or the stage of organizational development. In this context, these variables, namely: a) *degree of involvement of different stakeholders*, b) *level of water resources utilization (mainly technology/method)*, c) *type of production* and d) *the type of functions undertaken by farmers organizations and the scale of operation*, could be combined at different levels to yield various "options" or operational models. It is proposed that, not only the advanced production and irrigation methods and associated infrastructure, but also different organizational strategies may be "offered to" and "utilized by" FOs.

WORKSHOP OUTPUT

Objectives

A workshop was conducted to address the issue: "What should be the future vision for PIM? More specifically, participants addressed two important issues: a) expectations of irrigation management, in general, and PIM, in particular in 10 years (2010); and b) How to get there?" The following guidelines have been provided to focus the discussion and recommendations on the major aspects related to the objectives of the seminar:

1. ***General***

In recommendations, as much as possible, state whether there should be differences/ variations across countries.

2. ***Specific***

Organize the group discussions and the final presentation under the following topics:

i) As far as water management is concerned, how far should FOs be developed? For example, up to which level, within an irrigation system, they should take control/ responsibility? (on-farm? field channel level? up to distributary canal level in large irrigation systems? or even up to the system level?). Participants were requested to relate recommendations to the expected scale of operation. For example, in small village systems, farmers may take the full responsibility, however, in large systems how should the responsibilities be divided? It was expected that the two groups would include the management of groundwater utilization such as the institutional arrangements proposed for conjunctive use as well. Another area proposed for discussion in the two groups was: what should be the exact role of the government? – collaborating as a partner in "joint management"?; should the government perform only a facilitating role?; what should be the role of the organized private sector? etc.

ii) Who should finance Irrigation development, R&M and management and how?; should there be water markets?; how to evolve them? or at least for sometime, should there be group water rights?; should the respective governments continue to take part in irrigation development?, If so in which tasks? – R&M? and management at higher levels?; what strategies/processes/procedures should be recommended to operationalize these proposals? The groups were asked to discuss the organizational structures proposed for FOs and for the government. More specifically, they were asked to address such issues as: should FOs be involved in managing water beyond

irrigation systems? – for example, at the river basin level? In addition, the participants were requested to discuss whether FOs should get involved in non-water functions, and develop as multi-functional organizations. Input marketing? Output marketing? Organizing production? Forward contracting? Value-added production and processing?

To enhance the discussion and achieve a better sharing of views and experiences, the participants were divided into two small groups. The two groups were composed as follows:

Group I: Mr. Ashab Uddin Mahmud (Bangladesh), Dr. Balasubramanian Chandrasekaran and Mr. Pratik Ranjan Chaurasia (India), Mr. Watisoni Nuku (Fiji), Mr. Ahmad-Reza Azadi (Islamic Rep. of Iran), Mr. Nasir Ghafoor Khan (Pakistan), Mr. Egodage Vijitha de Silva and Mr. Lokawisthara P. Jeyampathy (Sri Lanka).
Chairperson: Dr. Balasubramanian Chandrasekaran
Rapporteur: Mr. Egodage Vijitha de Silva

Group II: Dr. Ming-Daw Su (Rep. of China), Dr. Ahmad Muslim (Indonesia), Mr. Naoya Fujimoto (Japan), Mr. Mahmood Haji Taib (Malaysia), Ms. Aquilina D. Mendoza and Mr. Enrique A. Sabio, Jr. (Philippines), Mr. Watchara Suiadee (Thailand) and Ms. Tran Phuong Diem (Vietnam).
Chairperson: Dr. Ming-Daw Su
Rapporteur: Ms. Aqulina D. Mendoza

The outputs of the two groups were presented and discussed in a plenary session and these have been summarized as follows:

Group I	Group II
Vision: "*FOs to take full responsibility of O&M at distributary canal and below*"	"*To hand over the responsibility, fully to farmers, irrespective of the size of irrigation system*"
* FO Responsibility: Hand over responsibility of O&M at distributary canal and below to FOs.	* Control and responsibility of irrigation systems (up to main system level) should be with FOs, in order to cut down government expenditure and at the same time to unify all possible resources to increase farmer profits.
* Role of the Government: Government's role should be, not only facilitating, but also regulating.	* Government's role should be: a) Facilitating technical assistance; b) Technology dissemination; c) Assistance related to capital; and d) Coordination of resources
• Private Sector: Depending on the financial capability of FOs, they may hire the services of the organized private sector.	• Private sector will provide such services as: suppliers, technological experts/consultants and buyers/consumers.

• Financing: The FOs should retain part of the ISFs collected. The amount of funds to be transferred to the irrigation agency should be decided upon by mutual agreement. Government will bear the cost of management beyond distributary level.	• Financing irrigation development, R&M may be done jointly by FOs and the govern-ment. Cost of management, will however, should be FOs' responsibility.
• In many countries, it is "premature" to have water markets. For the next 10 years, group water rights would be appropriate.	• The group's debate on water markets was not conclusive, however, all the members in the group agreed on the need for tradable water rights in the future.
• Appropriate organizational changes needed for FOs as well as for government agencies.	• Reforms are necessary. Government should be "smaller and efficient" and should be a facilitator/regulator.
• Not only FOs, all other stakeholders within a river basin/watershed should be involved in river basin/watershed management.	• Farmers using irrigation water are only one group of actors in the watershed/river basin. All the stakeholders within a river basin/ watershed should be involved in watershed/ river basin management.

FIELD VISIT

Participants visited the Sta. Maria River Irrigation System (RIS), and San Benito Communal Irrigation System (CIS), in the Laguna Province. During this visit they observed and examined the experiences in Participatory Irrigation Management and related organizational changes in the host country, the Philippines.

The Sta. Maria-Mayor RIS within the Southern Tagalog region serves a total area of 1,173 ha with 2,300 farmers. Transactions related to the operations of the irrigation system are being undertaken at its base office located at Nanguma, Mabitac, Laguna, approximately 42 km from the venue of the seminar (Manila). Mayor RIS and Maria RIS have been initially opened in 1957 and 1961, respectively, and both were undergoing major rehabilitations in 1976 and 1996. Paddy is grown in both seasons, May to October and November to April. The average crop yield ranges from 100 during dry season to 80 in the wet season.

Currently, the regular O&M activities are being undertaken by 10 personnel and these NIA officials are supported by farmer organizations, "SANTAMASI", which is organized within Sta. Maria RIS and "MIFFI" – the farmers' federation of the Mayor RIS. Participants studied the nature of farmers' participation in Irrigation management through these organizations. It was revealed during the visit that the organized IAs have played a prominent role in the rehabilitation of these systems. During project implementation, the IAs are trained to actively participate in the delivery and distribution of irrigation water and in undertaking minor repairs of the irrigation infrastructure. The IAs involve in the collection of ISFs as well. As a result, the systems have been categorized as "viable" for many years. Currently, following the vision of the Irrigation Agency, the systems are being upgraded to full transfer of O&M responsibilities to these successful IAs.

San Benito CIS irrigates 87 ha in the wet season and 100 ha in the dry season. Under the rehabilitation program, the area cultivated would be enhanced. It is expected that after rehabilitation, 137 ha could be cultivated in each season. Average size of farm holding is about

1.5 ha and there are 72 farmers. In 1986, the farmer-beneficiaries organized the San Benito Irrigators' Association with the assistance of NIA's Irrigation Community Organizer (ICO). After the determination of the work to be done for system rehabilitation, NIA discussed its policy, its terms and conditions in granting irrigation assistance. These were disseminated by the ICO during organization meetings. Pre-construction conferences were held. Program of work, estimated cost, expected involvement and participation of IA members and equity counterpart generation and the formation of various construction committees etc. have been discussed at such meetings.

NIA sponsored IA training and seminars to give them basic knowledge about the IA responsibilities, including O&M. Special training conducted included Basic Leadership Development Course (BLDC), Financial Management Seminar (FMS) and System Management Training (SMT).

In 1989, the IA established a cooperative. All members of the IA are also members of the cooperative but there are other members coming from adjacent *barangays* (villages). Total membership is 242 and all of them are rice farmers. Participants observed that the administrative operation of the IA and the cooperative is separated with each of the officials and members of the Board of Directors (BOD), doing separate administrative functions. However, the IA and the cooperative share the treasurer and bookkeeper.

In both systems visited the participants observed that the farmer beneficiaries have attained considerable degree self-reliance and enhanced their skills and ability to manage respective irrigation systems.

CONCLUSION

The Asia-Pacific region, which covers nearly one-fourth of world's land area and over 50 percent of global population is experiencing an increased pressure on its renewable water resources. Irrigation is the dominant type of water use in almost all the countries. Many countries in the region have attained a varying degree of success in cost and management transfer of irrigation as well as in developing partnerships between the irrigation agencies and the farming communities. FOs, that have been formed by the irrigation agencies or "evolved" through catalytic processes launched by irrigation or external agencies, are the major mechanism through which collective action in irrigation management has been established. The tradition of government patronage and control, however, in some countries is so strong and in a situation where the dependency syndrome cannot be easily broken and where there has been no tradition of formal recovery of O&M costs, the government funding and patronage extended to irrigation O&M cannot be suddenly withdrawn. Hence, it would be necessary for these countries to follow a gradual process of withdrawal of government control and assistance through the adoption of management transfer or enforcing of irrigation fees.

The measures adopted to date in PIM, have many advantages and contributed to infusing a sense of ownership or belongingness to farmers and also increased efficiency in O&M. These need to be continued; but the strategies and procedures, though they may follow the same principles of participation, need to be country -specific and suitably adjusted to suit the needs and aspirations of the particular societies they are applied to.

The future prospects of PIM will depend on evolving suitable PIM models matching with socio-political environment of the country; resource literacy and awareness building, political will, leadership and, changing attitudes of the government. Present low levels of farmer income

as well as constraints such as those associated with land tenure and credit markets may also affect the future development of participatory approaches in irrigation management. As farmer income may become a critical factor in PIM, organized farmer action for handling complementary inputs, achieving economies of scale in production and in marketing would become crucial.

The seminar highlighted that there is a critical need for water delivery service and of generalized service-orientation of institutions in the irrigation sector. The sustainability of the WUAs would depend on their capacity to provide an adequate water delivery service and control. Diversification could enhance profitability and, in this context, FOs may need to be restructured or reorganized to cater the new demands and services. Increased profits would improve farmers' capacity to meet the irrigation costs.

Moreover, the seminar highlighted the need for strategies and implementing mechanisms involving the total utilization or the IWRM based on river basins/watersheds. With the increase in ground water use and other competing demands for limited water resources, such considerations have now become more important.

1. RECENT DEVELOPMENTS IN IRRIGATION MANAGEMENT IN ASIA AND THE PACIFIC

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I. INTRODUCTION

Overtime irrigated agriculture has increased its importance in Asia as a source of food security, higher farm incomes, and increase in welfare of both rural and urban populations. The development of irrigation in the 20th century played an important role in generating food surpluses that have led to economic development first in East Asia and more recently in South and Southeast Asia. Over 60 percent of the world's irrigation is in Asia and since 1965 the irrigated area has almost doubled.

We have moved beyond the period when food security was the major goal and construction of large dams and surface irrigation systems was seen as the major investment needed to achieve that goal. Ways are being sought to improve the management of existing irrigation systems. However, in recent years the dramatic increase in groundwater has had the most important impact on growth in cereal grain productivity and in giving farmers the capacity to diversify to higher valued crops.

The exploitation of water resources coupled with the growing scarcity and competition for water has led to a new set of management problems. How will water be allocated to competing uses – to meet agriculture, industry, domestic and environmental needs? How will groundwater resources be managed to reduce or eliminate overexploitation? How will we integrate the management of surface and groundwater resources? How will we manage our systems to produce more food with less water, to protect the environment, and to alleviate poverty? New institutions, new technologies, and new ways of managing our water resources will be required to address these problems. To address these issues we must adopt the new concept of integrated water resource management (IWRM).

This paper is organized in six sections. The next Section sets out a conceptual framework for understanding the evolution of irrigation development in Asia. Section III discusses the constraints to management reform in public irrigation systems. Section IV deals with the revolution in groundwater development. Section V discusses the implications for management of water resources in an era of growing scarcity and competition and the move toward IWRM is introduced. The final section presents the conclusions.

II. THE EVOLUTION OF MODERN IRRIGATION DEVELOPMENT IN ASIA

The rise and fall of civilizations in Asia has been associated with the development and decline of irrigation for more than two millenniums. Much has been written about the massive irrigation works of ancient civilizations (Wittfogel, 1957). More recently the colonial powers invested in irrigation as a means of protection against famine and a source of revenues from agriculture.

In the 20th century the development of irrigated agriculture came to be seen as an essential step in generating the food surpluses needed for economic development. Review in this and the remaining sections concentrates on the experience of South and Southeast Asia over the past 30 years, but the ì our storyî begins with a footnote on East Asia.

The development of irrigated agriculture (including new varieties, fertilizer, and irrigation) first in Japan in the early part of the 20th century and subsequently in Korea and Taiwan laid the foundation for the economic development of these countries. The East Asian approach became the model for the Green Revolution in South and Southeast Asia (Ishikawa, 1967).

The development of irrigation in South and Southeast Asia can be conceptualized in four phases as illustrated by the hypothetical cost curves in Figure 1. Each of the curves reflects the marginal cost of producing a unit of agricultural output and each phase is marked by a shift to a lower cost curve. As one moves beyond Phase II, the increasing competition and rising value of water raises the benefits from improved management, but also changes the management requirements.

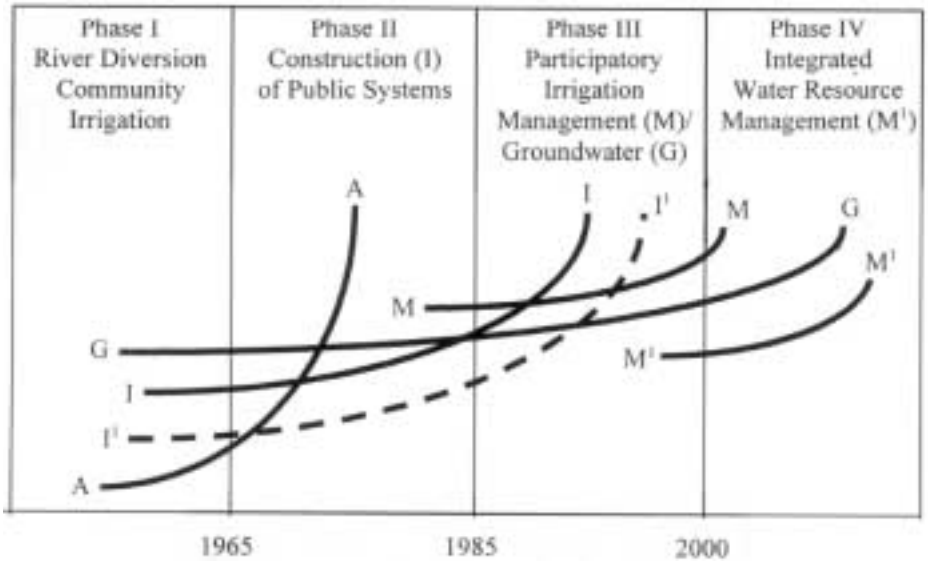

Figure 1. Hypothetical Development Paths of Irrigation in South and Southeast Asia
ñ Marginal Cost of Producing A Unit of Agricultural Output

In Phase I, Curve A – the marginal cost of opening new land – was lower than Curve I, representing the marginal cost of raising agricultural production by constructing new irrigation facilities. The irrigation systems that were developed in this period were simple river diversion systems designed to provide supplemental irrigation to the main season crop. Particularly in areas of high population density, irrigation systems were successfully developed and managed by local or community organizations.

Phase II ushered in a period of large dam construction and growth in publicly managed irrigation systems. These systems have, for the most part, been administered, with water released according to a set of rules, rather than managed to take account of the variability in rainfall and water availability. The construction phase reached its peak in the late 1970s and early 1980s. With the sharp decline in rice prices, rising construction costs, and growing opposition of environmentalists to large dam construction, the expansion of irrigated area, particularly public system investment in canal irrigation, declined in Asia, but more rapidly in some regions than others (Table 1). The emphasis shifted to the development of groundwater.

Table 1. Growth in Irrigated Area in Asia and Its Sub-regions, 1980-95

	1961-80 (percent)	1980-95 (percent)	Share of Total Irrigated Area in Asia (1995)
Asia	2.1	1.3	1.00
Southeast Asia (1)	1.7	1.8	0.08
Southeast Asia (2)	2.9	2.4	0.03
South Asia	2.1	1.6	0.15
China	2.1	0.6	0.35
India	2.4	1.8	0.35
East Asia	0.9	0.0	0.04

Source: Dawe, *et al*., 1998.

Notes: Southeast Asia (1) includes Indonesia, Malaysia, Philippines, and Thailand.
Southeast Asia (2) includes Cambodia, Lao PDR, Myanmar, and Vietnam.
South Asia includes Bangladesh, Nepal, Pakistan, and Sri Lanka (excludes India).
East Asia includes Japan, DPR Korea, and Rep. of Korea (excludes China).
Asia includes all, and only those countries covered in the six listed sub-regions.

Phase III (which has continued to the present) might logically is referred to as the management phase. It is during this period that concern over the poor performance of publicly managed irrigation systems reached a peak. Greater efforts have been made by donors and national governments to introduce irrigation management reforms that would reduce government expenditures and involve a greater degree of participation in irrigation management by user groups. Investments to improve management of surface irrigation systems showed higher returns than constructing new systems as indicated by Curve M. Management reform in public irrigation systems, however, has met with mixed success and transaction costs much higher than anticipated.

For many farmers, however, groundwater development (Curve G) has proved to be the more attractive alternative. The reliability of groundwater has allowed farmers to obtain higher crop yields and to grow higher valued crops. Hence, despite the added cost of groundwater irrigation, Curve G is positioned below Curve M (there of course may be situations where the

opposite is true). Exploitation of groundwater resources occurred first in semi-arid regions but has spread rapidly to the more humid areas. Much of the groundwater development occurred in the command areas of the surface irrigation schemes, but there has been a total lack of coordination between surface and groundwater use despite their vital physical connection.

Phase IV is called the era of integrated water resource management (IWRM). Integrated management must coordinate: (i) the allocation of water among competing uses and users; (ii) the activities designed to increase the productivity of water at farm, system, and basin level; (iii) conjunctive use of surface and groundwater; and (iv) the interactions between irrigation, human health, and the environment. For IWRM new forms of management will be required. We may have underestimated the transaction costs in positioning Curve M.

Sections II-IV discuss in more detail the recent developments in irrigation management – constraints to management reform in public irrigation systems, the groundwater revolution, and steps toward IWRM.

III. CONSTRAINTS TO MANAGEMENT REFORM IN PUBLIC IRRIGATION SYSTEMS

Why was management reform needed and why have reforms had such a mixed record of success in Asia? Management reform was needed for two reasons (Barker, *et al*., 1984; and Jones, 1995). First, public irrigation systems have grown faster than the institutions needed to regulate them and make them work. Second, irrigation systems have been inappropriately designed. Let us consider the institutional issue first.

A great deal of Asian irrigation was developed through communal or locally managed systems that evidenced a high degree of what we call today participatory irrigation management (PIM) (Coward, 1980). In many Asian countries, irrigation has been developed in a structurally dualistic mode, with the more recent state-run systems being developed independently from the community managed systems. In the rush to construct large public systems, donors and national agencies have often ignored the presence in the command areas or neighboring regions of well functioning communal systems and the associated rich local experience in management. Dissatisfaction with the performance of public irrigation systems emerged in the 1970s although their performance was not as bad as indicated by the widely accepted but faulty method of calculating irrigation efficiency based on water diverted rather than water consumed (Perry, 1999).

In the area of management reform, participatory irrigation management (the subject of this seminar) has gained prominence. The following definitions are from Svendsen, *et al*. (2000).

Participatory irrigation management (PIM), usually refers to the level, mode, or intensity of user participation that would increase farmer responsibility and authority in management processes.

Irrigation management transfer (IMT) is a more specialized term that refers to a process of shifting basic irrigation management functions from a public agency or state government to a local private sector entity.

The interest in transfer of responsibilities to user groups is twofold: (i) to help reduce government expenditures on irrigation, and (ii) to increase productivity. Recent experience with PIM and IMT seems to suggest that there has been considerably more success in transferring management responsibilities in more advanced countries such as Turkey and

Mexico than in Asia. Government expenditures for operation and maintenance (O&M) and number of government employees in most instances have declined. But there is little evidence as yet that transfer has led to higher productivity. The exception seems to be when transfer is combined with rehabilitation (Samad and Vermillion, 1999). The factors explaining the successes and limitations of PIM and IMT in Asia will be the subject of other papers and discussions at this conference.

We turn now to the issue of inappropriate design, a topic that in principle ought to be part of PIM. In practice, however, user groups are seldom involved in decisions regarding the construction and design of new or rehabilitated irrigation systems. A major design problem has been the tendency to use successful irrigation technologies from the semi-arid regions in monsoon climates. The design and operation of a rice-growing irrigation system is fundamentally different from that of other crops.

A debate has emerged between the advocates of what might be called crop-based or demand-driven design and water-based or supply-driven design (Jones, 1995). For the former the amount of irrigation water delivered is tailored to crops farmers choose to grow while in the latter farmers tailor their cropping to the timing of irrigation water deliveries. The demand-driven advocates argue that the evolution of the world economy points toward the need for this type of solution. The decline in the rice price has placed pressure on systems to provide water when needed to grow crops other than rice. If farmers in adjacent plots are to grow rice and chilies in the same season, neither the traditional, low-reticulation, field-to-field paddy systems nor the water-spreading warabandi type systems will do. On the other hand, supply-driven advocates point to the poor performance in practice of crop-based demand-driven systems.

Largely absent from this debate has been the potential for integration of ground and surface water technologies as reflected in the following two statements:

1. The near obsession of canal engineers with commanding the fields and avoiding pumping is only understandable if the system is a non-overextended desert system in contiguous operation, and the innovations of pumping technology in the last 40 years are ignored (Burns, 1993, p. 16).
2. While there is probably no real prospect for removing existing high-canal systems in rice deltas (of the Chao Phya), the alternative at least merits study; especially because of the widespread evidence that farmers in other delta rice systems spontaneously use low-lift pumps in an unplanned manner to overcome shortcomings in gravity systems that are unable to meet their demands (Jones, 1995, pp. 114-115).

Before leaving this section, it should be mentioned that the experience of East Asia is distinctly different from that of South and Southeast Asia. In the densely populated countries of East Asia, institutions for managing irrigation have developed over a long period of time. Most of the systems in East Asia have been designed with a greater concentration of irrigation and drainage ditches at the farm level and a greater number of farm ponds and small reservoirs. For example, the mellons-on-a-vine design is one in which a main canal system is used to supply a series of small reservoirs or ponds (Coward, 1980). Thus it is far easier to deliver water to farmers on demand, to diversify irrigated areas to grow crops other than cereal grains, and to collect fees on the basis of services delivered.

This can be illustrated by the case of Taiwan (Levine, *et al.*, forthcoming). To accelerate the diversification of agriculture, in the 1950s and 1960s the Taiwan Government invested

heavily in the development of highly reticulated irrigation schemes that permitted rotational irrigation at the 10-ha level, in improved water management, and in land consolidation. Figure 2 shows the trend in irrigated area and the value of crop production per ha. The area in rice and sugarcane, the staple crops of Taiwan in the pre-World War II period, fell by almost 50 percent from the mid-1960s to the mid-1980s. The shift to higher valued crops ñ fruits, vegetables, and livestock feeds ñ is perhaps the largest single factor accounting for the productivity growth in irrigated land. On more than one occasion, the Philippines has attempted to follow the Taiwan model of rotation at the 10-ha level, but has lacked both the appropriate design and the management capacity.

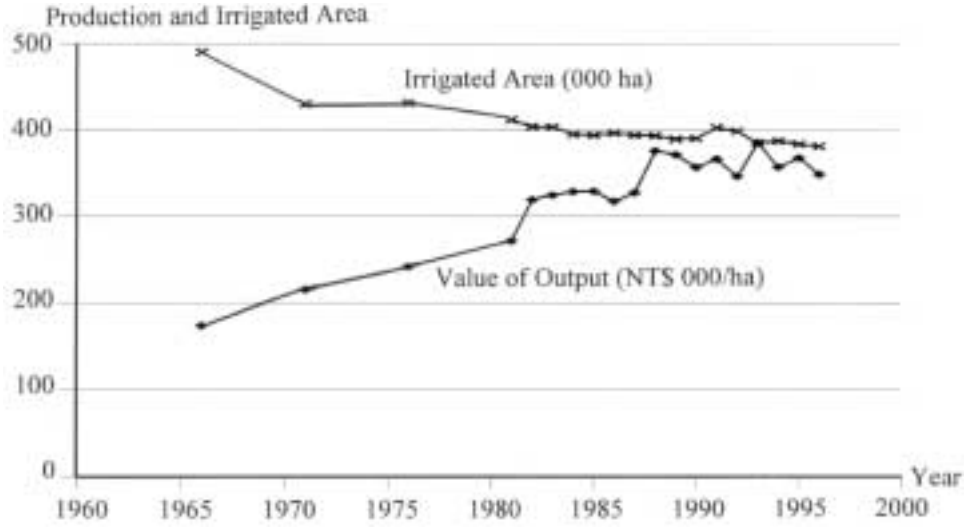

Figure 2. Trend in Irrigated Area and Value of Output (Taiwan)

IV. THE GROUNDWATER REVOLUTION

There is a tendency to associate irrigated agriculture in the developing world with canals, dams, tanks or reservoirs. Most recently the worldís attention focused on the problems associated with the construction of large dams, such as environmental degradation and the dislocation of people. By contrast, hidden from view and attention, a worldwide explosion has occurred in the use of wells and pumps for irrigation, domestic, and industrial use. While groundwater has contributed much to the growth in agricultural productivity, the overexploitation of groundwater is affecting both the quantity and quality of water available for agriculture, domestic use and other purposes (Shah, *et al*., 2000). Ways must be found to manage this common-pool resource in conjunction with the management of canal irrigation systems.

The groundwater revolution began in the 1960s in the semi-arid regions of Asia, Pakistan, Northwest India, and the North China Plain. With the development of low-cost tube-wells and portable pumps suitable for small farms, groundwater exploitation has spread into monsoon Asia. In India and China (which account for 40 percent of the worldís irrigated areas) the area irrigated by groundwater has grown from less than 30 percent in the early 1960s

to well over 50 percent (Figure 3). While the growth in area irrigated by canals has tapered off the area irrigated by groundwater has continued to grow.

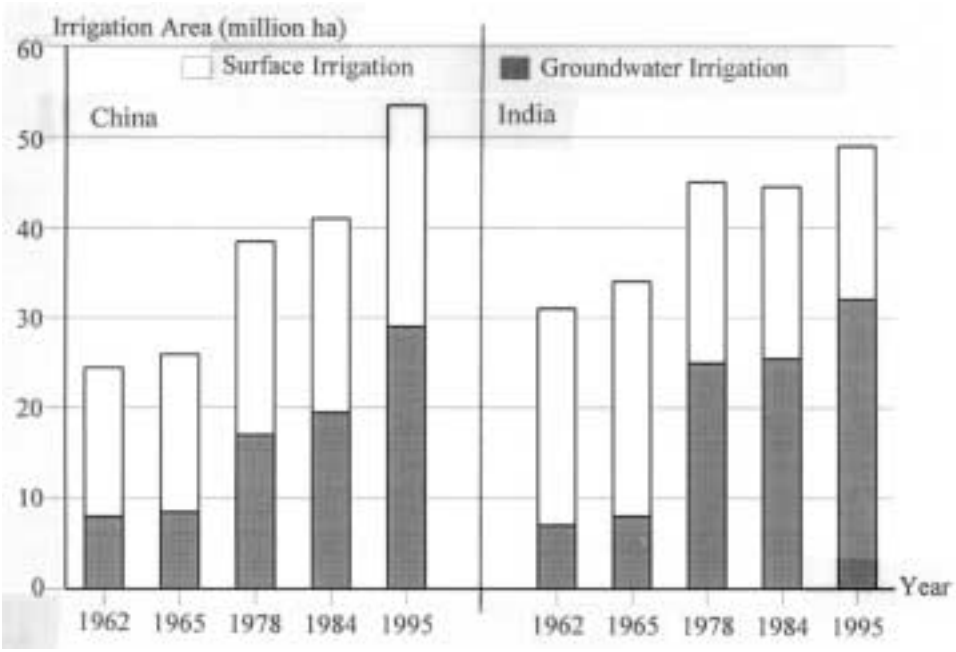

Figure 3. Proportion of Irrigation Area by Source

There is a natural link between the development of canal irrigation and the development of groundwater. Chambers (1988) notes that a major and perhaps the main beneficial affect of canal irrigation is to distribute water through the command allowing it to seep and so provide water for irrigation. Dhawan (1993) estimates that half of the crop output originating from tube-well irrigated lands in the Punjab is from groundwater that is of canal origin.

In discussing the development of groundwater, it is useful to distinguish three very different environments: (i) the semi-arid regions such as the Punjab and the North China Plain; (ii) the major river deltas such as the Ganges-Bramaputtra, Irrawaddy, Chao Phrya, and Mekong; and (iii) the rest of monsoon Asia where rice is the dominant crop in the wet season. Each of these environments presents very different management problems.

In the semi-arid regions cereal grain yields grew rapidly during the years of the Green Revolution. But overexploitation of groundwater has led to serious problems. In many regions, groundwater tables are falling a meter or more per year and overuse of chemicals has resulted in a decline in drinking water quality. In other areas groundwater tables are rising and the area affected by salinity is increasing.

In the major river deltas, introduction of tube-wells has made it possible to reduce the area planted to low yielding deep-water rice by planting and harvesting before and/or after the floods. With plentiful water, cheap labor, and the application of new seed fertilizer technologies, the deltas are increasing productivity and gaining a comparative advantage in rice production and exports. But the recent case of arsenic poisoning in Bangladesh shows that improper management of groundwater can be a hazard in these areas as well.

The monsoon areas outside of the deltas were among the first to benefit from expansion of irrigated area and the adoption of high-yielding varieties of rice. Until recently groundwater has played a relatively minor role. However, with advances in groundwater technologies and the decline in cereal grain prices, many farmers are finding ways of increasing incomes by using groundwater to raise high valued crops in the dry season. But these opportunities depend heavily on development of domestic and export markets.

Finally, we may yet be in the early stages of the groundwater revolution. With increasing pressure to increase the productivity of water (more crop per drop) new and cheaper micro-irrigation technologies are becoming available. One can easily imagine that two or three decades hence, irrigated agriculture in Asia will be very different than it does today.

V. TOWARD INTEGRATED WATER RESOURCE MANAGEMENT

Until recently, most people believed that we would also have enough water to provide all our needs. Now the growing scarcity and competition for water is in evidence everywhere. It is estimated that within the first quarter of this century, 2.7 billion people will live in regions that face severe water scarcity. However, the shortage of water will be pervasive, extending well beyond the semi-arid regions and affecting populations in well-watered areas. Urban centers will experience periodic water shortages similar to those experienced for energy. But the rural poor are most at risk. Many will lack access to potable water and to the quantity and quality of water needed for agricultural production.

Water scarcity is beginning to dramatically change the way we value and utilize water, and the way we mobilize and manage water resources. Over the past 30 years we have achieved global and national food security. It is now challenged to produce more food with less water, to enhance livelihoods and alleviate poverty in the rural areas, and to manage water to protect the environment and human health. This calls for a new approach to water management.

IWRM implies that we treat water as a resource and an economic good with a wide range of uses (of which irrigation is only one) that can benefit various members and sectors of society. The concept of IWRM has many dimensions.

First, as water supplies become limited, we need to allocate among competing uses and users. These basin-level allocations will favor water for municipal and industrial use over water for agriculture. Thus, we are going to have to produce more food with less water. At International Water Management Institute (IWMI) scientists are currently engaged in research on water saving management practices and technologies.

Second is the need to integrate management of irrigation water at farm, system, and basin level. Are the practices at farm level consistent with basin-level water use efficiency? This question becomes critical as more and more basins become closed. That is to say when all water resources are fully committed and no water of unusable quality is flowing to the sea. PIM can play an important role in providing the link between farm and basin level planning.

Third, there is the clear need to integrate the management of ground and surface water irrigation. Planned conjunctive use through PIM can help maintain water tables at sustainable levels, reduce salinity as a consequence of rising water tables, and avoid excessive draw down of water tables.

Finally, the impact of irrigation on human health and the environment needs to be assessed. With the intensification of irrigated agriculture over the past three decades, an

increasing number of health and environmental problems are emerging. The dislocation and environmental damage caused by large dam construction currently receive the headlines. Less publicized examples include the deterioration in the quality of drinking water caused by overexploitation of groundwater and nitrate pollution, the damage to wildlife sanctuaries and fishing grounds caused by uncontrolled drainage water, and the increasing incidents of malaria associated with irrigation development.

PIM is an integral part of IWRM. The latest trend toward local management should continue. But national governments must recognize that underwater scarcity, the demands for water management and planning at basin level are growing (Perry, 1999). IWRM will require new management skills and financial commitments.

The institutions needed to implement IWRM do not yet exist in most countries. The present institutions were created in an era when water was plentiful. They deal with water resources in a fragmented manner. The allocation of water among sectors is somewhat arbitrary. The state irrigation departments are not well informed on groundwater use even within their own command areas. The irrigation departments typically do not coordinate their activities with other agencies to manage the side effects of irrigation development and management including damage to the environment and threats to human health. In the period of transition, the transaction costs will be high, but it is anticipated that full implementation of IWRM will be lower transaction costs.

Steps are being taken by some governments to develop water resource boards and related organizations that will coordinate the planning for water use and management of water resources. The task is monumental. The short-run transaction costs are likely to be very high but in the long run internalizing decisions on water use should reduce the negative external or off-site effects created by separate agencies and individuals doing their own thing. Despite the urgency, the reform of existing institutions and creation of more appropriate institutions is likely to take years, perhaps even decades.

VI. CONCLUSIONS

In this paper we have presented a framework for examining the evolution of modern irrigation development in South and Southeast Asia. The 1960s and 70s saw a rapid expansion of publicly managed large irrigation systems. Dissatisfaction with the performance of these systems and pressures to reduce government budgets has led to a period of irrigation management reform.

Attention in Asia is now focused on PIM. However, inappropriate design limits the capacity of the canal systems to deliver water when needed by farmers even under good management. Declining cereal grain prices and the availability of low-cost pump and tube-well technologies have led to a rapid expansion in the area irrigated by groundwater. This has occurred often in canal areas with a lack of coordination in conjunctive use. Particularly in the semi-arid regions, overexploitation of groundwater is affecting both the quantity and quality of water available for agriculture, domestic use, and other purposes.

The growing scarcity and competition for water is leading rapidly to the need for IWRM. IWRM implies that we treat water as a resource and an economic good with a wide range of uses that can benefit various members and sectors of society. Water must be allocated equitably across sectors – irrigation, domestic, industrial, and environment. There must be coordination between farm and basin level management of water and between surface and

groundwater management. The impact of irrigation development on environment and human health must be carefully analyzed.

IWRM will take on many forms depending on the location, the stage of development of water resources and institutions and in particular the degree of water scarcity. PIM can be seen as an integral component of IWRM. However, while PIM is designed to reduce government expenditures for irrigation, IWRM will require new management skills, the reform of old institutions and most certainly the creation of new institutions as we move from the management of water for irrigation to the management of water as a resource. Many Asian governments are already beginning to move toward IWRM. The task is monumental. Despite the urgency of the problem, it may take years or even decades to create the appropriate institutions. But both the goal for managing water under scarcity and the direction to achieve this goal is clear.

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3. PARTICIPATORY IRRIGATION MANAGEMENT IN THE PHILIPPINES: ISSUES AND CONSTRAINTS

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INTRODUCTION

The Philippines is primarily an agricultural country with more than three million ha having the potential for irrigation development. Out of these potentially irrigable lands only about 43 percent (1.34 million ha) have been provided with irrigation facilities.

The National Irrigation Administration (NIA) is the primary agency responsible for irrigation development in the Philippines. NIA is a government-owned and -controlled corporation created under Republic Act 3601 enacted on 22 June 1963. The powers and objectives of the NIA were broadened with the issuance of Presidential Decree (PD) No. 552, on 11 September 1974, which included a mandate for NIA to delegate the management of National Irrigation Systems (NIS) to duly organized farmers organizations, and the authority to charge fees from the beneficiaries of irrigation which include, among others, recovery of capital investments in irrigation development.

In the pursuit of this mandate, the NIA forged an agreement in 1974 with the Farm Systems Development Corporation (FSDC),* another government corporation, wherein FSDC will be responsible for assisting the farmer-beneficiaries of irrigation to form an association and participate in the implementation of irrigation projects. On the other hand, the NIA will take charge of the technical/construction activities. FSDC's work responsibilities were defined as *software* while those of NIA's were termed as the *hardware* of irrigation development.

A review of the early years of the NIA-FSDC tie-up implementation revealed unsatisfactory relationships between field implementers of the two agencies that redounded to the dissatisfaction of the beneficiary farmers. Thus, the NIA opted to establish, in mid-1976, its own pilot learning laboratories for the purpose of developing the processes and procedures of integrating the technical (hardware) and institutional (software) aspects of irrigation project development and implementation, and whereby the farmers will have the right and opportunity to participate in all project activities. Thus, the renowned *Participatory Approach Program* was borne which contributed to catapulting the NIA to its former pedestal as the *finest irrigation agency* in the Asian region (World Bank staff remarks in the late 1970s).

* The FSDC is not in operation at present.

This paper will present the legal framework, policies and programs of NIA on Participatory Irrigation Management (PIM) as well as the issues and constraints being encountered in implementing the program.

IRRIGATION DEVELOPMENT IN THE PHILIPPINES

As of December 1999, the extent of irrigation development in the Philippines has been reported to be about 43 percent of the total potential irrigable area of 3.126 million ha. The government through the NIA and the Bureau of Soils and Water Management (BSWM) hopes to accelerate the development of the remaining 57 percent (about 1.8 million ha) through the infusion of sufficient funds under the Agriculture and Fisheries Modernization Act (AFMA, Republic Act [RA] 8435) which was enacted into law in 1997 and became effective in February 1998. Under the said law, the NIA was also mandated: (i) to devolve its functions concerning the development and implementation of Communal (farmer-managed) Irrigation Systems (CISs) to the Local Government Units (LGUs); and (ii) to accelerate the turnover of the management of the operation and maintenance (O&M) of NISs to Irrigators Associations (IAs). It is expected that the NIA would complete the delegation of O&M of NISs to IAs within a period of five years.

The status of irrigation development in the Philippines is shown in Table 1 wherein the NISs cover a total area of around 0.67 million ha, the CISs about 0.49 million ha and private irrigation systems about 0.18 million ha.

Table 1. Irrigation Development Status, Philippines

Category	Area (ha)	Percent
NIS	669,700	21
CIS	491,356	16
Sub-total	1,161,056	
Private	181,447	6
Total area developed	1,342,503	43
Undeveloped	1,790,823	57
Total potential area	3,133,326	100

NIA'S PARTICIPATORY IRRIGATION MANAGEMENT PROGRAM

NIA's PIM is basically anchored on the concepts, principles and processes of the *Participatory Approach Program* which empowers the prospective irrigation beneficiaries (farmers) to be involved in all phases of irrigation development – from project identification, planning and design (more on type and location of structures), construction, implementation and their eventual assumption of the O&M upon completion of the irrigation system. The program was developed through pilot efforts in the mid-1970s for the communal systems and expanded in the 1980s to the national systems that were then undergoing rehabilitation with financing from the USAID and World Bank. In 1983, the program was officially declared as the standard operating procedures in communal irrigation project implementation nationwide. In 1984, NIA started delegating the management of some NISs or portions thereof to duly

organized IAs under an arrangement wherein the NIA and the IAs will have a fair share of the benefits and burden of operating and maintaining the irrigation system.

1. ***Legal Basis of NIA's PIM***

The PD 552 and the recently enacted AFMA (RA 8435) provide the legal framework for NIA to pursue its program on the organization of farmers into IAs and their participation in all phases of irrigation development and eventual assumption of O&M responsibilities. Specifically, in its amended corporate charter, the NIA's powers and objectives are stated as follows:

i. PIM

" *... To operate, maintain, and administer all national systems; the authority to supervise the operation, maintenance and repair, or otherwise, administer temporarily all communal and pump irrigation systems constructed, improved and/or repaired wholly or partially with government funds; and to delegate the partial or full management of national irrigation systems to duly organized cooperatives or associations, under such terms and conditions which the NIA Board of Directors may impose ...* "

ii. Cost Recovery

"*...To charge and collect from the beneficiaries of the water from all irrigation systems constructed by or under its administration such fees or administration charges as may be necessary to cover the cost of operation, maintenance and insurance, and to recover the cost of construction within a reasonable period of time to the extent consistent with government policy; to recover funds or portions thereof expended for the construction and/or rehabilitation of CISs which funds shall accrue to a special fund for irrigation development ...*"

2. ***Basic Rationale of Farmers Participation***

If one has to delve into the basic rationale for organizing farmers into IAs and share with them the benefits and burden in operating and maintaining irrigation systems, she/he has to provide only simple answers to the following simple questions:

- For What purpose do we build irrigation systems?
- For whom do we construct irrigation systems?
- Who are the actual users of irrigation systems/irrigation water?
- Who are the direct beneficiaries of irrigation systems?

3. ***NIA-IA Partnership***

The long-term vision of the NIA is "*... dynamic and functional NIA-IA relationship working in partnership to accelerate irrigation development and provide efficient levels of irrigation services*". The achievement of this vision lies heavily on NIA's programs in providing assistance and guidance to the beneficiary farmers in the establishment of their IAs so that they can effectively participate, in an organized manner, in all aspects of irrigation management. One of the major accomplishments of NIA in strengthening the organizational capability and linkages among IAs was the establishment of IA federations at various levels (system, provincial and regional). These efforts resulted to the holding in June 1997 of the first National IA Congress wherein the National Confederation of Irrigators Associations (NCIA) was established. NCIA achieved its legal personality by registering with the Securities and Exchange Commission (SEC) on 13 October 1997. Besides the continuing technical and financial support to the IAs and their federations/confederation, the NIA also establishes

System Management Committees (SMCs) primarily at the irrigation system levels which serve as the formal forum and meeting platform between NIA field managers and the farmers and as a coordinating mechanism with various agencies and the LGUs for orchestrating support services. SMC is a main legacy of the NIA-IA partnership in action. The typical organizational structure of an IA and that of the NCIA are shown in Figures 1 and 2 while that of SMC is shown in Figures 3a and 3b.

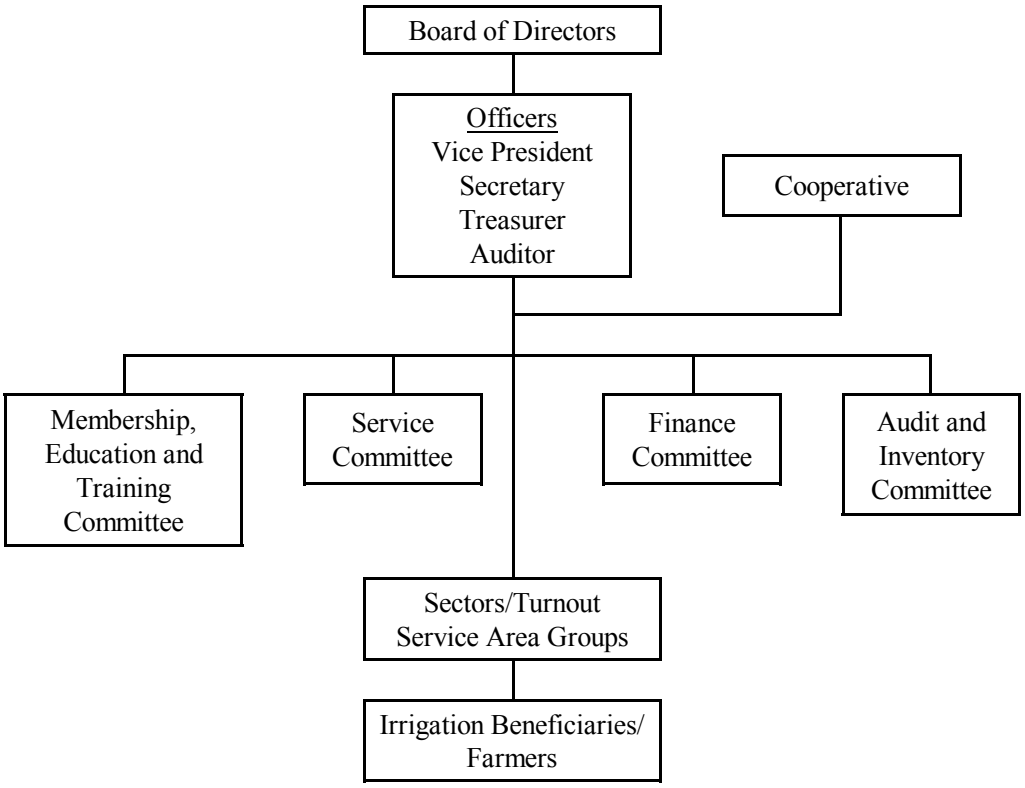

Figure 1. Typical Organizational Structure of an Irrigators Association

The NIA envisions that in the future the IA could become dynamic and self-reliant organization of irrigation farmers with the capabilities to respond effectively to the challenges posed by its environment. The configuration of effective/ideal IA as jointly envisioned by NiA and the NCIA is shown in Figure A-1 in Appendix I. Appendix II presents the current program focus of NIA to promote the establishment of effective IAs.

In the establishment of IAs and building their capabilities to participate, the NIA hires Institutional Development Officers (IDOs), who were formerly known as Irrigation Community Organizers (ICOs) during the early years of program implementation. In most cases, and specifically in the existing NISs, the NIA also engages the services of Farmer-Irrigator Organizers (FIOs) to assist the IDOs during the IA formation stage. It is to be noted that the working principle of the IDOs and FIOs is to work with and not work for the farmers. This is so in order to avoid the farmers from becoming dependent upon the IDO/FIO. In the routine

IA organizational development activities and in building the capabilities of the famrer-leaders/IA officers, the IDO applies simple processes as shown in Figure 4.

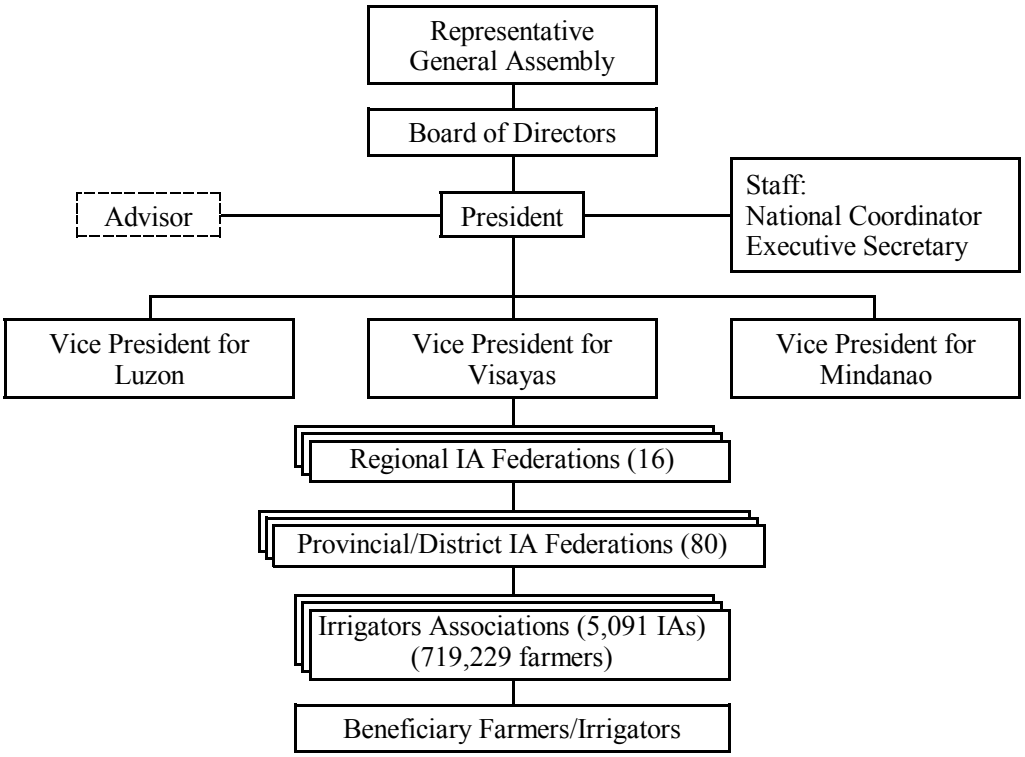

Figure 2. NCIA Organizational Setup

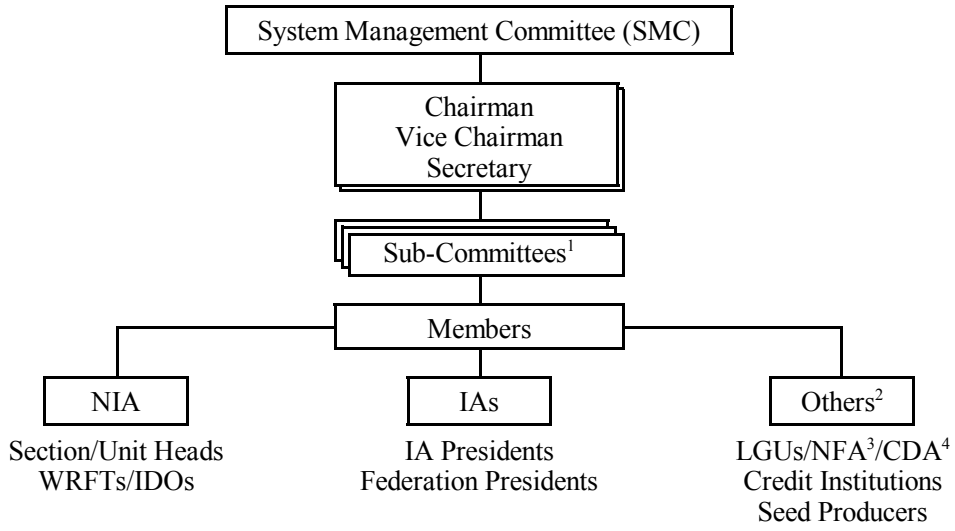

Figure 3. Typical SMC Organizational Structure for Small- and Medium-size NIS

Notes: [1] As the need arises; [2] on call basis; [3] National Food Authority; and [4] Cooperative Development Authority.

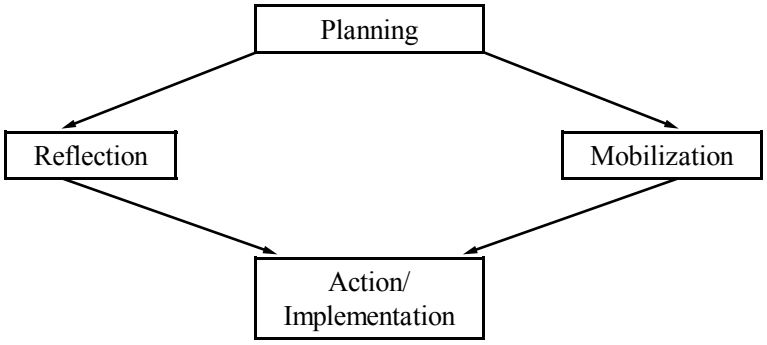

Figure 4. Organizational Development Process of An Irrigation Association

In performing his/her work responsibilities, the IDO assumes a multi-function role as catalyst, planner, facilitator, initiator, moderator, coordinator, trainer, tutor, counselor, liaison, etc. But, his/her major responsibility is to pass on to the farmer-leaders/IA officers these roles in order to enable them effectively manage the affairs of their organization.

Modes of Operation Types of Irrigation Management Transfer

After the formation and formal registration with SEC, the IAs can enter into various types of contracts with the NIA in the form of Memorandum of Agreement. The types of contracts are briefly discussed as follows:

1. ***Type I***

Primarily a canal maintenance contract wherein the IA receives remuneration from NIA at the rate of ₱1,400 per month for maintaining 3.5 km of irrigation canal. The IA work includes grass cutting, routine repairs, removal of debris from the canal, filling up of potholes, oiling of gates, etc.

2. ***Type II***

IA is responsible for the collection of Irrigation Service Fees (ISF) and is entitled to a share (incentive) from the collection which ranges from 1 percent to 15 percent of the amount collected when the collection efficiency is more than 50 percent of the current billings. In addition, the IA is also charged with some system operation functions such as distribution of water, monitoring of farming activities, preparation of List of Irrigated and Planted Areas (LIPA), etc.

3. ***Type III***

A full-management turnover wherein the IA assumes all O&M and ISF collection responsibilities and amortizes the direct chargeable investment cost to NIA without interest within a period not to exceed 50 years. This is the type of contract entered by IAs in CISs wherein after full payment of the amortizable amount, the IA is issued a Certificate of System Ownership. The IA likewise has the power to establish its own ISF rate for the O&M and management of the irrigation system.

Types I and II are applicable only to NISs. An IA can enter into an agreement either under Type I or Type II or a combination of the two. Another type of contract in the NIS presently being implemented by NIA in compliance with its mandate under AFMA is the Joint

System Management (JSM). Under this arrangement the NIA takes charge of O&M of the main facilities (wholesaler) while the IA takes care of the secondary and terminal facilities (retailer). The NIA and the IA also share ISF collections. The IA could have a share of as high as 50 percent or more from the current ISF billings depending on the agreed *break-even* direct O&M cost of NIA. The *logical* NIA-IA sharing arrangements on ISF collections are illustrated in Figures 5b and 5c.

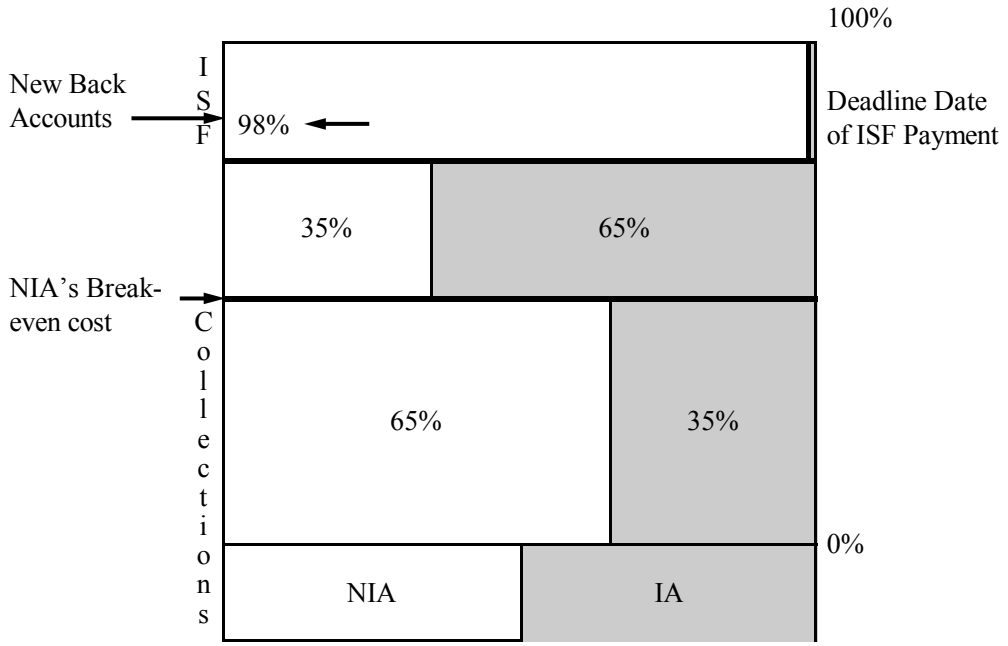

Figure 5a. Sharing Arrangements of ISFs Between the NIA and the IAs

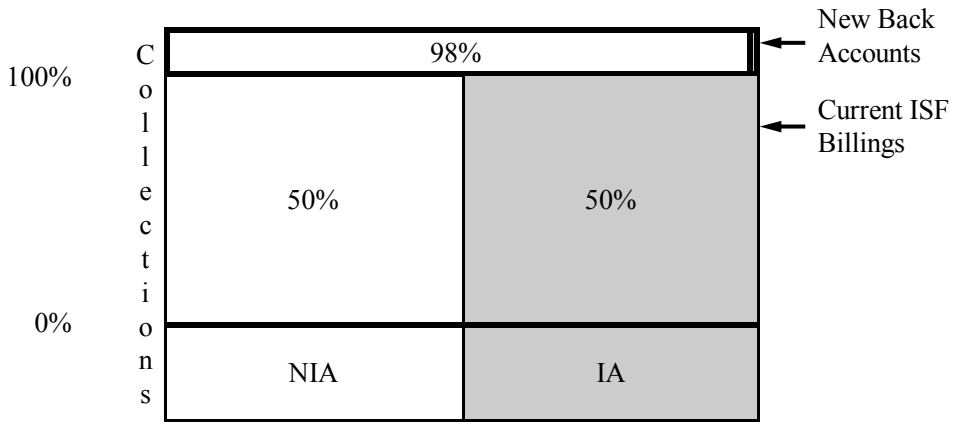

Figure 5b. Present ISF Sharing Arrangements under JSM (IOSP II)

Figures 5b and 5c show the present sharing arrangements of collections between NIA and the IA on current ISF billings in two foreign assisted irrigation projects. IOSP II (Irrigation Operations Support Project) is World Bank-funded covering 17 NISs while ISIP II

(Irrigation Systems Improvement Project) is ADB-funded being implemented in nine NISs in Region VIII (Eastern Visayas). In any of the three JSM contracts, the IA is entitled to 25 percent share from the collection of Old Back Accounts. These back accounts are the unpaid ISF prior to the affectivity of the O&M contract.

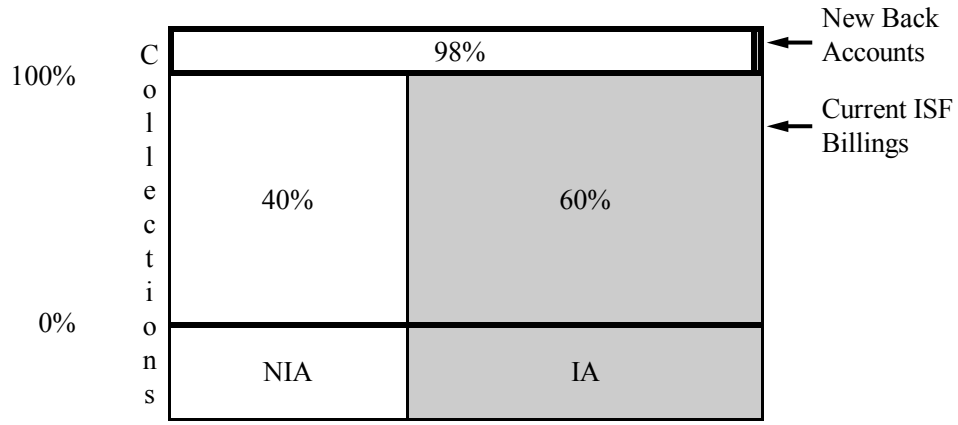

Figure 5c. Present ISF Sharing Arrangements under JSM (ISIP II)

The *logical* ISF sharing arrangements, Figure 5a, was adopted by NIA in the early 1980s. However, with the issuance in September 1998 of Administrative Order (AO) No. 17 reducing the ISF rates by about 50 percent, the NIA revised the ISF sharing schemes and which are now in effect in the two foreign-assisted projects as shown in Figures 5b and 5c. The new ISF rates (socialized) for rice farms in the NIS are as follows:

Farm Size	Wet Season (cavan*/ha)		Dry Season (cavan/ha)	
	Division Type Systems	Reservoir-backed Systems	Division Type Systems	Reservoir-backed Systems
2 ha and below	1.0	1.5	1.5	2.0
2-5 ha	2.0	2.5	3.0	3.5
Above 5 ha	3.5	4.0	4.5	5.0
Pump systems	Farmers have to shoulder the actual cost of energy consumed.			

* A cavan is equivalent to 50 kg of paddy at 14 percent moisture content.

Note: If the farmers plant cash crops (vegetables, corn, etc.), the ISF rate is 60 percent of the above rates in cash equivalent. For annual crops (banana, sugarcane, etc.), the rate is in cash equivalent of the annual ISF rate for rice. The cash equivalent of ISF is based on the Government Support Price (GSP) for paddy at the time of billing. Presently, the GSP is ₱10/kg of paddy (US$0.2/kg; exchange rate of ₱48.50 to a US$1).

Program Accomplishments

1. ***IAs Organized and IAs with Contracts***

As of December 1999, the number of IAs organized in the NISs is 2,078 while in CISs it is 3,018 or a nationwide total of 5,096 IAs covering a total area of 1.01 million ha (about 82

percent of the area developed nationwide). As of the same date, the number of IAs with contracts totaled to 4,501 or 88 percent of the number of IAs organized, covering a total service area of about 0.87 million ha involving around 0.55 million farmers. Table 2 presents the status of IAs at different stages in both the NISs and CISs.

Table 2. Summary Status of IA Organization and O&M Contracts, December 1999

Particulars	NIS	CIS	Total
A. IA Organized			
a.1 Number of IAs organized	2,079	3,018	5,097
a.2 Number of farmers	387,615	239,716	627,331
a.3 Area covered (ha)	655,760	358,602	1,014,362
B. O&M Contracts			
b.1 Number of IAs with O&M contracts	1,654	2,847	4,501
b.2 Number of farmers	319,537	228,355	547,892
b.3 Area covered (ha)	526,627	337,164	863,791

2. ***IA Functionality Monitoring and Evaluation***

For the past six years, NIA has been carrying out seasonal IA O&M performance assessment and annual IA functionality surveys. The key parameters being used in evaluating IA functionality are as follows: cropping intensity, ISF collection efficiency, financial viability, O&M plans implementation, organizational viability, and resource mobilization. The five-year summary of the IA functionality results is shown in Table 3.

3. ***Selection of Outstanding IAs***

The results of the survey are used in the annual search of outstanding IAs in both categories of systems, NIS and CIS, at various levels ... systems, provincial, regional and national levels. The outstanding IAs are given plaques of recognition and cash awards. At the national level, the recognition for outstanding IAs is timed with the celebration of the NIA anniversary (22 June) while at the field offices the recognition is usually done during IA congresses or similar gatherings. The annual search of IAs with outstanding performance is considered as a means of bolstering the morale of the IA officers and their constituent farmers.

The IA functionality results also serve as the basis for the field and regional offices in identifying appropriate strategies and means for enhancing the IA capabilities in handling O&M and in improving the management of the affairs of the organization. The IA capability-building activities include training, seminars/workshops, study tours (farmer-to-farmer learning process), etc.

4. ***Corollary Programs/Activities***

a) Financial Assistance to IAs

- ₱0.5 million for Cabadbaran RIS IAs, Region 13 for the procurement of 1,000 units of Petromax (light traps against insect pests) payable within three cropping seasons without interest.
- ₱0.5 million – loan to Lateral A IA, Mainit RIS, Northern Leyte, as a start-up fund for the establishment of detailed credit re-lending processes and procedures.

Table 3. Results of the Survey on IA Functionality

	1995	1996	1997	1998	1999
NIS IA Functionality: (number)					
Functional	393	484	859	1,044	1,042
Not functional	169	331	460	457	632
Total	562	815	1,319	1,501	1,674
Percent: Functional	70	59	65	70	62
Not functional	30	41	35	30	38
CIS IA Functionality: (number)					
Functional	437	831	847	1,030	834
Not functional	130	364	403	254	877
Total	567	1,195	1,250	1,284	1,711
Percent: Functional	77	70	68	80	49
Not functional	23	30	32	20	51
Overall IA Functionality: (number)					
Functional	830	1,315	1,706	2,074	1,876
Not functional	299	695	863	711	1,509
Total	1,129	2,010	2,569	2,785	3,385
Percent: Functional	74	65	66	74	55
Not functional	26	35	34	26	45

- One hundred units of bicycles for the IAs in Region 13 (CARAGA) – grant from a Japanese NGO.
- Provision of O&M start-up capital for IAs entering into JSM, an average amount of ₱250,000 (payable after two cropping seasons).
- Financing the IA activities such as quarterly BOD meetings, IA congresses, conventions, etc.

b) Technical Assistance to IAs

- Design and printing of identification cards (IDs) for IA farmer-members.
- Design and printing of NCIA brochure.
- Design, printing and distribution of 400,000 tickets for the NCIA Raffle Bonanza 2000.
- Proposed IA strengthening program for JICA financial assistance (feasibility study to start this JFY).
- NIA-NCIA-PSAE Memorandum of Understanding on feasibility study preparation of proposed IA projects.
- Secretariat services to the various IA federations and NCIA.
- Establishing linkages with other agencies/institutions.

Program Management

The overall responsibility for managing the program is lodged with the IDD under the Office of the Assistant Administrator for Systems Operation and Equipment Management (SOEM). Similar counterpart units manage the program at the regional and project levels. At

the provincial and system levels, the Provincial Irrigation Engineer (PIE) and the Irrigation Superintendent (IS), respectively, supervise the program through their Institutional Development Sections (IDS). The organizational structure of NIA with emphasis on PIM management is shown in Figure 6.

ISSUES AND CONSTRAINTS

While it is apparent that NIA has achieved substantial accomplishments in the establishment of IAs and in handing over to these organizations the management of irrigation systems there are still issues and constraints to the development of strong and viable IAs. Presented below are some of the issues and constraints being encountered by NIA and the IAs.

1. ***Accelerated Deterioration of Facilities***

Under RA 7160, Local Government Code, the NIA was mandated to devolve the development and implementation of locally funded CIS to the LGUs. Since 1992 when the Act became effective, NIA no longer received government appropriations (an annual amount of about ₱500 million) for the construction and rehabilitation of CIS.

On the other hand, the LGUs do not have the sufficient resources and experience to carry out the program. As a result of the abrupt shift of responsibility about 50 percent of the area in the CIS have been rendered non-operational or have been deprived of irrigation service.

2. ***Lack of Production Capital***

Most IA farmer-members can no longer avail of institutionalized credit as they are not members of cooperatives. Or, the cooperative in which they are members has defaulted in its repayment of previous loans. Some farmers resort to informal credit sources (private moneylenders and loan sharks) despite the exorbitant interest rates. The lack of production capital often results to farmers' non-compliance with the approved water delivery and farming schedules. On the other hand, as they have to pay high interest rates, after harvest the farmers usually give the loans from informal sources the utmost priority in settling their dues and, therefore, with very little concern for paying their ISF to NIA.

3. ***Stringent Bank Lending Policies***

While the IAs are registered as legal entities, their existence as non-stock and non-profit organizations somehow is a constraint for them to avail of credit from government financial sources. The credit institutions insist that since the IAs are non-stock organizations they do not possess the characteristics and qualifications to warrant security of loans from the government unlike the cooperatives wherein the physical assets and members' shares can be acquired by the bank in case of default.

4. ***Lack of Police Power***

This is one of the weaknesses of the IAs. They cannot impose sanctions to farmers particularly the non-members who violate O&M rules and regulations. The IA leaders usually allege that this function belongs to the LGUs as they are the constitutional bodies authorized by the government. However, where there is close working relationship and coordination between the LGU and the IAs, monitoring of violations is jointly undertaken and corresponding sanctions are imposed by the LGU. To name a few, the serious violations include the construction of illegal structures and squatting along and/or on top of irrigation canals (houses/shanties, restaurants, pig pens, etc.), planting of trees on the inside slope of canals, dumping of garbage in irrigation and drainage channels, and destruction of irrigation structures.

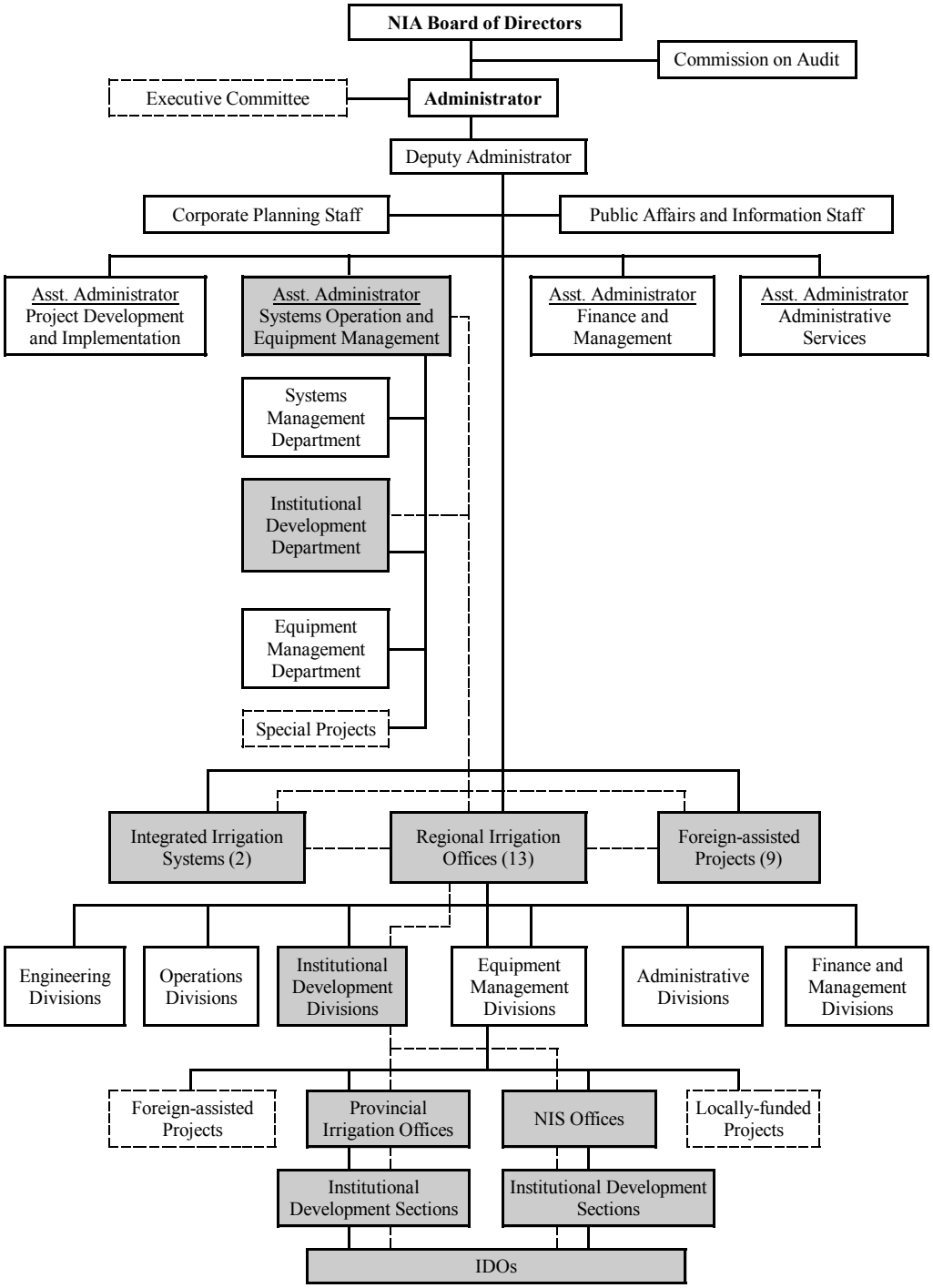

Figure 6. NIA Organizational Setup and IDP Management Responsibilities

5. ***Absence of Attractive Retirement Package and Lack of Funds***

While NIA wishes to accelerate its program on the delegation of O&M responsibilities or turnover completely entire irrigation systems (NIS) to IAs, the absence of an acceptable retirement package for the O&M staff to be affected by the program is a major setback. Mandated under RA 8345 to turnover O&M activities to IAs within a five-year period, NIA filed a request to the national government to infuse funds (subsidy) to pay for the retirement of NIA staff. The request has been favorably considered. However, availability of cash is still a big question mark. NIA also lacks the necessary funds to pursue its irrigation management turnover program. In 1998, NIA was able to get an appropriation of ₱20 million to support IA organization and strengthening activities. This amount was reduced by 50 percent (₱10 million) for 1999, which was very insufficient to implement the institutional development activities for the year. While the five-year financial requirement is estimated at ₱60 million/year, for the year 2000 NIA was given an appropriation of only ₱30 million.

6. ***Dwindling Morale***

Dwindling morale of program supervisors and implementers due to the recent streamlining proposal prepared by NIA in compliance with the requirement of the national government. The proposal is on the streamlining of the functions of the various offices under NIA including reduction of staff, but which practically abolishes the IDDs and IDSs at the regional and field offices, respectively. These units are the ones responsible for implementing the farmers Participatory Approach Program. To this end, the IAs through their nascent national confederation, the NCIA, have been voicing out their serious concern about the sustainability of their associations if the field units they used to work with would be abolished.

7. ***Policy Changes***

The executive pronouncement in mid-1998 on the abolition of ISFs, the bread and butter of NIA as a government corporation, followed by a directive to condone farmers' back accounts are serving as disincentive to NIA and the IAs. While AO No. 17 was issued which reduced the ISF rates by about 50 percent for small farmers (with farm holdings of two ha and below), it did not receive total acceptance by the IAs. AO No. 17 was a temporary measure to cushion the impact of the El Niño phenomenon and the financial crunch which occurred in 1997-98. Majority of the IA federation presidents and officers allege that their IAs have been deprived of the major source of funds for their capital build-up. They are not also amenable to the proposed condonation of back accounts. According to them this will just benefit further the influential, rich and well-connected farmers who, they further say, composed the majority of delinquent irrigation beneficiaries. They allege that it is the small farmers who religiously pay their dues to NIA.

Despite the reduced ISF rates under AO No. 17, collection dropped substantially from 47 percent in 1997 to only 36 percent in 1999. It is also ironical to note that the current NIA revenue from ISF is insufficient to finance the O&M of NIS, which is estimated to be about ₱2.500/ha (US$51.55). Much worse, is that ISF income is so low that the O&M staff of some NISs do not receive their salaries on time.

8. ***Untimely Realignment of Funds***

As discussed in the earlier sections, despite the meager funds that NIA receives from the national government for the implementation of its institutional development programs, about 62 percent of the current budget has been cancelled and realigned in August allegedly to mitigate the effects El Niño predicted to recur in the country early next year. Portion of the annual budget for IDP is for the salaries of IDOs working in areas formerly financed by the

recently completed foreign assisted projects. As a result of this untimely realignment of funds most of the IDP activities (IA training, etc.) have to be cancelled.

9. ***Political Intervention***

Members of the legislative body usually receive pork barrel funds from the annual budget for the implementation of projects within their respective areas of jurisdiction. In some cases, portion of these funds is allocated for the construction of small irrigation schemes or rehabilitation of existing ones, usually CISs. The concerned politicians, particularly those who are vying for re-election or for higher positions become so benevolent that they no longer impose cost recovery to the beneficiary IA. This is a gross violation of the government policy on cost recovery being implemented by NIA. The benevolence of some political figures often causes the recipient IA and nearby IAs that previously received financial assistance from NIA to question the policy on cost recovery. In such situation, NIA has to allocate its meager resources for going back again to the project sites and explain to the farmers the background and rationale of the policy.

4. ROLE OF WATER USERS ASSOCIATIONS FOR SUSTAINABLE IRRIGATION MANAGEMENT

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INTRODUCTION

In general, in developing countries the principal role in irrigation development rests with the government and it is the government and its irrigation agency that prescribes the role of Water Users Association (WUA) in the adoption and implementation of participatory irrigation management. Considering that economic, social and political conditions vary from one country to another it is to be expected that the role of WUAs prescribed by governments would likewise vary among countries and that it mould not be realistic to prescribe a standard role applicable to most countries. It may be useful however; to try to identify what factors may effect the role of WUAs and what are the various potential roles which WUAs could perform given those factors. This may help in the preparation of long range plans for participatory irrigation management. The importance of this has to be appreciated as in most developing countries farmers participation in irrigation management has to progress from the simpler to the more complex forms of participation that enables sustainable irrigation management.

In attempting to identify the factors did affect the role of WUAs in participatory irrigation management in the Philippines, this paper attempts to draw from experience in the National Irrigation Systems (NISs). In this regard, the Philippines' experience in Communal Irrigation Systems (CISs) may not be that relevant. In the communals, the irrigation system is fully turned over for operation and maintenance (O&M) by the WUAs after construction or rehabilitation by the NIA with participation of the WUAs.

FACTORS AFFECTING THE ROLE OF WUAs

In examining the factors, for possible adoption in respective countries, each participant has to assess each factor separately to examine whether that particular factor would be relevant to her or his own country. Those, which are not applicable, may be ignored. Similarly, certain new factors/strategies may have to be added, depending on the situation of a particular country. The factors identified are:

a. Laws and policies of the country and its irrigation agency;
b. Size and complexity of the irrigation systems;
c. Physical condition of the irrigation systems;

d. Size of irrigated farm holding;
e. Farmers net income;
f. Capability of irrigation agency and its staff;
g. Capability and organizational arrangements of the WUA;
h. Local politics;
i. Local social customs and practices;
j. Frequency of natural disasters; and
k. Environmental problems.

Depending on the mix of the above factors in a given situation, the role of the WUAs in irrigation management in the Philippines could include any of the following as may be agreed between the National Irrigation Administration (NIA) and the farmers:

i. The responsibility of the farmers is only at the terminal level. The NIA is responsible for the entire irrigation system and delivers water at the turnout. The farmers are expected to construct and maintain farm ditches and drainage ditches, distribute water among themselves, and pay the irrigation fees prescribed by the government. Under this arrangement farmers are usually organized into informal groups in preparation for the establishment of WUA for water distribution and maintenance of farm and drainage ditches. Irrigation Service Fees (ISF) are collected from the water users by NIA irrigation fee collectors.

ii. NIA and WUAs enter into two types of contract labeled as Type 1 and Type 2 contracts. Under Type 1 contract, the WUA undertakes canal maintenance, which do not require heavy equipment. Such activities may include clearing, desilting, embankment repair etc., for which NIA pays the WUA an agreed amount per km of canal, on a monthly basis. Under Type 2 contract, the WUAs assist in delivering water to the various turnouts, prepare the List of Irrigated and Planted Areas (LIPA) distribute ISF bills prepared by NIA, collect payment of ISF from farmers and remit the collection to NIA. For this activity they are entitled to a share in the amount collected in accordance with the following tabulation:

Percentage Collected	WUA Share (percent)
50-60 percent of billings	2
Above 60-70 percent of billings	5
Above 70-90 percent of billings	10
Above 90 percent of billings	15

iii. Each WUA in the irrigation system enters into an agreement with NIA for O&M of a lateral canal and the sub-laterals that irrigate the area of the WUA. NIA remains responsible for the O&M of the main canal and the headworks and delivers water to each WUA at the head gate of each lateral canal. ISF bills to farmers are prepared by NIA from the LIPA prepared by the WUA and verified by NIA staff. ISF is collected by the WUA and collections are shared between NIA and the WUA in accordance with a formula designed to cover the O&M expenses of NIA and provide incentives for increased collection by the WUA.

iv. The same arrangement as (iii) above, except that NIA's share is a fixed percentage of the ISF to be collected which is subsequently billed by NIA to the WUA. The WUA bills each individual member.
v. The WUA is responsible for O&M and financial management of the entire irrigation system in accordance with an agreement on irrigation management transfer that stipulates the responsibilities of the WUA and the NIA for attaining sustainability of the irrigation system.

Having generally outlined the various roles, which WUAs may have in irrigation system management, as experienced in the Philippines, the question becomes which of these roles would enable sustainable irrigation management in different countries. As suggested earlier, it may be more useful to address this in the context of specific circumstances of respective countries. The rest of the paper will be devoted to describe the joint-management experience of NIA and farmers in the *Libmanan-Cabusao* Pump Irrigation System (LCPIS) in the Philippines.

JOINT MANAGEMENT OF THE LCPIS BETWEEN FARMERS AND THE NIA

NIA and the LCPIS

The NIA is a semi-autonomous government corporation responsible for irrigation development in the Philippines. It constructs, operates, and maintains national irrigation systems and provides financial and technical assistance to farmer-managed irrigation systems. For its income it collects ISFs in national systems and amortization of construction costs of farmer-managed systems it has assisted. From 1975 to 1980, NIA constructed the Libmanan-Cabusao Pump Irrigation System as a national irrigation system in the towns of Libmanan and Cabusao in the province of Camarines Sur. After the completion in June 1980, the LCPIS was severely damaged by a typhoon and then restored to resume operations in May 1981. Presently it irrigates about 2,996 ha of which 2,393 ha are served by a pump installation on the upper Libmanan River consisting of four units of electrically-driven vertical mixed-flow pumps each with a rated discharge capacity of 1,526 liters per second (l/s). The rest of the area, which is about 603 ha, with higher elevations scattered mostly near its fringes, are served by nine smaller pumps, eight of which draw from creeks fed with water from the main system, and one which draws water from the lower part of the Libmanan River.

The O&M of the area served by the main pumps is jointly managed by the NIA office of the system and two irrigation associations (IAs) organized in the two O&M divisions of the area irrigated. ISF are billed at 300 kg of rough rice per ha for the wet season and the same for the dry season, payable in rough rice or cash at the official government price. One IA, with the acronym BCT PUMP IA, is in Division 1 covering 1,370 ha and the other, with the acronym LICUPPIA, is in Division 2 with 1,023 ha. Both IAs have O&M contracts with the NIA for canal maintenance, water distribution, and irrigation fee collection within their respective areas. The O&M of the nine smaller pump installations and their distribution facilities are being undertaken by nine IAs, one IA for each pump installation. These installations and their distribution facilities have been turned over by the NIA to each of the IAs under an agreement that stipulates amortization of the cost of the irrigation facilities by each IA, and its obligation to undertake the O&M of the system. These O&M arrangements

started only in 1990 during the institutional and physical improvements in the irrigation system. Previously, the O&M arrangements between the NIA and the farmers were structured differently, as explained later in this study.

The main canal of the system is 11.17 km long and the total length of its nine laterals and sub-laterals is 33.17 km. The two IAs in Divisions 1 and 2 is maintaining these canals under a maintenance agreement with the NIA, together with about 160-km of farm ditches within the two divisions. Within the service area are 42.5 km of service and farm-to-market roads maintained by the NIA. To protect the service area from flooding and salt water intrusion, there are two protection dikes with a total length of 15.3 km. Each dike is 2.2 m high, 4 m wide at the top, and about 17 m wide at the base. Maintenance of the dikes is the responsibility of the Department of Public Works and Highways.

Drainage facilities consist of a 9-km interceptor channel on the left bank of the main canal to drain storm run-off from a watershed area of about 23 km^2 on the left side of the main canal. The interceptor channel discharges to San Miguel Bay and has a bottom width ranging from 2.2 m to 6.5 m. Within the service area are 33.4 km of natural drainage channels improved during system construction. The NIA maintains the interceptor channel. The NIA and the IAs jointly maintain the natural drainage channels and the lateral drains.

The arrangements between the NIA and the IAs described above started only in 1990 when interventions were made to improve the management of the system. From the start of operation of the system in 1981 until 1989, the arrangements were different, and during those years the average annual deficit in O&M was about US$42,218. As NIA does not receive any subsidy from the government for O&M of irrigation systems, the LCPIS in those years was regarded as a useless system fit "for the waste basket" by most NIA officials because of its continuing huge financial losses. But from 1988 to 1990, institutional and minimal physical improvements were made in the system resulting in the improved management arrangements currently in effect that transformed LCPIS into a financially viable system with an average annual surplus from 1990 to 1992 of about US$42,880 and a system that has become a model for others. This transformation process is discussed in the subsequent paragraphs.

Status Before Transformation

As a project, LCPIS had two major components:

1. ***Infrastructure***

This included the planning and construction of the pumping stations, water distribution canals and structures, farm-level irrigation facilities, service and farm-to-market roads, flood protection dikes, interceptor channel and drainage facilities, and buildings and other facilities for O&M of the irrigation system.

2. ***Institutional and Agricultural Development***

This pertained to the organization of a viable irrigation association, land tenure improvement, applied research and demonstration projects, promotion of improved agricultural practices, provision for credit and agricultural inputs, access to markets, extension support services, training of farmer leaders and project staff and other activities for enhancing institutional and agricultural development.

The Implementing agency for LCPIS was the NIA, which had responsibility for the infrastructure, and the organizing of the farmers into an IA that can operate and maintain the

system after construction. The other components were handled by the Ministry of Agrarian Reform (MAR), Ministry of Public Works and Highways (MPWH), Ministry of Agriculture (MA) and the Ministry of Local Government and Community Development (MLGCD). The organizing of the farmers by NIA was specially important because all pump systems being operated by the government were incurring financial losses and it was thought that this could be avoided in LCPIS by turning over the system to an irrigation association for O&M.

Except for minor facilities, the infrastructure components of LCPIS were all undertaken by contracts tendered for competitive bidding at the NIA Central Office. The main contractor for the irrigation facilities started work in May 1976 and the contracts for the protection dikes, drainage facilities, and pump and motors followed a year later. In the planning and construction of all the physical infrastructures, there was no farmer participation. The initial pilot projects of NIA for developing processes for farmer participation were just being started at that time in Nueva Ecija far away from the LCPIS Project.

For handling the institutional and agricultural development components an Institutional Development Division (IDD) was set up in the project and for assisting in the formation and development of an IA, the NIA hired the services of the Economic Development Foundation (EDF), an NGO experienced in organizing cooperatives. EDF worked on the project from September 1977 to January 1980. During that period EDF organized an IA named Libmanan-Cabusao Irrigation Service Cooperative (LCISC) with a base consisting of farmers grouped into rotation areas, with each rotation area served with irrigation on a rotation basis through a designated turnout. Each rotation area elected a Leader and a Secretary-Treasurer for two-year terms. The rotation areas were then grouped into seven district associations of more or less equal areas and potential memberships. Each district association elected a District Director and a District Secretary-Treasurer. A District Management Committee was set up in each district with the District Director as Chairman and the District Secretary-Treasurer and all Rotation Area Leaders as members. The District Director was the representative of the district to the Board of Directors (BOD), the third and highest level of LCISC.

The District Directors, as members of the BOD, elected among themselves a President, Vice President, Secretary, and Treasurer of LCISC, and selected a General Manager who was not a member of the BOD. The BOD established five standing committees on: (a) member relations and elections; (b) audit and inventory; (c) water and farm management; (d) finance and projects; and (e) membership and education. EDF provided management training to the officers, leaders, and committees of LCISC. In addition, EDF conducted a series of pre-membership meetings and membership training to the cooperative. In January 1980, LCISC was registered with the Bureau of Cooperative Organization and Development, and the contract of EDF expired.

For continuing the development of LCISC, NIA 'fielded' Irrigation Association Workers (IAWS) who adopted the farmer participation approach being developed in communal irrigation projects, by that time. Farmer members and leaders of LCISC were encouraged to help in identifying problems, participate in decision-making and in the construction of whatever terminal irrigation and drainage facilities remained unfinished.

The structure, however, of the cooperative remained the same. After the restoration of the system in May 1981, and restart of its operations, LCISC was not yet in a position to take substantial O&M activities. Although EDF had prepared a manual for use of the cooperative in system operation and management, the preparatory training had all been classroom type

lectures without actual practice. Moreover, LCISC had only 254 members out of 1,843 farmers in the service area.

For working out water management procedures, NIA and LCISC were joined by researchers of the International Rice Research Institute (IRRI). Observations indicated that the system design area of 3,900 ha could not be entirely irrigated, as some areas were higher than the operating water levels in the canals. Moreover, defects in the construction of the distribution system and inadequate power supply did not allow continuous flow in all turnouts with water rotated in four or five blocks within each turnout as intended in the design of the system. Thus, the system resorted to rotation of water delivery by sections of laterals.

A sustained campaign for more membership in LCISC was conducted. As a result, membership increased from 16 percent in May 1981 to about 65 percent by 1984. Additional training for leaders and members was provided. This included pre-membership and membership training; water management and leadership training; and workshops on water distribution, system maintenance, conflict management, irrigation fee collection and rice production. To enable LCISC leaders and members to apply the various training procedures, a gradual turnover program was agreed upon and a memorandum of agreement was signed in April 1982 between LCISC and the NIA providing for joint management of the system. A Management Committee was formed. The Committee composed of four members from the LCISC BOD and three members from the NIA empowered to make policy decisions, provided that they do not contravene those of the NIA. The objective was to develop the capacity of LCISC by maximizing its role in O&M.

After two years of trial, the joint management agreements were defined in greater detail. Salient features of the division of responsibilities were as follows:

- The maintenance of all irrigation canals and terminal facilities, the water allocation and distribution among turnouts within every district, the collection of ISFs, and the maintenance of all drainage canals not requiring mechanized equipment were made the responsibility of LCISC.
- The O&M of the pumps; delivery of water to each of the district organizations; maintenance and repair of main canals, laterals and drainage requiring mechanized equipment; preparation of bills for irrigation fees for distribution by LCISC; and the provision of training and technical assistance to LCISC staff were made the responsibility of the NIA.
- The funds for O&M was provided by the NIA.
- The preparation of the annual O&M plans and budget and the monitoring and evaluation of O&M activities and expenses were made to be joint activities. The excess of income over expenses was to be equally shared, and any deficit carried over, to be covered by collections in the following year.

The main criterion of NIA for the performance of the system was its financial viability as reflected by its income and expense and the areas irrigated. Tables 1 and 2 show these data for LCPIS from 1982 to 1992.

An assessment made in 1988 showed a general decrease, reflected in Table 1, in wet season irrigated area and two suspensions of dry season operations from 1982 to 1987. Moreover, while O&M expenses substantially decreased, it was accompanied by decreases in income from irrigation fees that resulted in heavy financial deficits during the period.

Table 1. Annual Irrigated and Benefitted Areas of LCPIS

(Unit: Ha)

Year	Irrigated Area		Benefitted Area	
	Wet Season	Dry Season	Wet Season	Dry Season
1982	2,145	1,655	1,513	1,282
1983	1,469	2,013	1,024	1,694
1984	1,472	1,357	1,125	1,057
1985	1,632	724	OS	OS
1986	1,279	1,700	354	1,084
1987	1,118	1,097	OS	OS
1988	1,194	1,070	1,108	716
1989	1,437	1,152	1,493	201
1990	1,185	1,474	984	1,297
1991	1,430	1,592	1,144	1,437
1992	1,379	1,862	1,379	1,810

Note: OS = Operation Suspended.

Table 2. Income and Expenses of LCPIS, 1982-92

(Unit: ₱000)

Year	Annual Collection Irrigation Fees	Actual Collection Irrigation Fees	Percent Collection (percent)	Other Income	Total Income	Expenses	Surplus (Deficit)
1982	1,318	469	35.6		469	1,268	-799
1983	2,217	645	29.1		645	1,834	-1,189
1984	2,274	791	34.8		791	2,801	-2,010
1985	3,623	889	24.5		889	2,605	-1,716
1986	1,530	311	20.3		311	1,416	-1,105
1987	1,152	158	13.7		158	1,126	-968
1988	1,916	566	29.5	268	834	1,174	-340
1989	1,210	630	52.1	187	817	1,473	-656
1990	2,730	1,568	57.4	377	1,945	1,410	535
1991	4,646	3,167	68.2	131	3,298	1,864	1,434
1992	4,860	3,144	64.7	120	3,264	1,889	1,375

Note: Expenses do not include allowance for depreciation of facilities. Other income includes amortization of subsidiary pump systems turned over to IAs, and rentals of equipment.

A review of the situation of the irrigation system at the end of that period indicated the following problems:

- Only three of the four 250 horsepower (hp) pumps could be simultaneously operated due to lack of capacity of the transformers installed by the electric cooperative.

- Defects in the construction of conveyance system also limited the simultaneous operation to only three of the main pumps, thus reducing the water availability by about 25 percent, to avoid overtopping of canal embankments.
- Some areas are higher than the operating water levels in the canals and require further pumping.
- Negative attitude of most farmers towards payment of irrigation fees.
- Infective implementation of strategies for collection of irrigation fees.
- Inaccurate master list of farmers and their corresponding lots due to yearly changes in transient tenant cultivators in many irrigated lots.
- The BOD of LCISC lacked support from the rotation areas at the first level of the cooperative. The organization of the rotation areas was weak and lacked effective linkage with the higher levels of the cooperative. Decisions of the BOD could not be effectively carried out at the base of the organization. Some of the Directors had political motives.

THE TRANSFORMATION

Of the problems identified, the most serious relative to the objective of financial viability was the issue of management of the irrigation system. Even with its limitations, the physical facilities could still irrigate up to almost 3,000 ha with improved management by the NIA and the farmers association coupled with minimal physical improvements. It was felt that the basic problem was the lack of cooperation needed for restructuring to strengthen the base and that NIA procedures should be realigned along this effort. In the dry season of 1987 the operation of the system was suspended. In the same year the joint management between LCISC and NIA was likewise suspended and since then has not been renewed.

In 1988 another approach to organizing farmers was launched using farmer participation through a "bottom-up" process employing Farmer Irrigator Organizers (FIOs) as catalysts. The service area was divided into 24 sections of more or less equal area with each section having three to six turnouts. The two "Water Masters" and the Institutional Development Officer (IDO) of LCPIS selected three potential "Farmer Irrigator Organizers" from farmers in each section, to organize farmers. The criteria for the selection were:

- Earned the respect of the farming community;
- Adequate literacy;
- Good character;
- Good economic status to have time for organizing work without impairing farming and family activities; and
- God leadership qualities.

Each of the candidate-FIOs filled out a personal data form, and was interviewed by the IDD staff of the regional office. A written examination was given to all the candidates, and a final selection was made based on the following criteria, in addition to those mentioned above:

- Age (at least 25 years old);
- Not holding a political position;

- Physical fitness;
- Availability on call; and
- Good oral communication.

The 24 selected FIOs were given a five-day pre-deployment seminar. On 26 April 1988, after completion of the seminar, the 24 FIOs were fielded in their areas of assignment. Each FIO covered about 125 ha with 3-6 turnouts. Upon fielding, each FIO started to identify the irrigation and drainage problems in his section. With the parcellary map containing the location of farmers' lots and areas in the FIO's section, each FIO walked through his area of assignment and interviewed farmers on problems on location of turnouts, water distribution, maintenance, and drainage. He also checked the accuracy of the parcellary maps in relation to the size and ownership of each lot and reported to the Water Master on the amendments to be made. This work lasted for more than a month with each FIO working 2-3 hours a day. During this period of interviewing farmers, he identified a number of potential leaders from each Turnout Service Area (TSA) to help him in subsequent activities.

Having identified the problems, each FIO formed a core group of potential leaders from each TSA. With his core group, an action plan was prepared to address the identified problems. Each action plan was discussed and agreed upon with the farmers concerned in every TSA. Initially, the FIO had difficulty in gathering farmers because of previous experiences where "meetings" did not produce any action on problems. Every 15 days the FIOs submitted a report to the Water Master, who reviewed, clarified and integrated the actions into "Programs of Work" (POW), which were submitted to the Irrigation Superintendent for finalization and submission of requests for funds from the Regional and Central Offices of NIA. Most of these were for desiltliig and repair of the main canal and laterals, improvement of turnout locations and farm ditches, and in the case of the higher areas, installation of subsidiary pumps. Once a month, the FIOs met to share experiences, discuss and resolve problems and to develop strategies for doing their work.

While the identification of needed repair and improvement activities was going on, the FIOs started forming stronger TSA groups that would be able to participate in repair and improvement work and assume O&M of the facilities at the TSA level. This would constitute the base of a new IA. For this purpose a workshop for the FIOs was held for discussing and translating model by-laws for an IA, based on previous NIA experience. Among other matters, the workshop discussed a new organizational pattern to take the place of LCISC. The base of the new organization would still be "rotational areas", renamed "turnout service areas", but each TSA would have a chairman, a secretary, a treasurer and four standing committees to handle service, membership and education, finance, and audit. The BOD would no longer be composed of District Directors, as there would be no more districts. Instead, the BOD will be composed of all TSA chairmen.

The FIOs assisted by TSA leaders explained the new organizational pattern and by-laws regarding TSAs and guided their adoption at meetings of TSA groups. This activity took about four months. At the end of that period, the TSA groups were formed with their officers and standing committees, and each TSA group adopted the new by-laws in principle. The formation of TSA groups according to the new organizational pattern was relatively easy in the TSAs, which did not have water supply problems. But for those with problems on water supply, the FIOs had much difficulty. Other problems faced were those between farmers in the same TSA and seasonal changes in farmer cultivators in lots with temporary tenants.

The FIO approach was also used in preparing action plans for areas with elevations higher than the water level in the canals, which called for installation of subsidiary pumps to draw water from creeks fed by water from the main system. At that time, two such subsidiary pumps were already in operation. Under the new action plans, seven more subsidiary pumps were to be installed for the higher areas. The areas being irrigated by the two existing subsidiary pumps were likewise covered by the FIO approach.

After the organization of the TSA groups in the main system and the areas covered by the subsidiary pumps, a basic leadership development course was given to all officers and leaders of each TSA. A set of by-laws was formally ratified by all TSAs featuring an IA with a BOD composed of all TSA Chairmen and with officers and standing committees in the same pattern as the TSAs. The farmers decided that the main system would have two IAs, one for Division 1 and the other for Division 2 and that each area irrigated by a subsidiary pump would have its own IA. Soon after the IAs were organized along this pattern, the BOD of each were formed and officers and committee members elected. A typical IA organization chart for Divisions 1 and 2 is shown in Figure 1. It also shows the organization chart for joint management. The IAs of the subsidiary pump areas have organizational structures, articles of incorporation and by-laws similar to those of Divisions 1 and 2. Under the by-laws of the IAs, the FIOs became the Board of Advisers for all the IAs.

Next the IAs worked for their registration with the Securities and Exchange Commission. Most of them got their registration papers within two months. In the meantime, in order to prepare them for their future activities all IAs were given training on irrigation system management and financial management. In December 1989, the two IAs of Divisions 1 and 2 signed contracts with the NIA for maintenance of canals, water distribution and collection of irrigation fees. In effect, arrangements for a form of joint management of the main system between the NIA and the IAs of Divisions 1 and 2 have been the established by the contracts. The IAs of the subsidiary pump areas signed contracts for full turnover after completion of the subsidiary pump installations from June 1989 to October 1992.

Under the revised O&M joint management arrangements, the Management Committee was removed. The roles of the NIA and the IAs of Divisions 1 and 2 were defined in two contracts -- one for maintenance and another on collection of irrigation fees -- with both contracts containing provisions on sharing of water distribution functions. The overall O&M and financial responsibilities were lodged with the NIA. The provision on sharing of financial surplus or deficit was removed. Except for these and the rates of compensation to be made by the NIA to the IAs, the provisions of the new arrangements were similar to those in previous contracts between NIA and LCISC.

A MIX OF INSTITUTIONAL BUILDING AND PHYSICAL ACTIVITIES

The participatory approach for improving performance of irrigation systems is based on a combination of institution building activities and improvement of physical facilities to respond to farmers' needs.

In the process of combining these two, the planning and construction of facilities were undertaken with full farmer participation in decision-making. Such participation enhances the capacity of the IA and the confidence of the farmers in their organization. This principle was applied by the NIA in LCPIS. The repair and improvement of the physical facilities was

undertaken only after the farmers were properly organized for effective participation. By the end of 1989, the proper organizing of the farmers had been accomplished.

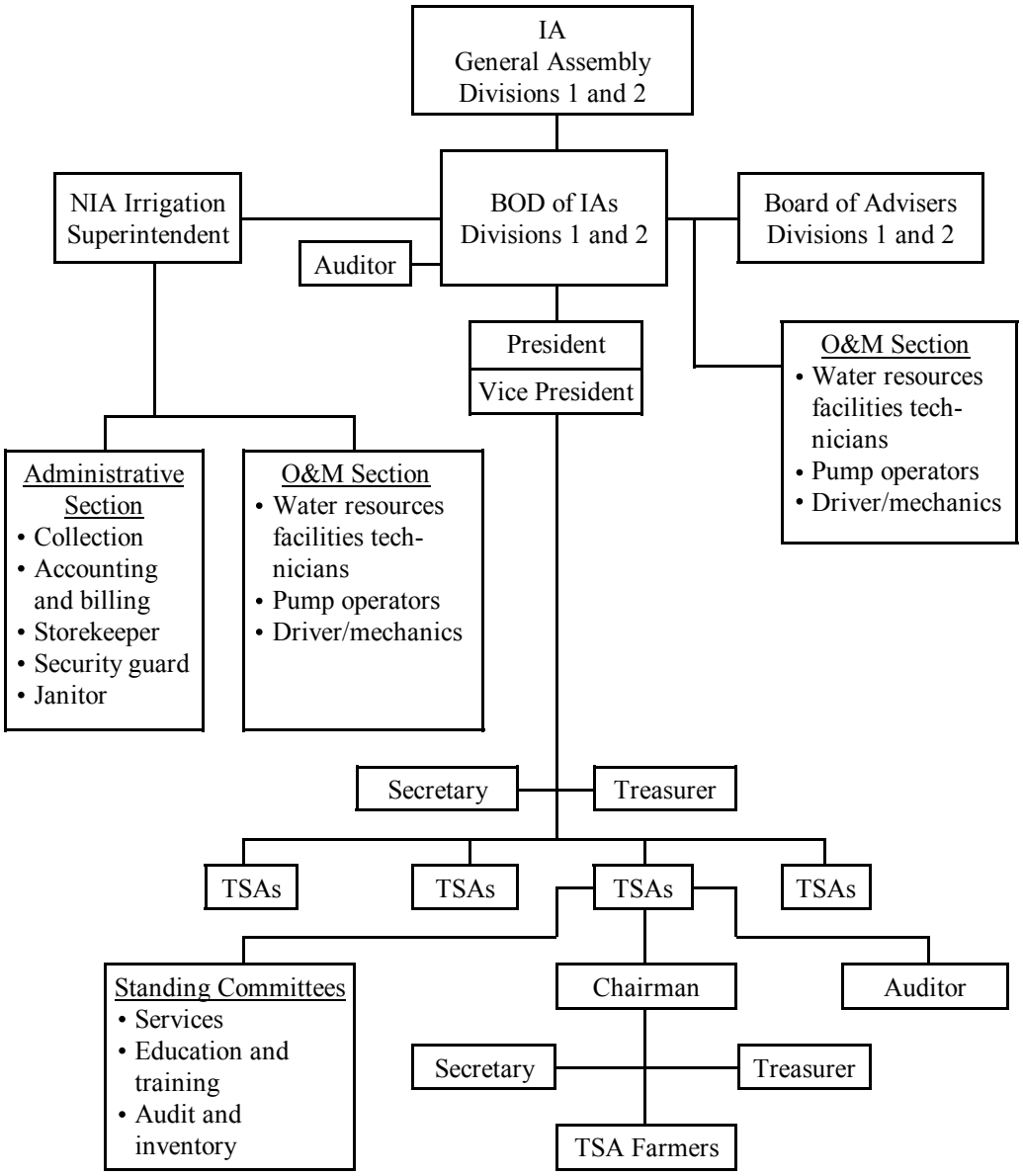

Figure 1. Organization Chart for Joint Management of the LCPIS between NIA and IAs

Notes: 1. Every TSA is organized as typically shown in the chart.
2. Each of the two Divisions has one IA organized as shown in the chart.

The improvement of physical facilities consisted of desilting and repair of the main canal and laterals, improvement of the drainage system, improvement of turnouts and farm ditches,

replacement of steel gates, repair of buildings, and installation of seven supplemental pumps for the higher areas. These items of work were identified jointly by the farmers and the NIA staff and were the basis for preparing the overall program of work and cost estimates for improving the irrigation system.

Except for the installation of the pumps and repair of buildings, the IAs through their respective TSAs has undertaken all the other repair and improvement activities. Each item of work was explained by the Irrigation Superintendent to the concerned TSA group with emphasis on cost estimate and schedule of implementation, after which the TSA groups undertook the work within the agreed schedule and costs. The scheduling of the work took into consideration the routine O&M activities of the system. As the farmers undertook most of the O&M this scheduling was facilitated.

The implementation of the O&M contracts between the NIA and the IAs of Divisions 1 and 2 developed the following management schedules and procedures:

1. ***Cropping Calendar***

The wet season cropping is generally from May to September and the dry season cropping from December to April of the following year. Before the start of any cropping season a "Review and Planning Workshop" is held for the main system, involving the two IAs of Divisions 1 and 2. The workshop reviews the operations of the proceeding cropping season and plans the operations for the next cropping season. This Review and Planning Workshop is followed by another, wherein the BOD of Divisions 1 and 2 and the NIA staff, meet with the BOD of the IAs of the subsidiary pumps to discuss the cropping calendar and other matters affecting the smaller pump systems. Thus, the cropping calendars of the main system and the nine smaller subsidiary systems are synchronized.

2. ***O&M of the Four Main Pumps***

This is undertaken by the NIA with two pump operators staying at the pump house. Generally, pumps are operated a maximum of 20 hours a day, with three pumps operating simultaneously. Operating at full capacity, three pumps can deliver about 4,200 I/s, which, together with water from the supplemental pumps is sufficient for irrigating about 3,000 ha of rough rice under good conditions of water conveyance and control. A service road on one embankment of the main canal links the main pumping station with the system office in the service area. Communication with the pump station is by motorcycle which takes about 30 minutes.

3. ***Water Distribution***

As provided in the contracts, water distribution is a joint activity of the NIA and the IAs of Divisions 1 and 2. The NIA staff has the responsibility of ensuring that water is delivered to the main canal and all the six laterals from A to F, in accordance with the following rotation schedule:

- Monday to Thursday -- Division 2 (1,023 ha); and
- Friday to Sunday -- Division 1 (1,370 ha).

Each IA of Divisions 1 and 2 has the responsibilities of opening and closing all turnouts in the main canal and laterals in accordance with the irrigation schedule. To irrigate Division 2, water has to pass through Lateral C, the first 4 km of which is within Division 1. Thus, when water is brought to Division 2 the service committee of the Division 2 IA closes all turnouts in the main canal and laterals leading to the Division 1 areas to enable full-flow to Division 2. The service committee of the Division 2 IA also has responsibility for delivering

water on schedule to four sub-laterals within the area of Division 2. The service committees of the two IAs see to it that the irrigation schedule of each TSA is observed. All TSAs of the two divisions take care of water distribution in the tertiary system. Figure 2 contains the water rotation schedule for the main system and Figure 3 shows the details of water distribution under the "joint management" system of the two IAs in Division 1 and 2.

Section		Area (ha)	Days						
			Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
Lateral B:	1	225							
	2	215							
	3	110							
Total		550							
Lateral C:	1	138							
	2	711							
	3	643							
	4	605							
Total		2,097							

Figure 2. Typical Water Distribution Schedule under Joint Management with LCPIS

Note: Rotation in Laterals B and C (78 percent of service area), continuous in rest of system.

Maintenance of all irrigation and drainage canals within Divisions 1 and 2 are done by its two IAs under contracts with the NIA. The Division 1 IA maintains 27.22 km of irrigation canals. This includes 9.23 km of main canal from the main pump site to the end of the canal. The Division 2 IA maintains 12.23 km of irrigation canals including three sub-laterals. Contract payment by NIA is ₱1,100 per month for every 3.5 km of canal. Work involves grass cutting, clearing of debris and obstruction to flows, greasing of gates, filling the gaps in embankments, etc. Where earth is to be hauled by trucks, hauling is undertaken by the NIA. Both IAs have designated members who do maintenance and get 90 percent of the contract amount. The IA gets 10 percent which goes to its operating fund and is used for advance payments to the maintenance workers as needed. The service committee of each IA inspects the maintenance work every month and submits to the NIA a statement of work accomplished. The work is verified by the NIA and is used for advance payments to the maintenance workers as needed. The service committee of each IA inspects the maintenance work every month and submits to the NIA a statement of work accomplished. The work is verified by the NIA Water Master and the IA Auditor. Payment for work accomplishment is made by the NIA on a monthly basis. Sometimes payment is less than 100 percent of the amount claimed due to deficiency in work. When there are damages to canals or dredging of the pump site due to natural calamities, the IAs mobilize their members to make emergency repairs within their capacity, with or without payment depending on arrangements with NIA.

The maintenance responsibilities of the NIA include the main pumps and motors at the Libmanan River pump site, the 9-km interceptor channel, 42.5 km of service and farm-to-market roads and lateral drains that require mechanized equipment. The two protection dikes with a total length of 15.3 km and about 16 km of natural drainage canals are considered as part of the flood control system under the responsibility of the Department of Public Works and Highways.

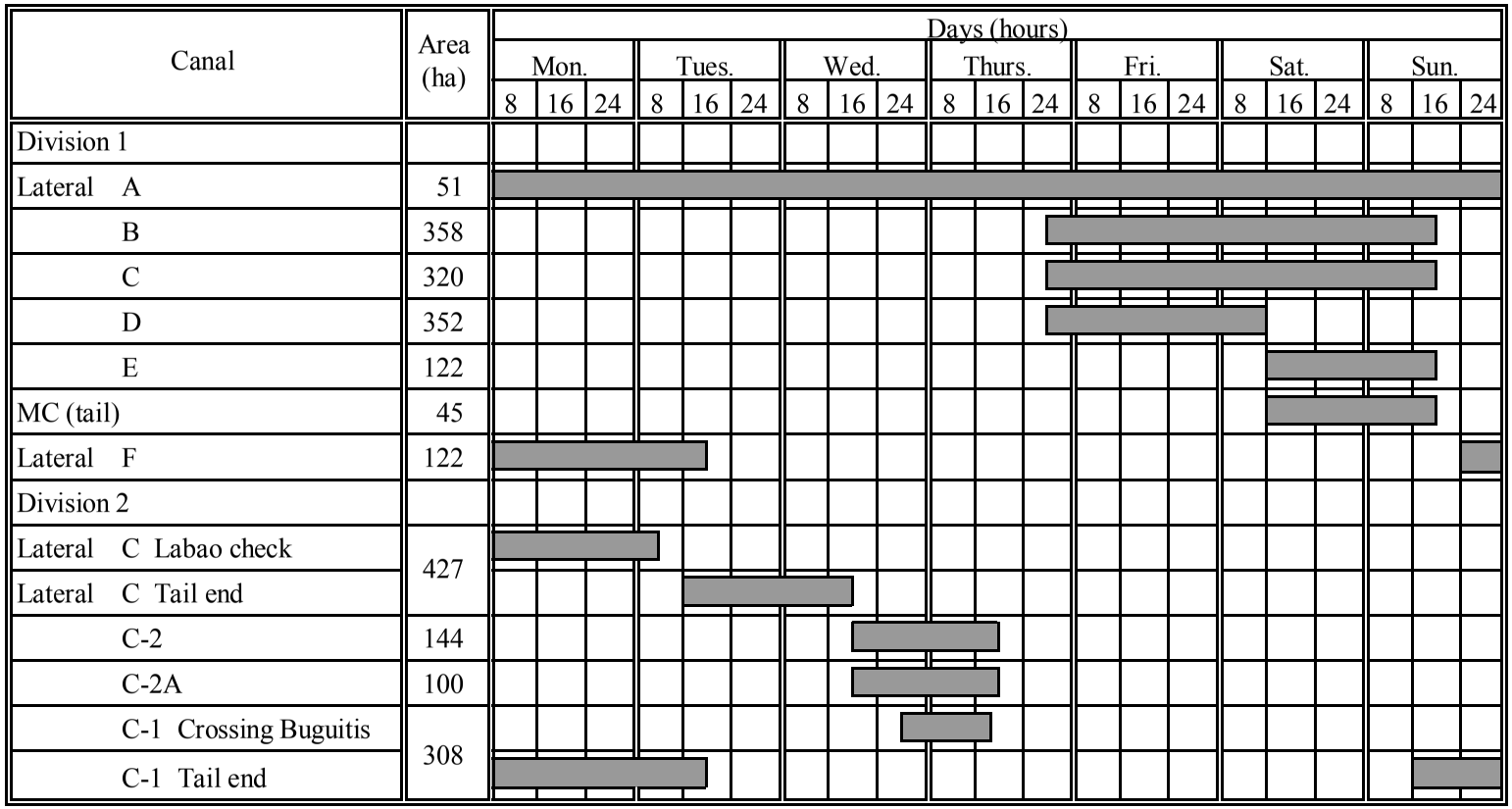

Figure 3. Details of Water Distribution Schedule for Main System under Joint Management with IAs of Divisions 1 and 2, LCPIS

Water-related conflicts between farmers are jointly settled by the IAs and the NIA, with NIA in a supporting role. These usually consist of destruction of part of a ditch or obstruction of irrigation or drainage water. The general approach is to settle these at the TSA level by the TSA Chairman with the assistance from the NIA Water Master and the TSA Service Committee. The Chairman notifies the farmers involved in the conflict. A visit to the field is made by a member of the Service Committee and the NIA Water Master. Next, a report is made to the TSA Chairman who then decides on the conflict. Most conflicts are settled in this manner. Where an appeal is made by one of the parties with regard to the conflict, the IA President makes settlement. Settlement of conflicts between TSAs follow the same general procedures, but investigation and settlement are done by the IA President and IA Service Committee with support from the NIA Water Master.

Collection of irrigation fees is undertaken by the IAs of Divisions 1 and 2 in their respective areas, but preparation of bills is done by the NIA. During each cropping season, as farming operations proceed, each TSA prepares its LIPA and submits it to the IA Service Committee for verification. The IAs submit the LIPA to the Water Masters for further verification and then to the Irrigation Superintendent for preparation of the bills by NIA staff in terms of kilograms of rough rice. Then the prepared bills are sent to the IAs for distribution. At harvest time the IAs collect the irrigation fees in rough rice. Each TSA has a collector, usually its Chairman, deputized by the NIA. Each collector issues an official receipt of the IA for the rough rice collected from every farmer. The IA official receipt consists of four copies, with the original for the farmer, one copy for the IA and two copies for the NIA. The official receipts of the IA are under the safekeeping of the Irrigation Superintendent for effective control and audit. They are issued to the IAs during the collection period. There are seven collection centers for Divisions 1 and 2. Farmers bring the rough rice payment to the collection centers and the payments are hauled by NIA trucks to the NIA warehouse where they are weighed and NIA official receipts issued. Each NIA official receipt shows the name of the collector, the farmer(s) who made the payment, the corresponding amount(s) paid, and the IA official receipt numbers, which acknowledged the payment of the farmer(s) to the IA.

Monitoring and evaluation of activities is undertaken by the TSAs through monthly meetings. Except during land preparation and transplanting when some TSAs have tight schedules, every TSA holds monthly meetings for assessing the status of water distribution, preparation of LIPA, collection of irrigation fees, and discussion of issues and problems which the TSA Chairman will bring to the monthly meeting of the IA. Every month, each IA of Divisions 1 and 2 holds a meeting with the NIA staff in attendance. Each of the four standing committees makes a report of activities and accomplishments. A report of pumping station operation is made by the NIA staff. The status of preparation of LIPA, the distribution of irrigation water, accomplishments on maintenance and collection of irrigation fees, and problems of O&M, are discussed for all the IAs, after which activities for the next month are agreed upon. After each IA has held its monthly meeting, a coordination meeting between the two IAs is held along with the Irrigation Superintendent and the NIA staff.

Out of the present irrigated area of 2,996 ha, about 603 ha are irrigated by the nine subsidiary pumps, and about 2,393 ha are irrigated in Divisions 1 and 2 by the main pump. The nine subsidiary pump installations and their respective command areas have been fully turned over to their corresponding IAs. Under the turnover arrangements, all O&M expenses are borne by the IA and all irrigation fees collected accrue to the IA. Except for the pump that draws water directly from the Libmanan River, all the subsidiary pumps draw water from

creeks fed by the return flows from the main pumps. In addition to defraying all O&M expenses, the IAs amortize the cost of the pump and irrigation facilities over a period of 10 years without interest. This is in accordance with the NIA policy established by the government. As these small systems are affected by the main system in terms of water supply and drainage, they are involved in the preparation of the overall cropping calendar. The Irrigation Superintendent of the LCPIS monitors the operations in terms of pumping, area irrigated, collection of irrigation fees and payment of amortization of construction costs.

"BEFORE" AND "AFTER" COMPARISONS

In this section, the present "Joint Management" (of IA-NIA) is compared with the earlier operation of the LCPIS. In many respects, the farmer organizations that resulted from the Farmer Irrigator Organizer Program, FIOP, were different from the earlier system (which is referred to here as the "LCISC"). A basic difference was the organizing approach. The FIOP was based on an organizing process that puts together the technical and institutional aspects of an irrigation project and develops capacity in farmers groups through participation in planning and construction of the irrigation system. In the case of LCISC, the EDF used the classroom lecture approach to organizing based on information sharing and consultation during farmers meetings, but without opportunities for capacity building during the planning and construction of the irrigation system. Thus, the base of the LCISC was weak and unable to implement procedures prescribed by the organization.

In the FIOP, the capacity building at the TSA level, initially developed by participation in problem identification and proposing measures for improvement of physical facilities, was further enhanced by an organizational structure that made all TSA chairmen members of the IA BOD. Moreover, the standing committees at the BOD level had counterpart committees at the TSA levels. With these arrangements the decisions of the BOD were based on reliable information and correct assessments of the situation at the base, of the organization, and implementation of the decisions was also facilitated. In contrast in the LCISC, while the rotation area leaders were members of the District Management Committee, they were not members of the LCISC BOD, and consequently, were outside of the decision-making process of the cooperative. Moreover, the rotation area in LCISC had only two leaders, the Chairman and the Secretary-Treasurer, while the TSA organization under FIOP provided for the development of many more leaders consisting of the Chairman, Vice-Chairman, Secretary, Treasurer, Auditor, and members of the four standing committees.

In the LCISC, the membership in the BOD was determined by the election of a district director at the district level. The coverage of a district was about 400-450 ha with 300-400 farmers. The resulting elections were similar to political elections and were greatly influenced by the political, economic and social resources and popularity of the candidates rather than the criteria for good leadership in an irrigation association. In the FIOP the members of the BOD of the IA were selected at the TSA level which usually had 30-40 farmers. Selection of the TSA chairman who also represents the TSA in the BOD is by consensus. Often, this is a difficult process, as the members know the responsibilities of being the chairman. A process adopted by FIOs is first to get all members to agree that whoever is selected, as chairman by the group will not refuse the position. When all members have agreed on this the selection by consensus proceeds.

In the LCISC, meetings of the rotational areas were seldom held. Whatever meetings were held did not produce the desired results. In FIOP, TSAs held regular monthly meetings to provide information and feedback to the BOD through the TSA Chairman on the situation and problems at the base of the organization. In this way remedial measures were facilitated.

During the LCISC period improvements were made in water distribution, taking into account the limitations of the system, with research assistance from the Water Management Division of IRRI. In the first year of O&M the system was initially operated as designed. Water was delivered simultaneously and continuously to all canals and turnouts for distribution by rotation among 4-5 rotation units comprising each rotational area served by one turnout. But research observations showed that because of low embankments, the main canal could safely carry only 4,140 I/s instead of its design capacity of 5,800 I/s, and Lateral C could safely carry only 1,900 I/s although it was designed for 3,400 I/s. Moreover, the capacity of the transformer installed by the electric cooperative at the main pump site allowed simultaneous operation of only three pumps instead of four. The result of this situation and mode of water distribution was that the upstream areas took most of the water and the downstream areas could not get their proper share.

The water distribution was then improved in the second year through rotation of deliveries by sections of laterals. This was done in Laterals B and C, which covered about 78 percent of the service area. Each of these laterals was divided into four sections and water was delivered at fixed periods in a week to all turnouts within each section of the lateral. For comparison purposes the rest of the system was supplied with continuous irrigation. This mode of water distribution was found to be more equitable and also implementable jointly by LCISC and NIA staff. With the phase-out of LCISC and the establishment of the new IAs under FIOP, this scheme of water distribution had to he changed. But the principle of rotation by sections of laterals was retained, especially in Lateral C and canals in Division 2. A comparison of Figures 2 and 3 shows the differences and similarities between the patterns of water distribution in LCISC and that of the two IAs of Divisions 1 and 2 under FIOP.

In both the LCISC and the IAs of Divisions 1 and 2 of FIOP, maintenance of canals was undertaken by the farmer organizations under contracts with the NIA in accordance with terms, conditions, and compensation rates established by the NIA for all national systems. But there were differences in the modes of implementation. In the LCISC the maintenance the district director of each district implemented contracts and decisions tended to be autocratic. In the IAs implementation of maintenance work was done by the service committee of the IA and decisions tended to be democratic.

The division of responsibilities between the IAs of FIOP and the NIA with regard to billing and collection of irrigation fees was the same as that between the NIA and the LCISC. In both, the farmer organization prepared the LIPA, the bills were prepared by the NIA and distributed by the farmer organization, and the irrigation fees were collected by the farmer leaders and turned over to the NIA. However, there was a big difference in the implementation of responsibilities. Under FIOP system, as the IAs were better organized at the base, the preparation of the LIPA was more timely and more reliable and thus billing was more reliable and more efficient. Because of better monitoring and control of receipts of the IAs and improved collection procedures, the collection of irrigation fees was more efficient.

Another important difference was in the incentives for the collectors. Under the LCISC, farmer leaders undertaking collection were given 2 percent of the amount collected by the NIA. Under FIOP, the incentive given by the NIA to the IAs was 2 percent of the amount collected

if total collection is 50-60 percent of annual billings, 5 percent if annual collection is 60-70 percent, and 10 percent if annual collection is 70-90 percent, and 15 percent if annual collection is over 90 percent of annual billings (see Table 2 for a comparison of irrigation fee collection under the LCISC and the IAs of FIOP).

A comparison of data in Table 2 indicates a very marked increase in irrigation collection efficiency in the period 1989-92 compared to 1982-88. From 1982 to 1988 the average collection efficiency was 27.2 percent. In 1989 the results of FIOP began to take effect. The average collection efficiency increased to 60.6 percent in the period 1989-92.

Instead of an average annual deficit of ₱1,097,670 during the previous years, the system posted an average annual surplus of ₱1,114,890 from 1990 to 1992. Judging from the great improvement in the payment of irrigation fees one may conclude that although more improvement is needed, the IAs organized under FIOP are more effective than the LCISC, and that farmers are generally more satisfied with their performance. Like those in the smaller pump systems, farmers now want to fully take over the main system and are now holding meetings to define terms and conditions to be proposed to the NIA.

LESSONS LEARNED

For those who are establishing joint management of irrigation systems between government irrigation agencies and farmers irrigation associations, the LCPIS experience offers the following lessons:

- The process of organizing the farmers is crucial. It is necessary to build the IA from the bottom by first organizing TSAs through farmer participation in activities that develop the farmersí capacity to make group decisions and to establish proper criteria and procedures for choosing TSA leaders. In most cases, these activities would be on planning and implementation of improvements to the irrigation facilities to make the system responsive to farmers' needs. Farmer participation should include decision-making in the identification and prioritization of problems, planning solutions and improvements and arrangements for takeover of O&M by the farmers.
- Organizing of the farmers should be done with a well-trained catalyst. An alternative to professional catalysts (community organizers) is the use of well-trained farmer organizers as in the LCPIS. In government-managed irrigation systems, potential farmer organizers can be selected by the irrigation agency staff who are familiar with the farmers and the problems and needs of the irrigation system.
- The higher levels of the organization should be established only after the TSAs have been established with good, responsible leaders. The role and selection of the TSA leaders is crucial in planning and implementation of water distribution, maintenance, and conflict management and irrigation fee collection. The TSA leaders should be members of the BOD or of the management and decision-making body of the organization and the operative committees at the top should be replicated from the base so that plans and decisions can be effective. The importance of the standing committees should be emphasized as it provides for leadership development within the TSAs and the entire IA.
- Sufficient lead-time should be provided for organizing the farmers before they go into contracts for joint management and undertake construction of improvements to the irrigation system. In the LCPIS, it took almost a year of organizing and training work

before IAs went into joint management with the NIA and effectively participated in the repair and desilting of irrigation and drainage canals and other works for improving the system.

- Organizing of farmers should not be contracted out in the same manner as construction or other projects. The best contract provisions cannot provide sufficient flexibility to meet field conditions that are difficult to predict and are likely to change in place and in time, especially in the coordination of technical and institutional activities essential to successful promotion of farmer participation. As in the case of the EDF contract in the LCPIS, organizing by contract tended to sacrifice quality of organizing in favor of completing the organizing work within the stipulated time.
- The IAs should be given proper training in irrigation system management, financial management, leadership development and holding regular meetings at IA and TSA levels, including review and planning workshops after every cropping season. However, no amount of training or strengthening will be effective if the organizational structure of the IA is deficient. As an example, rotation of water deliveries for equity of water distribution is possible only if the IA is properly structured.
- The role of the Irrigation Superintendent and his staff is crucial to successful establishment and implementation of joint management. Farmers can be organized into IAs that can go into joint management only if the task is adequately supported by the Irrigation Superintendent. In the process of improving an irrigation system to make it responsive to farmers' needs, the Irrigation Superintendent should foster farmer participation in all aspects of system improvement. He should consider and take action on all legitimate and feasible farmers' requests for system improvement and use these as opportunities for developing farmer responsibilities and capacities. Thus all improvements should be joint undertakings between the irrigation agency and the farmers with both sharing work responsibilities and affordable investment of resources. The Irrigation Superintendent and his staff and the IAs should work out jointly all procedures for managing the irrigation system and see to it that the procedures are properly implemented, periodically reviewed, and improved upon as needed.
- Two other crucial requirements are the policy and incentives on joint management adopted by the irrigation agency at the central level and the support given to the Irrigation Superintendent from the regional level when such intermediate levels exist. At the central level, it is essential that there is clear operational policy requiring farmer participation in all aspects of irrigation systems development and improvement, and that the policy is backed by adequate budgetary support for properly organizing and training IAs. Budgetary releases for such activities should be ahead of physical improvements to ensure that farmers are properly organized and ready to participate effectively in the physical improvement of the system. Sufficient funds should be made available on time to enable the Irrigation Superintendent to meet schedules of improvement work agreed upon with IAs to establish and sustain agency credibility with farmers. When the time is ripene for IAs to take responsibilities in the O&M of the system, the central office should see to it and a fair arrangement for sharing responsibilities and benefits is established between the IAs and the agency should be developed. Where the level of irrigation fees is properly set and collection is efficient in an irrigation system under joint management, as demonstrated in the LCPIS, it could generate substantial financial surplus in O&M. A major part of this surplus should be retained in the system for

emergency repairs during calamities and for further improvements. In the case of the LCPIS, for instance, much work still needs to be done to improve drainage facilities for further increasing the productivity of the system.

- When the system under joint management is under the supervision of a regional office of the agency, as in the case of the LCPIS, regional level support is crucial as the implementation of supervision and training activities are delegated to the regional office by the central office. For small- and medium-sized systems, agency capacity for training of staff and IAs, and for repair and improvement work requiring heavy equipment, are usually in the regional offices. Thus, regional level support is necessary for effective joint management.

5. REQUISITES OF ORGANIZATIONAL CHANGE FOR IMPROVED PARTICIPATORY IRRIGATION MANAGEMENT

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I. INTRODUCTION

People's participation in development programs had been a widely accepted practice in most ancient civilizations in Asia. However, for a variety of reasons, these great traditions had gradually faded away. In the recent past, many countries have attempted to pick up their ancient traditions of people's participation in agricultural development. In the industrial sector, some of the doctrines that emerged in the 19th century contained various expressions on the idea of "work force participation" in management decisions (ILO, 1981). Subsequently, at the beginning of this century, many countries in the developed world established institutional forms of participation through legislature and other means. For example, in the U.K., joint committees were advocated by the Whitley report in 1916; factory committees were recognized in Russia in 1917 and "work councils" were established in countries like Austria in 1919 and Germany in 1920 (ILO, 1981).

In the past few decades, with the aim of achieving income, employment and welfare objectives of rural communities and to enhance local food production; respective governments have intensively involved and incurred heavy expenditure as direct assistance in the form of the creation and management of economic and social infrastructure such as irrigation systems. In doing so, the governments, with the influence and assistance of the international donor community, have adopted different concepts and approaches of socio-economic development in different names and at different times. These included: Poverty Alleviation; Integrated Rural Development; Community-based or Participatory Development; etc. Sometimes, the approaches adopted have been bureaucratic and highly patronizing. In such cases, little or no mechanisms included to create a sense of "belonging" of these activities/programs to the local communities. And, the communities' potential for effectively participating in the relevant processes was overlooked. Moreover, many such programs have been influenced by the political and administrative changes occurring in the larger environment. It has been argued that these approaches have resulted in the nurturing and perpetuating of a dependency syndrome.

This is true for irrigation development as well. The donor financing for new constructions has also declined in the recent past, mainly due to price signals. Potential for expanding the area under irrigation is diminishing rapidly mainly because of the escalating cost

of tapping and developing new sources of water and the poor performance of existing irrigation systems. One should also examine the price fluctuations to understand how these induced shifts in investment decisions. A major shift in the supply function of food occurred when the global production of food grains dropped due to unfavorable weather that prevailed in major grain producing areas. Consequently, grain prices ñ notably rice ñ rose sharply in the mid-1970s. Naturally, this signified a situation in which irrigation investments appeared to be "*profitable*". And, in response to this situation, major donors increased the level of lending for irrigation development. These investments were biased towards "*hardware elements*" of irrigation development; new constructions were initiated and more and more lands were brought under irrigation. In the late 1970s, the reverse occurred. Food grain supplies increased and, consequently, a sharp drop in grain prices was experienced. This in turn led to a notable reduction in investments on irrigation by the major donors (Azarcon, 1990; and Rosegrant and Pingali, 1991).

The rationale for making investment decisions in irrigation development (which usually yields benefits over a longer period of time) based on market price fluctuations (which, more often than not is short term) is questionable. Moreover, significant "*time-lags*"[1] exist in the decisions between: a) price shift and investment decisions; and b) investment decisions and the realization of "*output*" (e.g., construction of irrigation systems).

The need for making irrigation systems "farmer-oriented" had been emphasized in 1980s. During this period, it has been noted that highly developed systems in East Asia were becoming "farmer-oriented" and the need for investing on human resources and changes in institutional structure had been emphasized (Barker and Herdt, 1985).

In general, agriculture in many countries has now entered a post-Green Revolution era. In order to take off from present stage of stagnation and, especially to enhance the economic conditions and general well-being of rural people, it demands new strategies and procedures. In many countries, the sector has to face with new challenges of structural adjustments towards liberalized markets. This implies that the sector has to face with local demands such as achieving food security, poverty alleviation, environmental concerns, income and employment generation etc., and at the same time, compete in export markets (and in the local market with imported products), based on comparative advantage. Hence, it is argued that sectoral policies must be revised, the infrastructure as well as the selection and adoption of technologies should be adjusted and organizations and institutional arrangements should be restructured to cater a "market-oriented" growth. In this process special emphasis may be given to the new institutional arrangements that will be necessary for the commercialization of irrigated agricultural production systems and the need for economies of scale to make agriculture profitable.

It is in this context that this paper examines the "*Requisites of Organizational Change for Participatory Irrigation Management*". The paper is organized in seven parts: following this introduction, Section II will briefly comment on the rationale for Participatory Irrigation Management (PIM) and Irrigation Management Transfer (IMT). Section III will examine the past experiences in PIM/IMT while Section IV elaborates on "Requisites for PIM/IMT". This section will only examine the general conditions necessary for PIM/IMT. Section V of the paper examines the need for multi-functional commercial organizations, where irrigation

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[1] In general, a 10-year lag exists between inducements in irrigation investments and changes in new irrigated areas in the Philippines (Azarcon, 1990).

management could be considered as an integral component. It will analyze the ways and means through which farmers could act as active partners of the structural adjustment process/ market economy mode and will emphasize on a process of transforming irrigators/farmers organizations into business organizations that would undertake, market-oriented production in irrigated agricultural production systems. Based on this discussion, Section VI will submit a framework for developing alternative organizational/management models for PIM/IMT and commercialization of irrigated agricultural production systems. Finally, Section VII will present the summary and conclusions.

II. WHY PIM/IMT/TURNOVER, IMT?

The governments of many countries worldwide have already recognized the need for transferring management responsibilities to water users. The major reasons for PIM/IMT are: improving irrigation system performance and productivity; responding to the advice/pressures of external funding agencies; reducing government expenditure on Operation and Maintenance (O&M) of irrigation systems; responding to broader democratization and privatization policies and programs of respective governments; enhancing the sustainability; and reducing environmental impacts (FAO/International Irrigation Management Institute [IIMI], 1995).

Irrigation water is central to the production activity of irrigated agricultural production systems and returns to collective action are more significant in irrigation water management. Irrigation water is a scarce resource in many areas and more often than not the source of supply, distributory systems and drainage systems are either state-owned or community-owned resources. As stated in Section I, it had long been customary for governments in many countries to extend patronage and control over irrigated agriculture. However, as this approach could not be sustained, the governments of these countries were compelled to look for alternative ways of circumventing the problem of O&M funding. One method was to charge an irrigation fee and the other was the devise of management transfer as a method of transferring O&M costs to water users:

> "*because of its importance and the perceived inability of the private sector sources to meet water demands, many countries have depended on the public sector to provide water services for their populations. Yet, this has resulted in many inefficient public water projects and in inadequate supplies of good quality and reliable water. Decentralization of water management, including the use of water markets, cannot solve all of these problems, but it can improve the efficiency of water allocation. When given adequate responsibility and authority, Water User Associations (WUAs) have effectively taken over management activities at savings to taxpayers*" (Easter and Hearne, 1995).

The tradition of government involvement in irrigation management, however, has been so strong in many countries and the dependency syndrome cannot be easily broken and the government funding and patronage extended to irrigation O&M cannot be suddenly withdrawn. The experience suggests that it would be necessary for these countries to follow a gradual process of withdrawal of funding through the adoption of management transfer. Several countries have had varied measures of success in cost and management transfer. The measures adopted have had many advantages other than transferring the cost of O&M. For example, these have contributed to infusing a sense of ownership or belongingness to farmers and also

increased efficiency in O&M. While the concept and principles seem to be generic in nature, the strategies and procedures may be country-specific.

III. PIM AND TURNOVER/TRANSFER EXPERIENCES

It has been stated that "the participatory approaches to irrigation development *pioneered by the Philippine National Irrigation Administration and the Gal Oya Project in Sri Lanka helped inspire similar efforts in many countries including Indonesia and Thailand*.[2] Irrigation agencies fielded workers to facilitate farmer involvement in design, construction, O&M of irrigation systems" (Korten and Siy, 1988; Uphoff 1991; and Manor, Patamatamkul, and Olin, 1990 quoted by Bryan Bruns, 1993). In Asia, developed countries such as Japan, Rep. of Korea and Taiwan have had relatively advanced WUAs with strong bargaining power. The WUAs in these countries manage irrigation systems. They employ technical staff and hire the services of the private sector (firms) for certain functions related to O&M and agricultural production. In China, too, certain farmer organizations are engaged in commercial activities such as conducting auctions to award irrigation management contracts to private parties (Svendsen and Liu, 1990, quoted by Vermillion, 1991). In China, local responsibility for water facilities and irrigation development and management is clear. Infusion of strong political ideologies or traditions may have contributed to the success in collective action in this country.

The countries in the region which had launched IMT programs in mid-1970s (such as the Philippines) and in the early 1980s (like Sri Lanka) have adopted a participatory "learning process" approach while certain other countries like Nepal, based on such experience and due to external (donor) pressures adopted a "blue print" approach in certain donor-funded projects. For instance, various conditions or "strings" are attached to the IMT process; for example, rehabilitation at different stages will not be commenced unless farmers assume responsibility for O&M.

Probably, out of the developing nations in Asia, the Philippines provides one of the best experiences relevant to the IMT process in many other countries in the region. In the Philippines, historical evidence suggests that indigenous small-scale irrigation schemes had been constructed and managed by local communities. For example, in the 17th century, cooperative societies, namely "Zanjeras", were involved in constructing irrigation schemes by means of locally constructed bamboo and rock diversion structures placed across streams and rivers. Usually, such an indigenous irrigation society comprised of members from two or more villages. The "costs" of construction of dams, main canals and other minor structures were all shared by the members either by giving construction materials or contributing labor. Subsequent O&M were also done collectively by the community. Moreover, the society had

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[2] This is true for developing countries in Asia. Certain developed countries such as Taiwan have had strong WUAs prior to this time. It should also be noted that, in addition to Gal Oya, two other interesting experiments on organizing water users towards PIM had influenced the large-scale adoption of PIM in Sri Lanka. One by a Deputy Director of Irrigation who was responsible for managing the *Minipe* Irrigation Scheme, and the other by a Technical Officer of the same Department at Kimbulwana Oya Irrigation Scheme. Even though both these efforts were on a much smaller scale and were confined to few O&M tasks, compared to Gal Oya, and were not organized as "action research", they can be considered as unique because they were not supported by external or project funding.

internal mechanisms to resolve conflicts. Hence, the operation of these irrigation societies resembles that of a complex organizational enterprise which involved engineering and construction activities, soil-water-crop relations, management and allocation of water rights to groups and individuals, physical maintenance activities, conflict management etc.

In 1963, a corporate agency, namely the National Irrigation Administration (NIA) was established. Later, NIA was confronted with the problem of inadequate funding, mainly due to farmersí hesitance to pay irrigation service fees (ISFs), destruction of irrigation facilities in certain cases and governmentís withdrawal of subsidy to NIA. In response to this challenge, in the late 1970s, NIA launched its PIM and Institutional Development Program (IDP) which has aimed at the formation, development and sustenance of functional, cohesive and viable Irrigatorsí Associations (IAs). Moreover, most of these systems have been constructed jointly by the State and the respective communities. At the stage of construction farmers form an IA and contributed to the design and construction. As a tradition, at the completion of the construction phase, the systems are turned over to the IAs, subject to a cost recovery arrangement. This means farmers participated at all stages of the communal irrigation development, that is, from project identification through feasibility studies, construction etc., up to the O&M of the completed systems. This process has helped in developing the capacity of the local communities and instilling a feeling of system ownership. At present, most of the Communal Irrigation Systems (CISs) covering close to half of the total irrigated area in the country are managed by local communities. While the systems vary in scope and type of structure, most serve less than 1,000 ha of farmland. With the successful experience in the communal (small) irrigation systems, NIA applied the participatory management strategy in large-scale National Irrigation Systems (NISs).

In 1983, NIA started using farmers as organizers/catalysts, on a pilot basis. With the experience gathered, in 1988, under the USAID-assisted Accelerated Agricultural Production Project (AAPP) and the World Bank-assisted Irrigation Organization Support Project (IOSP), NIA expanded this approach nation-wide. This was known as "Farmer Irrigators Organization Program" (FIOP). The FIOP provided a forum for the farmers to help mitigate their negative reactions towards NIA, if any. When problems confronted within organization farmers approached their organizer. If the problem related to NIA-IA relations, the organizer relayed the problems to NIA (Wijayaratna, *et al*., 1996).

There are three types of contracts governing NIA-IA partnership in the NISs: the Type 1 contract entitles the IA to undertake canal maintenance; Type 2 contract allows the IA collect ISFs from the membership, retain a portion according to an agreed incentive schedule; and the Type 3 contract can be executed either on a partial or total turnover of management of the irrigation system. Under "full turnover" the IA amortizes the cost of construction and owns the system.

Some important lessons can be learned from the Philippines experience in peopleís participation in developing and managing irrigation infrastructure. *Such experience (that have been already utilized in irrigation management in several countries) may be useful in designing strategies for utilizing social capital in developing and managing irrigation as well as other types of rural infrastructure in other countries. First, NIA-IA experience is that "turnover" has been considered (not in isolation), but as an integral component of the local institutional building process through which the local communities gained the capacity to manage infrastructure, including the generation of resources, management skills to handle complex socio-technical issues associated with irrigation. Second, the operationalization of the process, especially the NIA-IA partnership, was supported by clearly defined responsibilities from both parties and such conditions were governed by legal contracts.*

Cases have been reported where cooperative societies effectively managing irrigation systems. For example, in the Kakrapar Irrigation System in Gujarat State, India, the Mohini Water Distribution Cooperative Society is successfully managing the water it purchases from the Irrigation Department (Datye and Patil, 1987, cited in Vermillion, 1991). In Indonesia, there exist legal basis for WUAs for managing tube-wells and small gravity irrigation systems. Farmers participate in managing large-scale systems as well. There is a program for handing over irrigation systems with command areas over 500 ha. Nepal has a long history of communal irrigation. A great majority of irrigation systems are privately owned. The government extends support, in terms of subsidies and loans etc. to WUAs to develop irrigation facilities. Bangladesh, too, launched a program of privatizing irrigation facilities, mainly the tube-wells. It should be noted that traditionally, there were community-based irrigation in many countries in the region - village tanks in Sri Lanka, *Subaks* in Bali, Indonesia, Banave terraces and Zanjeras in the Philippines, water *panchayats* in South India are examples.

In 1984, the Government of Senegal initiated a policy of "disengagement" of the State agency from Senegal River Basin Irrigated Agriculture (SAED). IAs have been established and federated them upwards to take over the functions earlier handled by the State agency. In Madagascar, a 15-year program, involving the creation of WUAs, and turning over the O&M responsibilities to WUAs, was launched in 1986. Rehabilitation by the government was an "incentive" for farmers to take over the systems (Vermilion, 1991).

It is important that the PIM/IMT process evolve effective mechanisms to ensure active user participation (and WUA responsibility), not only in the day-to-day O&M of irrigation systems, but also in the formulation and implementation of relevant policy, as well as in legal and institutional arrangements indicated above. It is aimed at enhancing water use efficiencies by improving the management of existing systems, increasing agricultural productivity and production, and reducing governmentís expenditure on O&M of irrigation systems. Certain basic conditions necessary for the institutionalization of PIM/IMT are examined in Section IV. Subsequently, in Section V, it is argued that multi-functional business organizations would be more appropriate to achieve sustainability.

REQUISITES FOR INSTITUTIONALIZATION OF PIM/IMT[3]

In general, the conditions necessary for successful PIM/IMT program include: strong high-level political support, clear policy direction, legal basis for new managing entities, economic benefits to farmers, well-defined water rights at system and farm levels and functional irrigation facilities (FAO-IIMI, 1995).

An effective institutional arrangement is essential for the success of an IMT process. The functions of institutions will include:

- Deploying mechanisms to ensure active and productive participation of water users;
- Planing and conducting O&M and Rehabilitation and Modernization (R&M);

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[3] This section has been adopted from Wijayaratna, 1992: "Institutionalization of Participatory Management: Sustainability of Farmer Organizations", paper presented to the Second Asian Farming Systems Symposium, 2-5 November 1992, Colombo, Sri Lanka.

- Administer water rights;
- Resolution of conflicts, and implementation of regulatory and control mechanisms;
- ISF/revenue collection, budgeting, and financial management;
- Providing/coordinating irrigation and agriculture-related services; and
- Managing information, M&E and research.

The following have been suggested as the *basic conditions that are necessary to achieve the goals* of PIM/IMT (Wijayaratna, 1992):

- Suitable irrigation infrastructure/physical system;
- Appropriate institutional arrangement:
  - i) Role of change agents/facilitators, with changing roles at different stages of farmer organization (FO)/farmer company (FC) development;
  - ii) Need for an "Institutional Home"; and
  - iii) Self-correcting mechanisms.
- Information systems (knowledge) and skill development;
- Policy support, including legal and financial; and
- Increased benefits/profits to individual members, through collective action.

Appropriate Irrigation Infrastructure

Obviously, the availability of appropriate irrigation structure is a prerequisite for successful production, in general and the sustainability of PIM/IMT in particular, in any irrigated agricultural production system. Irrigation systems need to be rehabilitated and **modernized** to suit the present day needs. The needs of farming communities are fast changing. Agricultural development programs (including irrigation development) which were largely geared towards the achievement of self-sufficiency in staple food have now been reoriented. There exist increasing trends towards diversified cropping, the commercial production of high-value cash crops and on intensification of production using advanced irrigation and production technologies. Hence, it is argued that the restoration of irrigation systems to original design status or effecting *ad hoc* improvements may not be productive enough to meet the new demand and challenges. Some of the original irrigation system specifications may even be inappropriate for the changes demanded in the cropping patterns, cropping intensities etc. There is a need for diversified cropping, the commercial production of high-value cash crops and intensification of production using advanced irrigation and production technologies.

Moreover, irrigation system modernization should be a process of making appropriate changes/improvements in the physical, institutional and socio-economic objectives of irrigation systems. It is argued that the projects and other opportunities for "rehabilitation of irrigation systems" should consider hydrological and other linkages between the sub-systems of the main irrigation system as well as the hydrological, socio-economic and other relevant interactions within the river basin/watershed. Also, projects and programs should take a much more holistic approach and integrate irrigation system modernization with the adoption of novel production technologies and marketing of agricultural products. Such a strategy would *enhance farmer profits and this in turn will enhance their capacity to manage their systems, including self-financing*. What is needed then are irrigation betterment or modernization programs and not just simply to rehabilitate or restore the systems. Hence it is proposed that irrigation

improvements should bring in modifications (in physical structures, irrigation methods and in drainage and re-use) to the systems to meet the present day needs, whether the post-modernization management be done by the small farmer groups, FCs or other private companies, government or jointly by several stakeholders. This approach will also provide opportunities to benefit from changes in technology that have occurred since the original design of irrigation projects (see Section V for a conceptual framework).

Appropriate Institutional Arrangement

"*Institutions at any level involve more than purely individual efforts. They embody some kind of collective action in which the interests, resources, ideas and ideals of many persons are brought together. Institutions serve as channels for collective actions that are reinforced by diffused benefits, legitimacy and shared expectations. There can also be penalties imposed for persons who violate institutional obligations*" (Uphoff, 1986, p. 14). In addition, there is a need for institutional mechanisms to coordinate the decisions taken by a large number of individuals operating in small units. A rational institutional framework is necessary to involve these "mini decision-making units" through organizational activities and to *sustain* such processes. To achieve sustainability, the challenge is to facilitate and institutionalize a process through which rural communities themselves would evolve local organizations to satisfy their own local needs. For this, a catalytic process or a "planned intervention" into the community is required. *Such a catalytic effort should be strong enough to generate the internal dynamism of the community and controlled enough not to dominate it.* Our experience with small FOs suggests that these "ideal" features are not found frequently in state-sponsored organizing processes. Instead, local organizations are "formed" (and not "evolved" from within the communities) by field officials not to fulfil peopleís needs, but merely to follow the orders of the superior officials or to satisfy the politicians.

In addition, the normal disequilibrium which may occur with the introduction of a social innovation, such as group action over individual action (Cernea, 1987). Moreover, many other problems may occur in such kinds of unplanned and *ad hoc* formation of rural organizations in a "rush". These may include rural elite taking the leadership or organizations, conflicting goals and vague objectives, inadequate or lack of participation by the membership, unacceptable patterns of benefit distribution and malpractice and corruption. Farmers in certain rehabilitated systems in the region complain about the poor quality of rehabilitation. As the systems would be handed over to farmers, it is strongly suggested that they be assigned with the responsibility of checking the rehabilitation process.

1. ***The Need for Change Agents/Catalysts***

The intervention methodology requires potential members (of the rural communities) to promote association, interaction and cooperation with each other; develop their perception of problems and needs; and then begin a process of exploring how these needs could be met. In effect, what needs to be done is to make a planned intervention into the community. Carefully selected and well-trained catalysts or change agents could make such interventions. Such planned interventions have been successful in managing irrigation infrastructure in certain cases. For example, in a pioneering experiment of establishing FOs in Gal Oya,[4] Sri Lanka, the change agent or the Institutional Organizer (IO) entered the community with a trained but

[4] The author was the Team Leader (1980-83) of this action-research program.

open mind. She/he did not take with her/him a "model organization". She/he did not have a ready-made organizational structure complete with constitution, by-laws, qualifications for membership, objectives (pre-conceived by the bureaucracy or politician), functions, sanctions for transgressions, etc. The objectives of the IO were to initiate a process, encompassing a range of options applicable to different locations and situations. It was expected that during this process, the IO, the farmer and the field level officials would attempt jointly to develop participatory organizations for operating and maintaining irrigation infrastructure and managing water. An IO was expected to respect farmers, their ideas, values and beliefs. The IO had faith and confidence in people, and trust in their ability to define and contribute to local needs and solution of local problems. An IO was neither an instructor nor an educator in the classic sense. Instead, an IO was a facilitator. She/he promoted interaction among villagers, and between the villagers and the government officials. The IO helped village groups and the government agencies interact with each other based on mutual respect. His/her role was to make villagers self-reliant. In this sense an IO was a catalyst. She/he did not make decisions for people but helped them analyze issues, always leaving the decision-making to them. For example, with regard to the formation of farmer groups, the IO left the decision-making about the form, structure, membership, rules, etc of the organization to the farmers themselves (Wijayaratna, 1985).

2. ***Need for An "Institutional Home"***

A necessary condition for this purpose is to establish a proper "*institutional home*" for institutional development, more specifically to facilitate the process of organizational development within the target communities. It is a requisite for the "turnover" of responsibilities to local communities. For example, for developing and managing irrigation infrastructure, the NIA in the Philippines, tapped external resources for institutional development at the early stages, because, the agency did not have adequate capacity. Later, the NIA established its own "Institutional Development Division", which was instrumental in nurturing the organizational change and capacity development within the irrigation communities all over the country. Institutional home would also act as the link between the State and the WUAs/FOs/FCs or cooperatives and facilitate policy adjustments to support PIM/IMT. With maturity, rural institutions are expected to be involved in the development and management of water resources, market-oriented production processes and business at different levels. Hence the role of the catalyst or change agent should also vary and adjust according to the demand. This aspect is discussed elsewhere in this paper.

3. ***Self-correcting Mechanisms***

"*Once a large number of small self-help organizations have been established, there is need for some methodology for monitoring and evaluating their performance. Agencies, governmental or non-governmental, working with such groups should be able to identify and assist week groups, while knowing the strong ones and learning from them. Agencies often need to satisfy donors that widely dispersed gains (often small but to their beneficiaries, very important) are real and increasing. Monitoring and evaluation (M&E) are particularly difficult under such circumstances, dealing with program participants who are quite scattered and often not amenable to conventional M&E undertakings. The difficulties are compounded if one wants to avoid M&E in conventional top-down ways that "expropriate" information without direct involvement or benefit to program participants. Ideally, one wants to evaluate the development of participatory capacities and performance in a participatory manner*" (Uphoff, 1988, p. 44).

To attain self-reliance, local organizations need to adopt self-correcting mechanisms on a continuous basis. Participatory self-assessment procedures can be used by local organizations, to measure and monitor the performance of the organization as well as the development and management processes. Involvement of the members of respective organizations, local officials of relevant agencies, resource persons such as technical experts, participating NGOs, etc. will *pave the way, especially at the planning stages, for participatory M&E and Management Information Systems (MIS)*. Such a planning would help the membership to articulate a possible future vision for their organizations. In addition, the set of indicators[5] used for planning activities can be used for M&E during the implementation period. Database management and assisting the organization in the self-evaluation process should be an essential function and contribution by the facilitators at the initial stages of organizational development.

Information Systems and Skill Development

To assist in the identification of potential opportunities, the information must encompass a wider range. Information on water resources, irrigation and production technologies, and infrastructure as well as on value-added production and marketing, etc., becomes important when attempting to discover new economic potentials. The objectives of the information systems are manifold. First, the information on new and sustainable technologies, relevant to the activities undertaken by the local communities, should flow down from appropriate sources to the local organizations. Such technology should be affordable by the respective communities and viable. Second, information on opportunities available for local users such as banking and credit facilities, market and processing, etc. should be made available to the local organization. Third, the flow of information on policy, legal and regulatory aspects and information on relevant government or private sector collaboration/assistance and on the work of other relevant user groups/local organizations is of significant importance for pronounced growth and sustainability of local organizations involved in the development and management of rural infrastructure.

A continuous flow of information is required to enrich the implementation process facilitating interaction, debate and resolution. The prudent use of information technology (IT) in the generation, process and analysis of information needed is crucial to support the planning, implementation and evaluation of PIM. For this, the organization may use a MIS and a rigorous self-M&E activity through a participatory procedure. It may review the progress and employ a feedback/correcting/warning mechanism to ensure that inputs, work schedules targeted outputs and other related actions are proceeding according to plan.

Similarly, the training and skill development needs of organizations that are engaged in new tasks are of different types and are of continuous in nature. Changing technology and the expansion of activities of the local organizations with their maturity will call for new kinds of

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[5] Indicators are defined as specific (explicit) and objectively verifiable measures of changes or results brought about by interventions/planned activities of respective organizations. As much as possible, indicators should be selected considering characteristics such as validity, reliability, sensitivity, specificity and cost-effectiveness. Both qualitative and quantitative indicators could be included. Qualitative characteristics of some indicators – such as those related to organizational behavior and strength – can be transformed into quantitative measures by assigning scores and converting into indices.

training and skill development. Also, the matured organizations will enter into transactions and business with outsiders such as the organized private sector. Therefore, the sustainability of the organizations will depend, among other things, on the knowledge and skills of their managers and those who are entrusted with specific functions. For example, training on financial management, acquiring skills in managing different types infrastructure etc. are essential, especially for a multi-functional organization. A healthy and rigorous financial management system should be an integral component of an organization undertaking financial transactions. Organizations will have to develop their own financial plans, maintain proper records on financial transactions, assess their own financial activities (self-assessment) and establish and maintain an effective system of internal control.

The roles and functions of individuals within the organization would change over time. For example, the Board of Directors may be rotated or changed periodically. This situation too, calls for continuos training.

Policy Support

Government commitment is a necessary condition for the sustainability of rural organizations. In certain areas, sustainability of organizations is restricted due to inadequate policy support. In certain other areas, different perception on participation by different actors, chiefly the bureaucrats, including policy-makers hinder the development and sustainability of organizations. As Korten correctly stated " ... *Closing the gap between bureaucracy and the poor poses formidable requirements for the reorientation of the organizational structures and management systems of large public bureaucracies*" (Korten and Alfonso, 1981, p. 224). Certain policy-makers and bureaucrats view participation or local management merely as a process of mobilizing of rural labor and investment for grassroots level tasks, which would otherwise borne by the government while for some others, participation mean manipulation and regimentation. The latter tend to have a rigid "control" over local organizations.

The policy support mechanisms desired to evolve and sustain local organizations under consideration would include legal support and financial support, especially at the initial stages of development. An efficient and carefully designed legal framework to support the efforts of local organizations is essential, especially in areas where the procedures and structures of the decision-making process of the public service are oriented much more towards control than to innovative and creative work. For instance, it may be prudent to provide local organizations with legal rights to participate in decision-making bodies at higher levels.

However, it should be noted that a participatory system could not be brought into being by legislature alone. Further, in certain areas, there is no guarantee that enacting a procedure or legalizing something would ensure the implementation of the same. On the other hand, once specific mechanisms or strategies of participation are identified and agreed upon, then the legal support to facilitate their operationalization may be helpful to sustain those practices. It should also be noted that all the operations of a participatory system need not be supported by the legislature. Certain operations may occur on the basis of mutual understanding, norms or through informal agreements. In other words, the law can lay down a number of fundamental rules and rights of respective parties involved in specific aspects; e.g. forward contract for the sale of produce or in obtaining a service.

In addition to legal support, financial investment by the State is a necessary condition in organization building, especially at the early stages of development. At initial stages, financial assistance may come in the form of employing the correct type of agency for

catalyzing the development of local organizations, training and skill development and to meet the operating costs of establishing the correct "institutional home". *Investing in organization building should be considered as an effective form of investment in enhancing the human capital stocks.*

Profits to the Individual Members

The pattern of distribution of benefits and costs is an important factor motivating individuals to organize for collective action. If a certain type of collective action reduces the cost to the individual or when the individuals experience more equity in the distribution of profits generated from collective action, then they would be attracted to participate actively in such group action. In addition, if there is a need for "sharing" responsibilities in order to increase individual profits OR if there exist "interdependence" of different roles – such as producers, collectors, processors, store or warehouse keepers, managers etc. – it implies "comparative advantage" for advanced and large-scale FOs such as FCs.

In an open market economy, liberalization not only leaves economic activities open to the market forces, but also results in a substantial withdrawal of the government interventions. In addition, as mentioned earlier, due to budgetary problems the respective governments find it increasingly difficult to develop and maintain certain rural infrastructure including irrigation. In areas where government had played an important role, the reforms or the "adjustment and stabilization programs" have introduced private sector participation for increased efficiency and to reduce the burden to government. On the other hand, in certain cases rural people may not have the access or cannot afford the prices of such services offered by the organized private sector. Therefore, it would be beneficial if the communities utilize social capital in developing and managing such services and related infrastructure. And, this would enhance profits to the individual (Wijayaratna, 1999).

The benefit or the profit margin of the individual members will significantly influence the viability of group action, especially in a market economy. The common benefit derived from group action should be distributed in a manner acceptable to the individual member. And, the individual member must have the right to enjoy freely her or his share of profit derived from group action. There could, however, be exceptions. For example, there is evidence to claim that an inspiring atmosphere of cooperation or strong collective action (in rural communities) could also be generated and sustained through the *infusion of political ideologies or strong traditions/customs or cultural ties*. Nevertheless, in this discussion, it is assumed that "profit making" behavior dominates and may even act as a decisive factor for members to stay in their organizations. And, the organizations may not be sustainable unless they help enhance the profits of their membership. At the same time, it should be noted that farmer profits, in general, are declining, compared to the profits earned by other actors in the marketing chain.

In this context, Section V is devoted to a discussion on the "need for multipurpose organizations, particularly to organize and undertake market-oriented production processes within irrigated agricultural production systems, for identified markets".

V. IRRIGATION PRIVATIZATION: FROM PIM TO COMMERCIALIZATION OF IRRIGATED AGRICULTURE

In many countries, WUAs or FOs for irrigation management have been introduced at a time when:

- Irrigation water was considered to be the most important limiting factor in the agricultural production process, and while it was considered as the major determinant of the income of the people in irrigated agricultural settlements.
- Large-scale rehabilitation efforts had been implemented for which farmer inputs were required to improve R&M efficiencies and lower the project costs.
- Most of the irrigation systems, despite their heavy costs (of construction and operation) were operating at low efficiencies.
- As a measure of enhancing management efficiencies, there was a need to create a "sense of ownership" in the farmersí minds, through "shared control" or establishing partnerships between the government and the users.

(Wijayaratna, 1998)

However, as stated earlier, the situation has changed. In many countries, the governments find it increasingly difficult to maintain even the minimum levels of support to the rural communities, mainly because of budgetary constraints and also due to the influence of donors and other pressure groups. And, following the global trends in "privatization", there has been a growing tendency for respective governments to adopt participatory or shared management processes as well as "privatization" of government undertakings. Relative inefficiencies in the government bureaucracies in improving infrastructure (such as irrigation) and delivering support services to the rural sector as well as the increased evidence of success of programs and projects involving beneficiaries in managing rural development have also motivated the respective governments, donors and pressure groups to look for participatory and joint or collaborative processes. There is however, a need for continued government involvement in irrigated agricultural production systems, but it should be different from the approaches and strategies adopted in the past. As the individual farmerís access to the required services and supplies cannot be assured through bureaucratic modes, the evolution of new forms of organized service delivery is imperative. Therefore, governmental support in facilitating a process of more intensified and strengthened organizational activities on the part of the small farmer, needs special emphasis.

In the light of such considerations, PIM/IMT need to be considered as a process of "privatization". It is believed that, especially in the rural sector, the policy imperatives of governments on "privatization" need to be implemented in a manner that would promote the interest of the large rural segment of the population. With the creation of a competitive environment to ensure quality and fair cost, these policies will have to be implemented to benefit the ordinary villagers than to strengthen the intermediaries. Can FOs be financially viable if they are restricted to irrigation management alone? – this is yet to be tested in the region.

What organizational changes and strategies would then be appropriate to the farmers (especially the small farmers) in the irrigated agricultural production systems to benefit from "privatization"? This section will address such issues. It will first discuss briefly the tradable water rights and water markets and subsequently examines the relevance of multi-functional business organizations geared towards market-oriented production in irrigated agricultural production systems.

Water Markets

There are examples of enhancing water use efficiencies through tradable water rights and water markets. *In Chile, market-oriented water policies and tradable water rights have improved the efficiency of agricultural use of water and this has resulted in higher agricultural productivity. Mexico and California also provide "guidance in resolving the complex issues that arise in the process of implementing a system of markets in tradable water rights...., (however) even comprehensive water law reform allows a phased approach to implementation, which can begin with regulated markets that are progressively opened up as market experience gathered* " (Rosegrant and Schleyer, 1994, pp. ix and xi). Palanasamy, in a comprehensive analysis of water markets in India, reports that *many farmers in Tirupur, Coimbatore District, are selling water for non-agricultural purposes because it is more profitable in the context of unfavorable crop prices and rising costs of agricultural inputs. Some farmers switched on to crops with low or no irrigation demand, such as coconut and other perennials, to save water and sell it* (Palanasamy, 1994, in Rosegrant and Schleyer, *ibid*.)

In certain countries, the ownership of different forms of irrigation water (such as ground, surface etc.) and the irrigation facilities is retained by the government, even after the IMT. However, WUAs are vested with rights to use water. They are not allowed to sell, transfer or rent out facilities. Individual use of water is granted through a licensing system, however, it is both sellable and transferable. There are different opinions about the possible impact of this "lack of perfect markets" on water use efficiencies and productivity. However, due to paucity of data it is difficult to conduct an objective assessment.

Usually in developed countries the markets are based on individual rights. However, in many developing countries in Asia, there exist difficulties in creating water markets based on individual rights. In these countries there are a large number of small farmers operating on tiny smallholdings. They do not have irrigation infrastructure (and it may not be profitable) to cater to the individual farmer. For example, there is no way (at present) of delivering the exact volumes of water for a given price to individual farm plots. It would be costly and also these countries cannot afford at this stage of development, to provide such facilities at the farm level. Also, re-use patterns in water basins (and even within micro-watersheds) make it nearly impossible to measure the exact amounts of irrigation water utilized by individual farmers operating tiny smallholdings, often scattered in a locality. Moreover, if one expects land consolidation to occur in the process of development it is not logical/rational to incur such expenditure at the present stage of development. In addition, implementation of a costing mechanism based on volumes delivered to individual farms becomes irrational due to excessive re-use pattern. As stated above, the drainage and re-use patterns in a typical river basin/watershed aggravate this situation.

Moreover, for water pricing, water quality becomes an important determinant and for water quality, there is a need to conduct detailed Environmental Impact Assessment (EIA) and Initial Environmental Evaluation (IEE) according to a set of criteria and for each base unit. In many systems, the base unit is usually a small farm and thus the quality assessment based on individual "private units" would become a difficult task. *Further, one should not ignore the historical evidence exist in many countries that local organizations could enhance the efficiency of irrigation management sustainably*. On this basis, group water rights may be the logical mechanism in minor as well as major irrigation systems in many developing countries, at least for some time. Multi-tier systems are useful to accommodate different interest groups or users with different privileges, such as those cultivating at head, middle and tail areas.

In many countries, the record of irrigation fee collection too is not encouraging, there is a tendency for the WUAs to seek other sources of revenue. Based on regional experience it is doubtful whether the WUAs could be financially viable as long as their mandate is limited to irrigation management. Their scope of work may have to be expanded to include non-water factors, specially the integration of water with other factors of production, diversified cropping (following the principles of comparative advantage), value addition and enhancing the bargaining power of users. In this, it is imperative that FOs establish business links more with the organized private sector, for services, including input and output marketing.

Multi-functional Organizations

It is clear that unless farmers enhance their incomes through increased productivity – both land and water, their organizations will not be in a position to undertake O&M functions of irrigation in a sustainable manner. In addition, it is proposed that the "takeoff" from agricultural base to achieve the industrialization goals of certain countries (where agriculture sector still plays a dominant role as the provider of food and employment etc.) should rely on rural agricultural diversification, specialization, market-oriented modernization and promotion of agro-industries. Such a strategy would also provide the necessary impetus for minimizing uneconomical agricultural activities, which have resulted in small and frequently fragmented holdings. Instead, it would help consolidate lands into more economically viable units by pooling of resources under new organizational structures of farmers. It may also speed up the processes of mechanization of agriculture and the application of improved technologies resulting in greater productivity, inducing movement of excess people away from agricultural production into agro-based and other industrial pursuits. In that strategy, *the management of irrigation, including O&M responsibilities would become an integral task of a special "arm" of the business organization*.

1. ***Adjustments in Local Institutions to Cope Up with New Demands***

In this context, it is believed that the matured organizations/institutions would benefit if federate upwards and expand their scope, for instance by expanding their area of work to cover main irrigation system, the watershed/river basin as well, and most importantly, enter into other economic activities. Thus, new activities, roles and functions will be added and new skills will be required. Then the organizational structure should be adjusted for efficient handling of these new tasks and roles: it may be diversified and division of management and labor may be necessary to undertake special functions. One alternative may be to form task-based groups within a single organization to handle different tasks. Similarly, in order to achieve economies of scale (or to enhance collective bargaining power), the organization may be federated upwards to higher levels, or councils/shareholder companies may be established. For example, in Malaysia, the FOs are organized as a federated system at three levels, namely; area, state and national farmers organization at the apex level. The membership of an area FO[6]

[6] Actually there are smaller informal farmer units at the base, within the area of a given FO. a farmer unit comprises of villagers as members. Each unit has a unit chief, who maintains close links with the area FO, and a working committee. Similarly, an agro-based cooperative society has its own Board of Directors or a "committee of management". From each farmer unit and agro-based cooperative, members are elected to form a "members' Representative Assembly". This is the "formal authority" of the area FO.

is open to any Malaysian citizen of over 18 years or to any agro-based cooperative society registered under the Cooperative Societies Ordinance, 1948 and operating within an area FO. The federated system permits the base or area FOs to become members of higher level FOs. The activities of the FO are coordinated and managed by a general manager and several staff members assist him. The FOs are entrusted with various responsibilities including: diversification and commercialization of agriculture; farm mechanization and other farm supplies, marketing services including infrastructure such as drying complexes, storage facilities and warehousing; transport, infrastructure for agro-processing such as processing plants; social services; and education and recreational facilities. The FOs are also entrusted with the responsibilities to facilitate capital formation and promote investment by its members through equity participation in business ventures or through the formation of companies.

2. ***Farmer Companies***

Certain FOs established under the various legislature and institutional reforms have emerged as forceful pressure groups and they manage to organize water distribution, input supply, and, in a limited way, sale of production. The fact remains, however, that a major breakthrough was not seen to ensure small farmerís economic and social well-being through profitable economic ventures. The absence of a combined set of interventions to promote year-round cropping, crop scheduling, value-added production and other agro-industries, market links in the form of forward contracts of sufficient scale as profitable business, the absence of procedures for decision-making in the implementation of trade policy sensitive to farmers, promoting partnerships between FOs and the organized private sector as well as between State and FOs ñ all these remain as obstacles. On the other hand, FCs could be helpful in overcoming at least some of these obstacles.

FCs or similar institutions should operate as independent business organizations, which could avoid political and other problems. *Investments through FCs can produce competitive economic ventures for which a necessary condition will be the partnerships with the organized private sector and the State*. Further, one of the biggest national riddles, for which a sustainable solution has not been found by many governments with continued donor assistance, is the inadequacy of income earning opportunities for the land less rural youth. FCs can tangibly address this issue and also harness the skills of the educated youth in making them important actors in profitable business.

Cooperatives, on the other hand, are "associations of persons with common needs, who join hands for self-protection, promote social cohesion, encourage individual initiative through collective actions. Cooperatives have an ideological base, economic objects and a social approach. They are based on social parity and equality" (Dwivedi, 1996, p. 714). The concept of cooperatives was born in England in 1844, in the environment of a free economy to *protect consumersí* against exploitation by the traders. It can be argued that exploitation occurs in an environment where perfect conditions for economic liberalization do not exist. FCs, cooperatives or similar institutions could help create a competitive environment (Wijayaratna, 1997).

"*Even in the highly market-oriented countries like the U.S.A., Scandinavian countries, Japan, etc., cooperatives play a significant role in influencing markets. In the U.S.A., for example, cooperatives annually account for nearly 70 percent of fluid milk, 80 percent of fresh fruit, 35 percent of agricultural credit of all types, 30 percent of grains, oilseeds and major share in the rural electrification production, transmission, and distribution; the bulk of fertilizers and petroleum is handled by the cooperatives. Similarly, in Japan, cooperatives are fairly strong in the field of agriculture, consumers, fisheries and forestry*" (Dwivedi, 1996, p. 723).

In companies, shares are marketable. Therefore, shareholders are interested in speculating potential gains from buying or selling stocks. This in turn could provide an incentive for them to monitor the performance of their firm. In cooperatives or other people's organizations, shares, in general, are non-tradable. Moreover, unlike in companies there is no direct association between equity participation and voting power. In certain countries in the region, cooperatives and rural organizations such as FOs are comparatively more susceptible to political bureaucratic and other pressures. However, as indicated earlier, there exist efficient cooperatives in certain countries and the most appropriate form of rural organization could vary across countries or areas within the same country.

It might be possible that FOs and FCs perform different roles at different levels. FOs (such as field channel water user groups or distributory canal organizations) as the "base units" can justify their existence within a company framework. These organizations are crucial as base and intermediary units for collective functioning. Usually such institutions are characterized by attributes like: one vote for each member; device for collective operation rather than an economic organization; and largely dependent for success on the maximum participation of a great majority of (if not all) members.

FCs can take the other forms of capital – physical, natural and human – and technology into consideration in an economically and socially optimal manner; can go for relatively large-scale investments; can establish voting rights depending on the ownership of shares; can invest in capital intensive service functions yet offering equitable opportunities for a given member to benefit; operate as an economic organization, matching with the market economy; and can afford to bargain at the market.

3. ***Other Types of Business Organizations***

It is not the intention to rule out the possibility of using cooperatives or strong FOs and their federations in the process of commercialization of agriculture and handling O&M of irrigation in a sustainable manner. In many developed countries as well as developing countries both agricultural cooperatives and FOs play an important role. In Korea for example, agricultural cooperatives are basically designed to meet the demands of both member farmers and consumers. Since 1991, the National Agricultural Cooperative Federation (NACF) and its member cooperatives emphasized the development of agribusiness. The objectives of this business include value addition through processing, higher income for member farmers, helping the farming community indirectly by stabilizing the market prices of related farm products, controlling the balance of supply and demand in the market place, and developing new markets or "creating new consumption" by supplying newly developed processed items. The business confronts many problems such as low profitability, technical difficulties and low competitiveness against the products imported by private companies. The NACF and its member agricultural cooperatives attempt to overcome these obstacles of agribusiness ventures. Korean agricultural cooperatives have also put emphasis on banking services ever since their establishment in 1961. The government provides subsidies for the construction of processing plants and extends low interest loans to cooperatives as well as to the private companies.

There are many direct and indirect effects of the agricultural processing business operated by cooperatives. First, it offers member farmers job opportunities at the plants. Second, it strengthens the bargaining power of member farmers and cooperatives for higher sales prices of farm products, as they are not compelled to sell overproduced volume at

dumping-level prices to private companies when cooperatives have the capacity to absorb this excess volume. Third, it enlarges the feeling of homogeneity between cooperatives and member farmers. Fourth, it maximizes the synergistic effects in cooperatives' management through providing complementary banking services and other marketing activities. Finally, it contributes greatly to regional economic development.

4. ***"Produce for the Market" or Demand-driven Production***

FCs or similar (large-scale) business organizations of farmers/water users, in collaboration with their base organizations/groups (such as field channel groups, distributory-level organizations), may organize production and establish partnerships (e.g. through forward contracts) with the organized private sector, nationally and internationally. This will reduce government's direct involvement in production and marketing. Moreover, it will no longer be necessary to provide subsidies.

5. ***The Need for Different Types of Facilitators for Advanced Tasks***

It is clear that, with the diversified and expanded functions expected from the rural organizations, the role and functions of the change agency/agent or facilitator/catalyst should also be changed. The added roles of a facilitator/catalyst in such situations would include:

- Identify and estimate market potential for selected agricultural enterprises and agro-processing. Assist in the scheduling of production in a given user company/ organization area; inform the company/organization and other technical officers (such as the extension and credit, input supplies) of the availability of markets for enterprises that would match with the agro-climatological and socio-economic conditions of the area and for the selected processed products.
- Estimate the production of these selected enterprises jointly with the rural people and then arrange for forward contracts with identified markets buyers. In this way, the facilitator will link the producer groups/companies/organizations with potential markets/private sector firms. This process will include market surveys and discussions with buyers and members of the company/organization, providing market information to the rural community, training members of the company/ organization on the required quality, quantity, grading and other aspects expected by the buyers, etc.
- Assist the rural community in monitoring the feasibility of meeting the contractual agreements: For this, he/she will join the local staff of government agencies and other staff of the company/organization. He/she will assist the organization/ company to monitor, whether there are any constraints faced by the rural community in the water markets, production and processing etc., which may affect the quantities and quality standards included in the forward contracts or other agreements.
- Arrange for expert advice as well as other needs of the organization/company. These will include all aspects of water markets, marketing and processing farm products, storage, packing, transport, etc. The objective is to evolve the required business mode of operation within the organization/company.
- Be accountable to the producerís organization/company. For example, in a project mode, or at the initial take off stage the facilitator may be paid by the project or by a grant/loan given to the organization/company. However, the performance of the facilitator should be evaluated by the organization/company. After the initial phase the facilitator is expected to be absorbed by the organization, if further services are necessary.

VI. ALTERNATIVE MODELS FOR PIM/IMT AND COMMERCIALIZATION OF IRRIGATED AGRICULTURAL PRODUCTION SYSTEMS

This section will submit a framework for defining and developing "Models" for rehabilitation and post-rehabilitation management of irrigation. It is suggested that, in general, different models for irrigation management (and/or rehabilitation and post-rehabilitation management) can be specified on the basis of three variables namely: a) type or the nature of improving water resource utilization (mainly technology and method), including rehabilitation; b) post-rehabilitation management of the system – mainly the type of production process including crops and cropping patterns, methods of production, including irrigation methods and O&M; and c) the degree of participation by different "actors" or the stakeholders in "a" and "b".

Improvements to water supply conditions may take different forms. It may vary from simple improvements to existing infrastructure such as irrigation canals to complex modernization processes that may introduce advanced/precise irrigation methods. Such improvements or rehabilitation may also be based on individual irrigation system or on watershed/river basin or clusters of irrigation systems, taking into account the hydrological as well as other linkages between irrigation systems within a cluster/watershed/river basin. For illustration purposes let us define four levels:

W_1 = Simple improvements to existing irrigation infrastructure: e.g. desilting an irrigation canal;

W_2 = W_1 plus modernization of the irrigation facilities such as: lining of canals, improving the drainage systems, on-farm improvements etc.;

W_3 = Water resources utilization/improvements in a watershed context considering their hydrological considerations. Conservation of soil and water etc.; and

W_4 = W_2 plus the establishment of advanced and more efficient irrigation methods such as drip or sprinkler systems.

The level of rehabilitation or modernization as well as the level of investment for such improvements to water supply conditions may best be decided and designed on the basis of post-rehabilitation management of the irrigated agricultural production system, including the methods of irrigation. For example, after rehabilitation/modernization of irrigation systems and depending on the type of irrigation methods, different levels of production can be established.[7] Changes or improvements in post-rehabilitation management of irrigated agricultural production systems may vary from improving the use of major inputs such as seeds and fertilizer to the establishment of capital intensive but highly profitable production systems such as greenhouses under controlled conditions of relative humidity, temperature, air movement etc.

Again, for illustration purposes let us consider four levels of agricultural production after rehabilitation/modernization:

P_1 = Simple improvements in the use of major agricultural inputs, e.g. use of high-yielding crop varieties, improved use of fertilizer in a low land paddy system;

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[7] Obviously, the demand or market condition, climatic conditions as well as other aspects related to crop selection and cultivation methods should also be considered at this stage.

P_2 = Planned diversification of cropping in low land systems together with improvements in the use of major agricultural inputs, e.g. cultivation of other cash crops, multiple cropping;

P_3 = Integrated farming system based on a watershed or a cluster context; diversified cropping, integration of livestock, conservation farming etc.; and

P_4 = Establishment of advanced production systems that saves water and space, including systems such as greenhouse technologies. P_4 may be coupled with W_4.

Theoretically, different combinations of water resources/supply improvements (or rehabilitation/modernization) and production may result in different "models". This is illustrated in Figure 1.

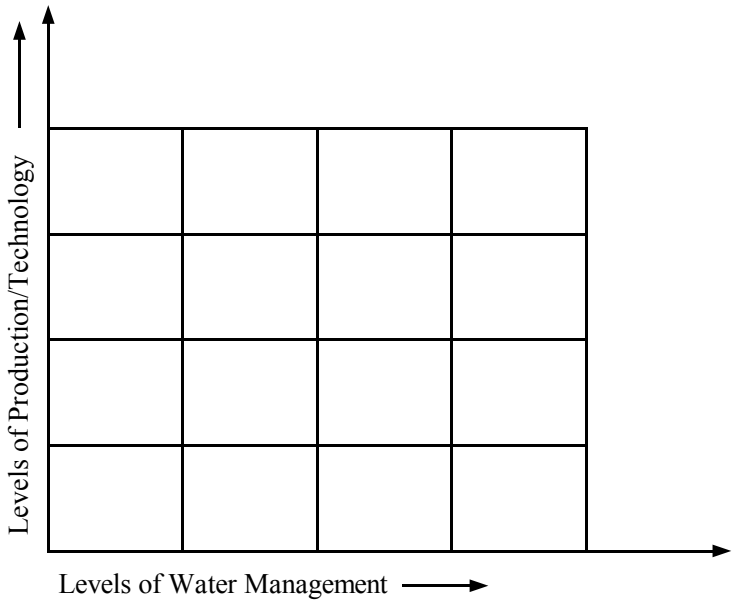

Figure 1. Matching Different Levels of Water Management and Production

1. ***Mode of Management***

Different combinations of stakeholders, primarily FOs, government agencies and the organized private sector (private firms), may undertake R&M and post-R&M activities (like the production process) at different levels of intensity using different levels of R&M and post-R&M (production) technologies.

For example, each one of the three types of stakeholders may participate in R&M by providing one or more of the following inputs at different levels:

- Physical design.
- Financing.
- Organizing.
- Labor and other physical inputs.
- Supervisory, monitoring and/or evaluation inputs.

Similarly, in post-rehabilitation management, different actors/stakeholders (farmers, organized private sector and government) may participate and collaborate with each other in different ways (and at different levels) by providing one or more of the inputs such as the following:

- Managing the main source of water supply/reservoir, including the pricing and selling of water.
- Managing canal system and downstream water distribution.
- Decision-making in relation to irrigation and crop scheduling.
- Primary production: crops, livestock, fisheries, other enterprises.
- Providing services.
- Purchasing produce through forward contracts.
- Processing, value-addition.
- Policy and regulatory mechanisms.
- Handling disputes.

Each one of these R&M and post-R&M tasks could be performed at different degrees of efficiency. When different levels of R&M, production and water management/irrigation technologies/methods are used, a multiple number of "models" could be formed.[8] In other words, when all three variables are combined a large number of ì modelsî can be defined and this is illustrated in Figure 2.

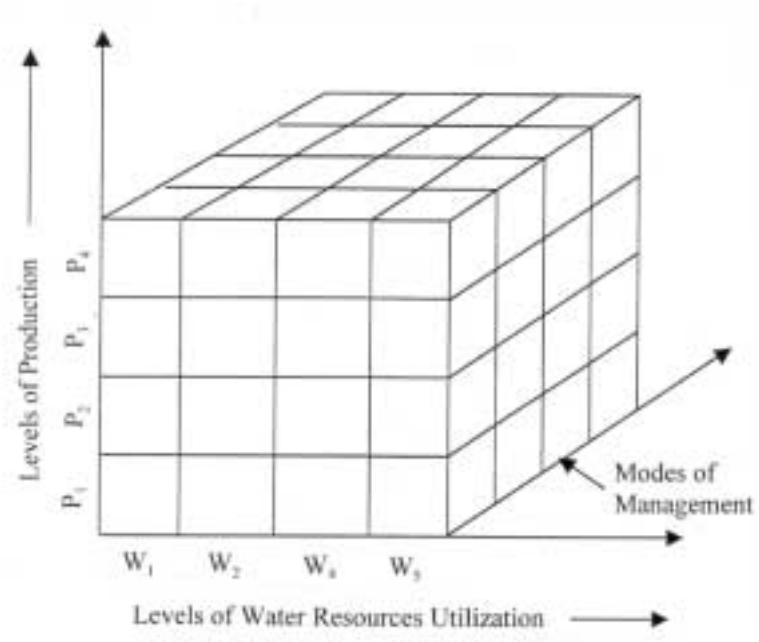

Figure 2. Water Management, Agricultural Production and Associated Management Options

[8] However, it should be noted that, in practice, certain combinations may not be considered as logical (or profitable) and may not exist. For example, advanced irrigation methods will not be coupled with mono-crop culture with low production technology.

Unfortunately, in certain countries, certain options are not considered in typical R&M projects. *It is proposed that, not only the advanced production as well as irrigation methods and associated infrastructure, but also different organizational strategies may be "offered to" and "utilized by" FCs or similar organizations.*

In this context, let us now consider "how far could/should irrigation organizations go?" For convenience let us classify their scope or tasks in to four categories:

- Managing irrigation (only);
- Managing water and handling input marketing;
- Managing water and involved in input as well as output marketing; and
- Managing water, involved in input and output marketing and engaged in other business, such as value-added production, processing etc. (business mode).

Anyone of these functions could be performed at different scale. For example, in regard to water, there can be organizations managing water only at field channel level whereas certain other organizations may be managing large irrigation systems or even river basins. Similarly, area of operation in regard to production or scale of operation in relation to marketing or processing may vary across organizations. Hence, one may include a variable for "scale of operation". Obviously, the type and number of functions undertaken by any organization as well as the scale of operation would directly related to its organizational strength or the stage of organizational development. In this context, various "options" could be defined (Figure 3).

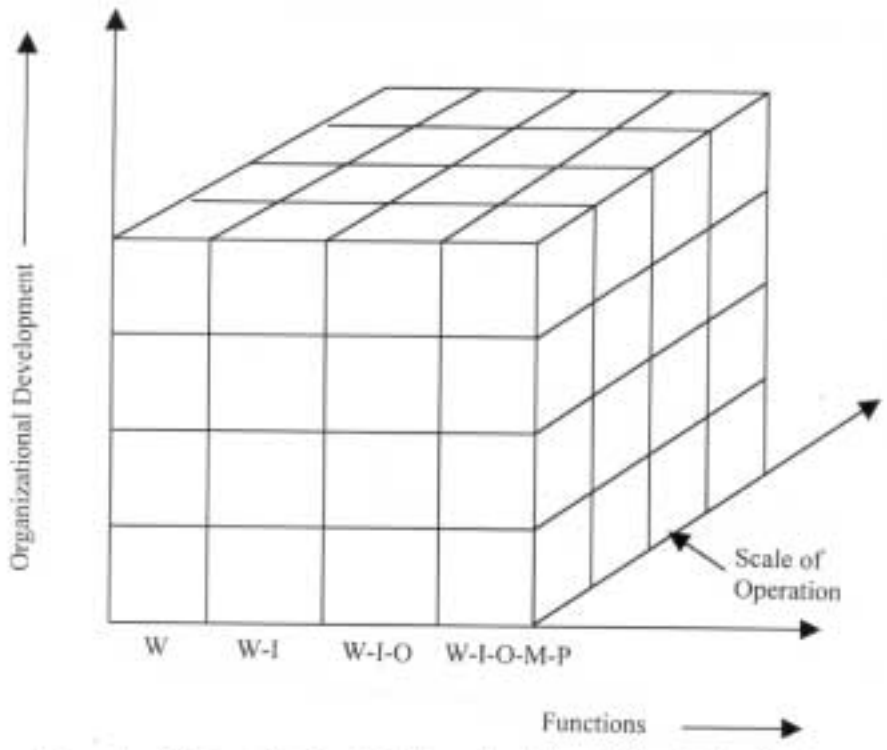

Figure 3. Different Options for Managing Irrigated Production Systems

Notes: W = water; W-I = water plus production inputs; W-I-O(-M-P) = water, inputs, output and market-oriented production, value-added production, other business.

Based on such considerations, a ìmodelî or a strategy has been developed[9] for the Mahaweli Irrigation System, the largest Irrigation system in Sri Lanka. This strategy is illustrated in Figure 4. It is aimed at transferring the irrigation management responsibility to farmers and to achieve the goals of sustainable farmer income, initially at field channel and distributory canal levels and later on at main system level. It should be reiterated that such an approach or achieving a status of sustainable farmer income (through commercialization of production and related business conducted by their own FOs/FCs, cooperatives or similar organizations is considered as a prerequisite for achieving sustainable O&M by farmers.

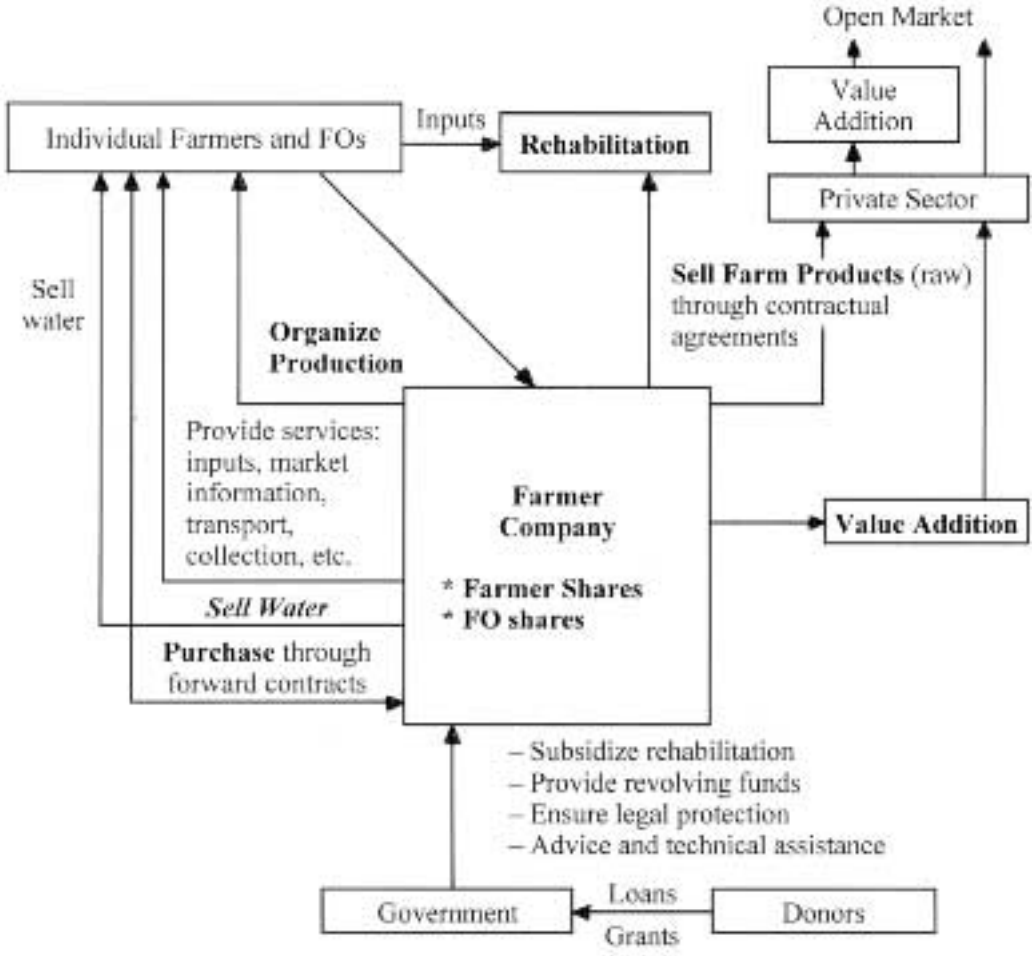

Figure 4. A Strategy for Rehabilitation and Post-Rehabilitation Management of Irrigation Systems

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[9] The author developed and proposed this model to the Mahaweli Restructuring and Rehabilitation Project in Sri Lanka. Mahaweli is the largest river diversion/irrigation system in Sri Lanka. The inputs of Gamini Batuwitage, Paul Rajasekera, Neela Adikaramge, I. K. Weerawardene and M. U. A. Tennekoon – all members of the Mihidiya Foundation of Sri Lanka, in conducting consultations with stakeholders, including Mahaweli farmers and officials and policy-makers and in developing the strategy, are gratefully acknowledged.

Tasks Related to Irrigation Management

For PIM/IMT to be sustainable, farmers need to improve the organizational structure and, within a "multi-function" organization they may create an "arm" for irrigation management. At this stage they would have identified specific roles for O&M.

It is important that the leaders/farmer representatives as well as the members of organizations have a clear understanding on such aspects as the need and basis for collective action in irrigation management (including division of O&M-related responsibility within the organization), rules governing collective action, obligations in regard to contributions/ irrigation fees/rates, mechanisms for conflict management in relation to O&M, the "Reward-Punishment" mechanisms. In addition, they should be aware of water supply/delivery mechanisms (under normal conditions as well as under the conditions of scarcity); water requirements for planned cropping patterns at different places of the command area and at different times etc.

Further, the modes of ordinary farmers' participation in decision-making at different levels and procedures ensuring accountability of higher level decision-making to ordinary farmers should be clear and transparent.

It is proposed that a manual be prepared containing a detailed action plan to guide the PIM/IMT *process*.[10] This may begin with the organization of a small multidisciplinary team to guide and provide technical assistance/"back-stopping" to the catalysts and farmer representatives. The most important tasks would be the facilitation of irrigation and production scheduling, arranging for markets, ensuring quality production in quantities required by the market and the O&M task related to the market-based production. Farmers' involvement as decision-makers in rehabilitation is also important. As for rehabilitation and O&M tasks, the manual/guidance package would include the following:

- Selection and recruitment of catalysts;
- Training of catalysts;
- Orientation/familiarization (two-way process);
- Plan and commence implementing the FO strengthening program;
- Design and establish by laws and other legal aspects;
- FC/cooperative/FO federation may have been established at this stage;
- Walk-through/identification of rehabilitation needs, initial cost estimates and prioritization;
- Form task forces/committees for different tasks;
- Action plans for rehabilitation, division of responsibilities – who will do what, when, with what quality etc, and contracts related to rehabilitation;
- Plan for M&E;

[10] See for example, Wijayaratna, *et al*. (1996), "Farmers Organizing Farmers", for a comprehensive action plan and flow chart prepared for the Philippines' (NIA's) Farmer Irrigators Organization Program, and the series of associated manuals.

- Facilitate the participatory rehabilitation process;
- Preparation of cropping calendar/patterns and the comprehensive production plan;
- Preparation of water management plan, seasonal and intra-seasonal;
- Plan and enter into contractual agreements with partners;
- Plan for conflict management;
- Continuous education and training (as indicated above, this is a continuous process and depend much on experiential training); and
- Inter- and intra-season monitoring.

Certain organizations or FCs may decide to appoint employees for certain O&M functions. Even though one may expect less wastage and increased efficiency in O&M after the transfer, it would be unrealistic to believe that the farmers would undertake O&M completely and bear the full cost of O&M immediately after the full turnover. The experience suggests that it would be necessary to follow a gradual process of withdrawal of government funding through the adoption of management transfer. On the average, a minimum period of three years would be necessary for an average farming community to establish a business organization, help enhance the incomes of its membership, improve its capacity to undertake O&M in order to cater the demands of its commercialized production, develop internal mechanisms to manage conflicts and disputes, establish financial management systems and self-correcting mechanisms and adequate M&E procedures etc. Instead of continuously subsidizing O&M, the government could provide revolving funds, extend funding to cover the cost of managing of business organizations created by farmers (such as FCs that are aimed at commercialization of farm production and enhancing farm incomes), provide legal and policy support etc. Funding, however, may be limited to a specified period at the initial stages.

VII. CONCLUSIONS

In many countries, agriculture sector in general, and irrigated agriculture in particular, has now entered a new phase of development. In the 1970s and 1980s, there was a shift in focus towards rehabilitation and improving management of existing systems rather than the earlier emphasis on constructing of new irrigation systems. This interest gathered momentum due to: diminishing land and water resources available for, and the increasing cost of developing new irrigated agricultural production systems; demonstrated under-performance of the existing systems; and comparative advantage of undertaking rehabilitation programs over new construction activities. At present, most of the countries face with new challenges of structural adjustments towards liberalized markets. This implies that the agriculture sector has to face with local demands such as achieving food security, poverty alleviation, environmental concerns, income and employment generation etc., and at the same time, compete in export markets (and in the local market with imported products), based on comparative advantage. In this context, this paper argued that, sectoral policies must be revised, the infrastructure as well as the selection and adoption of technologies should be adjusted and organizations and institutional arrangements should be restructured to cater "market-oriented" production. In this process, special emphasis should be given to new institutional arrangements that will be necessary for the commercialization of irrigated agricultural production systems and the need for economies of scale to make agriculture profitable.

Expected improvements in irrigation management alone may not generate adequate incremental benefits for them to be financially viable. A better alternative would be to utilize the established organizations and enhance their scope of work to adopt a holistic approach. In this, the FOs will have to deal with the organized private sector, in a business mode, for irrigation-related as well as non-irrigation services. While the countries are increasingly embracing open market policies, FCs, cooperatives or other forms of federated FOs would be the most appropriate organizations for small farmers to coexist with free market forces. Such organizations would also help reach economies of scale and enhance the bargaining power of producers and may sustain as strong and viable production and marketing organizations which will be responsible, not only for irrigation management, but also for primary production, collection, storage, quality control, value-added production and marketing. Hence it is argued that the matured organizations/institutions would benefit if federate upwards and expand their scope, for instance by expanding their area of work to cover main irrigation system, the watershed/river basin as well, and most importantly, enter into other economic activities. Thus, new activities, roles and functions will be added and new skills will be required. Then the organizational structure should be adjusted for efficient handling of these new tasks and roles: it may be diversified and division of management and labor may be necessary to undertake special functions. One alternative may be to form task-based groups within a single organization to handle different tasks. FCs or similar (multi-functional business) organizations, once they gain economic strength and management capacities, would become the appropriate organizations for "self-managing" irrigation systems. They could take the responsibility of managing the "agricultural production system" as a whole within which irrigation remains as an integral component. The basic conditions that are necessary to achieve the goals of PIM/IMT could then be defined as: a multi-functional business organization, within which a special division/"arm" established to handle irrigation management; suitable irrigation infrastructure/physical system; change agents/ facilitators, with changing roles at different stages of FO/FC development; an "Institutional Home"; self-correcting mechanisms and M&E; information systems (knowledge) and skill development; policy support, including legal and financial; and increased benefits/profits to individual members, through collective action.

The proposed process may be summarize as follows:

1. Strengthen the managerial capacity of FOs or WUAs;
2. Facilitate the establishment of multi-functional business organizations like FCs with irrigation management as an integral part of the overall business;
3. "Full transfer" of responsibility and authority to "rehabilitate, own and operate";
4. Financial support, technical assistance and skill development; and
5. Assist initially in feedback and self-correcting mechanisms, establishing transparency through the establishment of a people-centered M&E system based on a set of objectively verifiable indicators.

For PIM/IMT to be sustainable farmers need to improve the organizational structure and, within a "multi-function" organization they may create an "arm" for irrigation management. At this stage they would have identified specific roles for O&M. It is important that the leaders/farmer representatives as well as the members of organizations have a clear understanding on such aspects as: the need and basis for collective action in irrigation management (including division of O&M-related responsibility within the organization); rules governing collective action; obligations in regard to contributions/irrigation fees/rates;

mechanisms for conflict management in relation to O&M; and the "Reward-Punishment" mechanisms. In addition, they should be aware of water supply/delivery mechanisms (under normal conditions as well as under the conditions of scarcity); water requirements for planned cropping patterns at different places of the command area and at different times etc. Further, the modes of ordinary farmers' participation in decision-making at different levels and procedures ensuring accountability of higher level decision-making to ordinary farmers should be clear and transparent.

The major functions of the irrigation "arm" of a federated organization/company would include: deploying mechanisms to ensure active and productive participation of water users; planing and conducting O&M and R&M; administer water rights; resolution of conflicts, and implementation of regulatory and control mechanisms; ISF/revenue collection, budgeting, and financial management; providing/coordinating irrigation and agriculture-related services; and managing information, M&E and, at advanced stages, research.

Different combinations of stakeholders, primarily FOs, government agencies and the organized private sector (private firms), may undertake R&M and post-R&M activities (like the production process) at different levels of intensity using different levels of R&M and post-R&M (production) technologies. In general, different models for irrigation management (and/or rehabilitation and post-rehabilitation management) can be specified on the basis of three variables namely: a) type or the nature of improving water resource utilization (mainly technology and method), including rehabilitation; b) post-rehabilitation management of the system – mainly the type of production process including crops and cropping patterns, methods of production; and c) the degree of participation by different "actors" or the stakeholders in "a" and "b". Obviously, the type and number of functions undertaken by any organization as well as the scale of operation would directly related to its organizational strength or the stage of organizational development. In this context, by taking into account the levels of these variables, namely, degree of involvement of different stakeholders, level of water resources utilization (mainly technology/method), type of production and the type of functions undertaken by FOs and the scale of operation, various "options" could be defined.

Unfortunately, in certain countries, certain options, are not considered in typical R&M projects. It is proposed that, not only the advanced production as well as irrigation methods and associated infrastructure, but also different organizational strategies may be "offered to" and "utilized by" FOs.

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Dhaka

INTRODUCTION

Bangladesh is richly endowed with water resources, with an elaborate network of rivers criss-crossing the country. However, the availability of water for productive use is characterized by wide seasonal as well as spatial variability. As such, the planning and management of country's water resources must take into account the dual problem of flooding and water shortage, along with the competing demands of various water using sectors, including agriculture, domestic, fisheries, industry, navigation and environment.

The water regime of Bangladesh has made it one of the most rice intensive agricultural systems in the world. Farmers in Bangladesh have adopted themselves to country's unique water regime in many ways. Growth in grain production is almost directly related to the availability of irrigation, the indispensable "platform" supporting all other Green Revolution units.

Water resources development is directly linked with irrigation expansion which is instrumental in increasing the production of crops and management of water through flood control, drainage improvement and river training measures. National Water Policy (NWP) adopted in 1999 provides guidelines for identification of future programs of government as well as non-government sectors for the optimum development and sound management of water resources. To operationalize the water policy, a National Water Management Plan (NWMP) with an integrated approach is being developed. The NWMP aims at optimal use of available water resources and distribution of benefits to all concerned.

Socio-economic Overview

Arguably, the most critical problem faced by Bangladesh is the large size of its population. Population pressures have added to the stress on natural resources, including water and contributed to their over-exploitation. However, the country has succeeded in significantly reducing the population growth rate over the years. In 1973, the population was 74 million, measuring at a rate of 3 percent per annum. The population growth rate was down to 2.17 percent by 1991 and, currently it is below 2 percent. But, in absolute terms, the population has increased by 52 million or more in 25 years since 1973. The national goal is to reach a zero population growth status by 2045. The estimated population of the country, as of 1999, is about 128 million with a population density of about 860 persons per km^2.

Bangladesh has remained an agrarian society. Nearly 75 percent of the population is directly or indirectly dependent on agriculture although this sectors contributes only about 30 percent to the national GDP. Agriculture is still the main user of water and its share in water

demand will further increase concurrently with efforts to attain food security through increased food grain production.

STATUS OF WATER AND LAND RESOURCES

The water ecosystem of Bangladesh comprises the tributaries and distributaries of three major river systems – the Ganges-Padma, the Brahmaputra-Jamuna, and the Meghna – and numerous perennial and seasonal wet lands like *haors, baors* and *beels*. All the three major river systems originate outside the country. In fact, out of some 230 rivers in the country, 57 are trans-boundary rivers – 54 coming from India and three from Myanmar. Owing to the fact that 90 percent or more of Bangladesh's annual runoff enters the country from outside its borders, there are uncertainties regarding the quantum of water with serious planning implications for the management of water and water-dependent sectors.

Bangladesh has three broad types of landscapes namely, floodplains (80 percent), terraces (8 percent) and hills (12 percent). The total area of the country is 147,570 km^2 (6.7 percent), of which consists of rivers and inland water bodies. Land is the most precious resource in Bangladesh, being the mainstay of a primarily agricultural economy. The arable area constitutes 8.74 million ha (out of 14.76 million ha), which is about three-fifths of the total area. Of the net cultivable area, 33.33 percent is single cropped, 45.0 percent is double-cropped, 11.5 percent is triple cropped and 10.2 percent is cultivable waste and currently left fallow.

Water Supply

The natural surface water resources in Bangladesh are mainly obtainable from the country's dense network of river systems, which include a combination of upstream inflows and runoff generated from rainfall within the country. Preliminary estimates at the inception phase of the NWMP indicate that cross-border flows into the country amount to around 1,010 billion cubic meters (BCM) and an additional amount of 340 BCM is generated from local rainfall, averaging 2,300 mm. Of this total quantum of available water (1,350 BCM), about 190 BCM is lost in the atmosphere through evaporation and evapotranspiration, while the balance of 1,160 BCM is available for use or flows into the Bay of Bengal. Eighty percent of this huge flow of water is concentrated in the five-month monsoon period of June to October.

In the monsoon season, flood flows enter Bangladesh from upper riparian states of China, India, Bhutan, Nepal and Myanmar through 57 trans-boundary rivers. The area of the country influenced by floods of the three major rivers is approximately 128,168 km^2. High flows in the trans-boundary rivers, internal rainfall and general low level of the country are the major causes of flooding in Bangladesh. In addition, combined effects of the peak flows of the major rivers, spring tides in the Bay of Bengal and cyclonic surges can join together to worsen the flood situation as happened in 1988 and 1998. Unfortunately, the peak discharge of the main rivers occurs in the period July to September, at the same time as local rainfall. The rainfall excess cannot escape and ponds up until the main rivers abate. The ponded water can only escape when the water level outside is lower than that inside. The resulting drainage congestion may last for over a month or longer, as notably was the case in 1998.

Dry Season Water Resources

Gross dry season resources comprise rainfall and trans-boundary inflows during the season, the volume in storage, in both surface and water bodies, and groundwater.

1. ***Surface Water Resources***

Surface water is the largest component of water resources available to Bangladesh. Each day, on the average, approximately 3,000 MCM (million m^3) are discharged into the Bay of Bengal. Surface water resources available during the period November through May comprises flow in the main rivers, other trans-boundary inflows and stream flow generated within the catchments inside Bangladesh. In Table 1, the major river inflows are shown on a monthly basis, calculated using data over 20 years.

Table 1. Regional and Major River Border Inflows

(Unit: m^3/s)

	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
50 percent Dependable							
Regional river	1,592	1,027	779	618	630	1,250	2,614
Brahma-putra	10,625	6,465	4,554	3,876	4,427	7,627	13,965
Ganges	5,385	2,829	1,735	1,108	804	789	1,149
Total	17,602	10,321	7,068	5,602	5,861	9,666	17,728
80 percent Dependable							
Regional river	1,091	738	558	460	419	697	1,533
Brahma-putra	8,746	5,516	4,003	3,453	3,834	6,348	11,466
Ganges	4,202	2,284	1,306	829	571	544	880
Total	14,039	8,538	5,867	4,742	4,824	7,589	13,879

Source: NWMP.

Arrangement for sharing of the dry season flow in the Ganges are set out in the 1996 Ganges Water Treaty (GWT) between Bangladesh and India which makes provisions for sharing flows for each 10-day period between 1 January and 31 May. The treaty makes special provision for each country to receive a guaranteed minimum 35,000 cfs (cubic feet per second) on alternating 10-day periods.

2. ***Groundwater Resources***

Groundwater is the most important source for domestic, industrial and irrigation supplies. Recent studies and the trend in groundwater development for irrigation have proven that the alluvial aquifers in Bangladesh are amongst the most productive aquifers in the world. The aquifer is annually recharged through rainfall and flooding and replenish every year, except underneath Dhaka City where an imbalance between recharge and groundwater abstraction is established.

Bangladesh do not have problems of saline groundwater except in the coastal zones. Groundwater in the coastal zones is vulnerable to saline intrusion. Arsenic in groundwater was identified in Bangladesh in 1993. Previously there had been no policy to test for arsenic, as no problem was suspected. The full extent has yet to be defined but the problem is most strongly concentrated in the Southwest, Southeast and Northeast regions.

The effects of arsenic are far from uniform. In some hot spots all tube-wells are contaminated while in other places both positive and negative results are obtained. The problems mainly affect shallow tube-wells (STWs), although some deep tube-wells (DTWs) are also contaminated. Farmers are likely to continue to use groundwater for irrigation unless a reliable and cheaper alternative becomes available.

Irrigation Development Scenario

The transformation of "traditional monsoon-dependent crop agriculture" has been the centerpiece of the agriculture development strategy of Bangladesh Government during the past three decades. Minor irrigation development has been the primary instrument for realizing the goals of achieving self-sufficiency in cereals.

Since 1960s, minor irrigation has been the main source of growth in irrigation command area. Minor irrigation consists of the following:

- Motorized suction (centrifugal) pumps lifting water from STWs;
- Power-operated low lift pumps (LLPs);
- Power-operated force mode pumps (i.e. turbine pumps, submersible pumps) extracting water from DTWs;
- Power-operated barge mounted floating pumps (mostly axial flow) diverting water from major rivers to small rivers, creeks etc.;
- Manually-operated pumps (MOPs) siphoning water from STWs; and
- Traditional manual lifting devices such as doons and swing baskets.

The area irrigated by different types of irrigation technology and source of water in *Rabi* seasons, 1982-83 to 1998-99, is shown in Table 2. The growth of these irrigation technologies (STW, DTW and LLP) in the same period is shown in Table 3.

The LLPs and barge mounted floating pumps get water from surface sources while the STWs, DTWs and MOPs extract water from groundwater aquifers. The use of LLPs was started by Bangladesh Agriculture Development Corporation (BADC) in early 1960s and increased rapidly until 1979 when about 35,300 LLP units under rental programs were reported to be irrigating about 0.56 million ha. During 1998-99, 0.628 million ha of land were irrigated by LLPs. The introduction of DTWs for irrigation was initiated by BADC in mid 1960s. It was not, however, until the early 1970s that significant annual increases in DTW command area were realized. In the early 1970s, the government through BADC, launched STW loan programs that proved very successful in popularizing STWs. As a result the government initiated in 1979 a series of policy changes aimed at promoting STW development. These included the privatization of the trade in STW equipment, removal of the restrictions on the siting of tube-wells and the withdrawal of import duties on small diesel engines. These resulted in the rapid expansion of the area under STW irrigation.

Growth in Irrigated Area and Potential for Future Expansion

The contribution of different technologies to total irrigated area has changed considerably over time. STW have increased in importance, from 24 percent of total area in 1982-83 to 58 percent in 1998-99 whilst the total irrigated area has also increased rapidly. After contributing to over 15 percent of total irrigated area during 1992-93, DTWs coverage has decreased to 12 percent of total area in 1998-99. On the other hand, LLPs show a long-term relative decline from 22 percent to 14 percent of total area between 1982-83 and 1998-99.

Table 2. Irrigated Area by Irrigation Technology in *Rabi* Season

(Unit: 000 ha)

Season	STW	DTW	Manual	LLP	Traditional	Major Canal	Total
1982-83	371	234	17	337	406	160	1,525
1983-84	480	263	17	342	372	136	1,610
1984-85	586	287	17	351	384	147	1,772
1985-86	586	304	17	356	314	163	1,740
1986-87	639	318	16	386	326	155	1,840
1987-88	753	345	16	402	433	115	2,064
1988-89	941	380	17	482	391	170	2,381
1989-90	1,037	384	17	484	478	176	2,576
1990-91	1,078	365	19	513	498	316	2,789
1991-92	1,234	434	19	500	316	251	2,754
1992-93	1,392	437	22	496	323	291	2,961
1993-94	1,388	389	29	458	348	326	2,938
1994-95	1,638	502	25	538	250	352	3,305
1995-96	2,004	538	50	577	226	355	3,750
1996-97	2,159	475	38	570	186	358	3,786
1997-98	2,182	465	63	622	201	358	3,891
1998-99	2,522	507	100	628	232	361	4,350

Source: NMIC.

Table 3. Operational Irrigation Equipment by Season

(Unit: 000 units)

Irrigation Season	Annual Operating Equipment		
	STW	DTW	LLP
1982-83	93.1	13.8	35.5
1983-84	120.3	15.5	36.0
1984-85	147.0	16.9	37.0
1985-86	146.9	17.9	37.5
1986-87	160.3	18.7	40.6
1987-88	188.7	20.3	42.3
1988-89	235.0	22.4	50.8
1989-90	260.0	22.6	51.0
1990-91	270.3	21.5	51.6
1991-92	309.3	25.5	50.3
1992-93	348.9	25.7	52.2
1993-94	359.2	24.5	52.6
1994-95	448.9	26.7	57.1
1995-96	576.2	27.1	60.6
1996-97	629.8	25.2	62.9
1997-98	664.7	25.35	66.25
1998-99	736.1	26.7	72.9

Source: NMIC.

Traditional systems have declined considerably, from 27 percent to 5 percent. The contibution of groundwater to total irrigated area has increased from 41 percent in 1982-83 to 72 percent in 1998-99 (Figure 1).

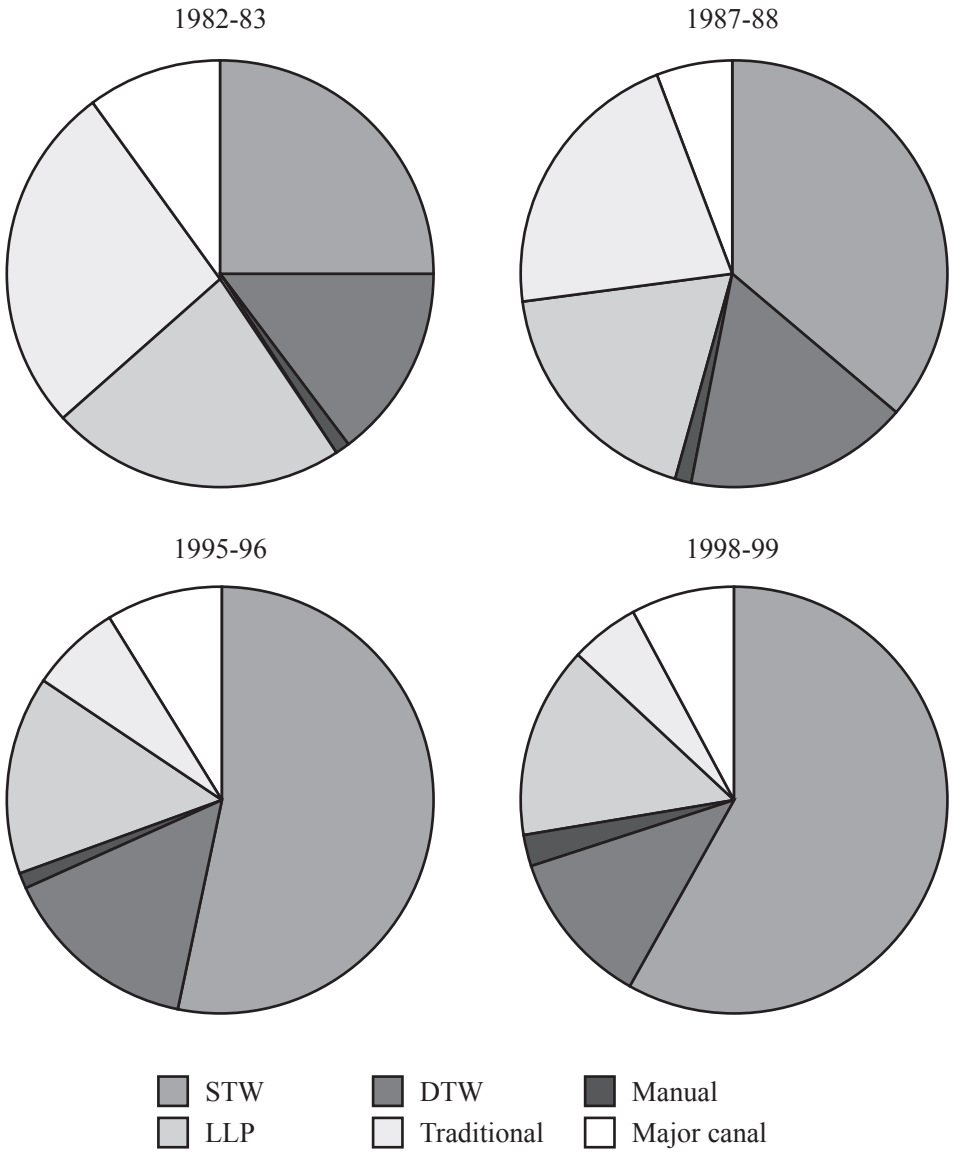

Figure 1. Growth in Irrigation Technologies

Food self-sufficiency is of prime importance to Bangladesh. The introduction of high-yielding variety (HYV) rice and the expansion of irrigation have both contributed to increased food production over the past two decades. However, in a normal year, the country faces with a deficit in food grain production by about 1.5-2 million mt. There is, therefore, a clear need for Bangladesh to expand food grain production as the total population continues to increase.

And, a major strategy to increase food grain production will be through the expansion of irrigation coverage in terms of installed capacity, improvement in capacity utilization, and further increases in cropping intensity. Irrigation, therefore, is expected to contribute heavily to a surge in water demand in the next 25 years. As mentioned earlier, of the total irrigable land in the country (7.6 million ha), only 4.35 million ha were irrigated in 1998-99.

Based on the 1991 National Water Plan estimates for irrigation expansion, the irrigated area would reach its maximum potential limit by 2025. However, in reality, this target does not seem attainable. Even a cost-effective and environment-friendly expansion of irrigation along with commensurate supplies of complementary inputs, may not be enough for attaining food self-sufficiency as the population would continue to increase over the period under review. Hence, other means of achieving national food security should be kept under regular review and adopted as appropriate.

Government Expenditures/Investments in Irrigation Facilities

GDP growth is highly correlated with agricultural growth and it also significantly contributes to poverty reduction through increased income to the large rural population. Furthermore, agricultural growth promotes diversification and development of non-farm activities in the rural economy. It also supports industrial growth. Crop agriculture accounts for about 72.23 percent of total agricultural output. Higher growth of agriculture is promoted through higher investment in agriculture sector, adequate and timely supply of input such as fertilizer, seed credit, improved irrigation and price support to the growers. In FY 1998-99 food grain production was 21.82 million mt, which is nearly 6 percent higher than the previous yearís output despite the devastating flood of 1998. The gross production of good grain is projected at 22.40 million mt in FY 2000.

Agricultural intensification and diversification has been pursued as the major strategy for the development of crop agriculture. Table 5 shows progressive increase in the annual development budget of agriculture during last three years. Higher allocation in water resources sector, which includes minor and major irrigation, is also observed during FY 1999-2000. Table 6 shows sector's share and growth rate of GDP. The growth rate has been substantially increased (7.24) during 1999-2000.

Table 5. Year-wise Budget of Annual Development Program

(Unit: Tk. million)

Sector	1996-97	1997-98	1998-99	1999-2000
Agriculture	6,407.1	5,990.1	7,380.0	8,350.0
Water resources	10,580.0	10,377.8	8,830.0	10,150.0

Source: Planning Commission.

Table 6. Sectoral Share Growth Rate of GDP at Constant Price (Base: 1984-85)

Sector	Sectoral Share					Growth Rate				
	1995-96	1996-97	1997-98	1998-99	1999-2000	1995-96	1996-97	1997-98	1998-99	1999-2000
Agriculture (crop)	23.69	23.75	22.80	22.62	22.88	2.77	6.18	1.40	4.39	7.24

Source: Bangladesh Bureau of Statistics (BBS).

IMPACT OF IRRIGATION ON FARM PRODUCTIVITY

Agriculture is the mainstay of the economic life of Bangladesh. Food grain production has increased about three times in last decades, mainly as a result of introduction of minor irrigation. Introduction of HYVs, of rice and wheat has further accelerated the growth of minor irrigation. Agriculture intensification and diversification are being pursued to attain self-sufficiency in crops. The strategy for intensive food production is based on increased irrigation coverage combined with expanded cultivation of HYV rice and wheat. Total irrigation coverage was 3.79 million ha in 1996-97, which has increased to 4.35 million ha in 1998-99. Despite the growing population, food deficit remains almost static due to rapid increase in *boro* and wheat production, which are irrigated crops. Table 7 shows the production trends of food grains.

Table 7. Production of Food Grain

(Unit: Million mt)

Item	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99
Food grains	19.7	18.08	19.06	20.33	20.66	21.82
Aus (broadcasted and transplanted)	18.5	1.79	1.68	1.87	1.87	1.62
Aman	9.42	8.50	8.79	9.55	8.85	7.74
Boro	6.77	6.54	7.22	7.46	8.14	10.55
Wheat	1.13	1.25	1.37	1.45	1.80	1.91

Source: BBS.

CHANGES IN IRRIGATION POLICY AND RELEVANT STRATEGIES

The NWP adopted in 1999 focuses on balanced use of water as well as flood and drought management. The policy provides guidelines for identification of future programs for optimum development and efficient management of water resources. An NWMP is under preparation to operationalize the water policy and ensures optional use of available water resources.

The Strategy of National Water Policy

The water policy of the government aims to provide direction to all agencies working with the water sector and to the institutions which are related to the water sector, in one form or another, for achieving specified objectives. These objectives are broadly as follows:

a) To address issues related to the harnessing and developing of all forms of surface water and groundwater and management of these resources in an efficient and equitable manner.

b) To ensure the availability of water to all elements of the society including the poor and the underprivileged, and to take into account the particular needs of women and children.

c) To accelerate the development of sustainable public and private water delivery systems with appropriate legal and financial measures and incentives, including the delineation of water rights and water pricing.

d) To bring institutional changes that will help decentralize the management of water resources and enhance the role of women in water management.
e) To develop a legal and regulatory environment that will help the process of decentralization, sound environmental management, and improve the investment climate for the private sector in water development and management.
f) To develop capability that will enable the country to design future water resources management plans by itself with economic efficiency, gender equality, social justice and environmental awareness.

Organizational Structure of Irrigation Administration

Water resources management extends across much water using sectors as well as political jurisdiction and geographically and hydrologically diverse areas. Table 8 shows the concerned Ministries and water-related agencies with the activities related to national water management.

Table 8. Government Agencies Involved in Water Management

Organization	Ministry	Setup	Main Activities Related to Water Sector
Water Resources Planning Organization (WARPO)	Water Resources	National level	Producing strategy and plan, monitoring and regulation of water regimes.
Bangladesh Water Development Board (BWDB)	Water Resources	Up to *thana* level	An agency for water resources development and assessment of major projects.
River Research Institute (RRI)	Water Resources	National level	Surface water modeling and river training studies.
Surface Water Modeling Center (SWMC)	Water Resources	National level	Deals with mathematical modeling.
Local Government Engineering Department (LGED)	Local Government and Rural Development	Up to *thana* level	Dealing with minor schemes up to a maximum of 1,000 ha in each unit.
Bangladesh Agriculture Development Corporation (BADC)	Agriculture	Up to *thana* level	• Planning and monitoring of minor irrigation. • Small-scale water use planning. • Implementation of surface and groundwater development.
Department of Agriculture Extension (DAE)	Agriculture	Up to union level	Information dissemination on agriculture technology including land and water use.
Department of Environment (DE)	Environment		Dealing with environment

Source: NWMP.

RECENT DEVELOPMENT IN PROMOTING PARTICIPATORY IRRIGATION MANAGEMENT (PIM)

Participation is an important voluntary process in which local stakeholders influence policy formulation, alternative plans/designs, investment choices and management decisions affecting their communities and establish the sense of ownership. With increased participation of the local stakeholders in managing water resources, project selection, service delivery and cost sharing, the efficiency of projects would be increased. In particular, the essence of participation is to exercise voice and choice. Most of the underdeveloped and developing countries follow top-down policy in formulating schemes. Bangladesh is no exception and this age-old policy of top-down approach has failed to deliver goods and services to the beneficiaries at desired level.

Modern concept of project management suggests more involvement of the target groups in the policy formulation and implementation process of the project. To address the problem, a more participatory approach has to be adopted to ensure wider participation of the users and beneficiaries at all stages of implementation. Until recently there have been very few attempts to involve end-users which are evident from the following actions:

i) Decision-making at all level has been divisible.
ii) Pre-feasibility and feasibility stages have been done without the notice of the people in the area.
iii) Detailed design and construction, with key decision on project options have been made without stakeholders' input. Traditionally people are brought to the table only during project implementation, operation and maintenance (O&M) stages.
iv) A full commitment on the part of project initiators to genuine peopleís participation has not been made. Due to this reason, BWDB is facing numerous problems in the operation of the major projects.

The planning and implementation of water management strategies in Bangladesh has tended to follow a top-down technocratic pattern and has often been accused of being unresponsive to public opinion. With the development of NWMP, the government has taken up steps to change this trend. The Government of Bangladesh published the first "National Water Policy" in January 1999. It provides policy directives for all the agencies and institutions for Public Water Resources Projects. The NWP guides both private and public actions to ensure optimum development and management of water that benefits individuals as well as society at large.

The NWP, through its various provisions, emphasizes the issue of participatory water management and highlights the importance of stakeholders' participation. The following provisions have been made in NWP in this respect:

- Planning and Management of water resources.
- Public and Private involvement.
- Economic and financial management.
- Stakeholdersí participation.
- Institutional policy.

Stakeholders

Types of stakeholders:

- Local stakeholders.
- Water users organization.
- Local government institution (LGI).
- NGOs/community level self-help groups.
- Implementing agencies.
- Other public sector agencies.

Type and Levels of Water Users Organization

To be meaningful and sustainable, local stakeholder participation has to be institutionalized. Water users will be encouraged and assisted to form different types of water users organizations. The institutional framework in which the local stakeholders participate in water use/management is the "Water Users Organization (WUO)". The WUO comprises of Water Users Group (WUG), Water Users Association (WUA) and Water Users Federation (WUF). These will be the institutional mechanisms at various levels of the local stakeholders for participatory water management. Organogram of WUO is shown in Figure 5.

The WUG/WUA/WUF as the institutional channel for stakeholders is the driving force in water resource management. They have decision-making power at all stages and all aspects of local water resource management that concern them. The WUOs will be responsible for planning, implementing, operating and maintaining local water resources schemes in a sustainable way. And, depending on the type of the project/sub-project/scheme, they will contribute towards the investment and O&M cost of the project/sub-projects/schemes, as decided by the government from time to time.

Importance of Capacity Development

In order to achieve the objectives of the participatory water management, capacity development of WUOs is essential in respect of organizational, technical and financial aspects. Capacity development is not only to develop the capacities of WUOs but also to ensure the improvement of the capacities of these who work with them, such as LGIs, NGOs and the implementing agencies. Capacity development approach should, therefore, be taken as a comprehensive task and aimed at enhancing capacities of all the key stakeholders in participatory water management.

Local Government Institutions

The LGIs will carry out supporting and facilitating roles for the concerned WUO in respect of participatory water management at the local level. The purpose will be to ensure sustainable management of local water resources in line with the overall development of their areas and inhabitants.

Orientation and Training Needs

Since the participation of the local stakeholders and others involved is a lengthy and complicated process, appropriate program for orientation and training of all concerned will be of utmost importance for ensuring effective participatory water management. Such orientation-training program will cover all the stakeholders, which will include:

Composition of WUF

- Representatives from the general members of the WUA will be the general members of the WUF.
- Representatives from the LGIs will be the advisors of WUF.

Composition of WUA

- For either the apex level of project/sub-project/ scheme or the mid-level for each sub-system of the project/sub-project/scheme
- Farmers, fishermen, small traders, craftsmen, boatmen, aquaculturist, landless people, women, PAP etc. will be the general members of WUA or representatives from the general members of the WUG will be the general members of WUA.
- Representatives from the LGIs will be the advisors of WUA.

Composition of WUG

- For each smallest hydrological unit or social unit (para/village) of the project/sub-project scheme.
- Farmers, fishermen, small traders, craftsmen, boatmen, aquaculturist, landless people, women, PAP etc. will be the general members

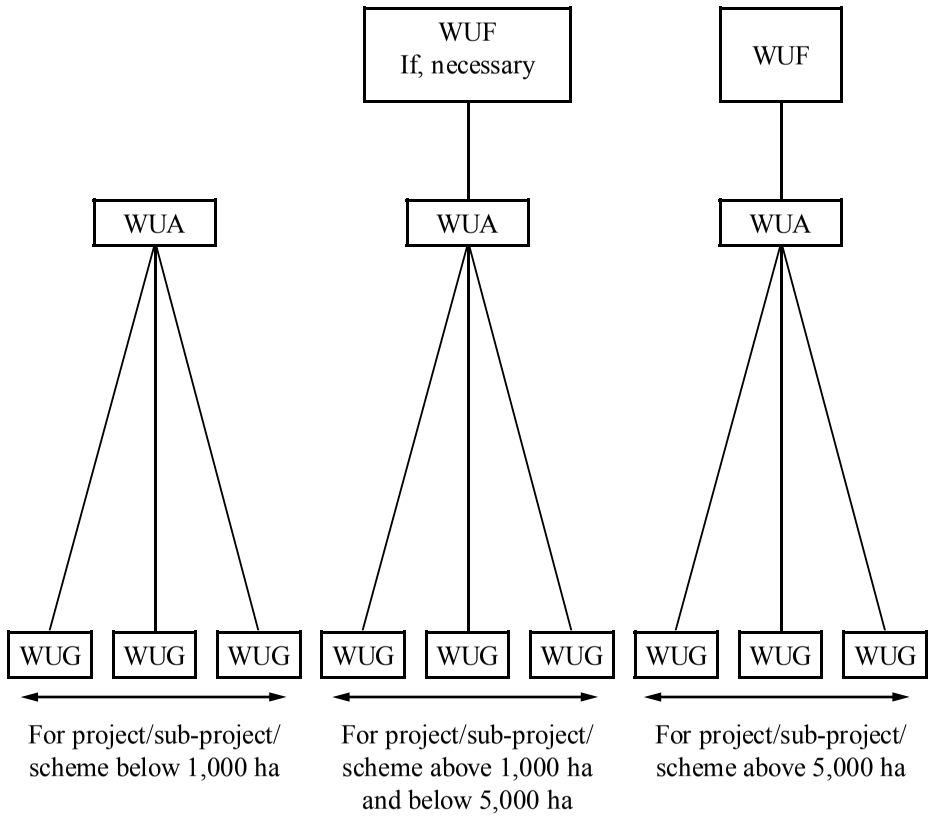

Figure 5. Organogram of WUO

- WUOs.
- Representatives of the LGIs.
- Representatives of NGOs and community self-help groups.
- Members of Labor Contracting Society (LCS) labor groups/laborers and contractors.
- Officials of the implementing agencies.

Such orientation/training programs will cover all relevant issues from the identification stage to the monitoring and evaluation (M&E) of the water resource schemes. The orientation/training programs for different stakeholders will be planned and implemented in an integrated manner, so that efforts made in this respect for different categories of the stakeholders will be mutually supportive to each other. Separate orientation/training modules for various topics/issues and stakeholders will be prepared as considered necessary and implementation of orientation/training courses will be done on the basis of the Annual Orientation/Training Calendar.

At present, there is no separate rule or act for registration of WUOs. Most of the WUOs are unregistered. Some WUOs are registered under the Co-operative Societies Ordinance. To ensure effective WUOs the government is considering formulation of a separate and appropriate act for registration of WUOs for PIM.

PARTICIPATORY PROCESS

Stakeholder Participation in Different Stages of Project Cycle

Participation of the local stakeholders is a continuous process in the pursuit of sustainable development. For water resources development, participation starts from the very early stage of identification of land and water resources in general, and schemes or projects in particular. Water sector projects involve two parallel but inter-related processes – one dealing with engineering, agricultural and environmental issues and the other concerning local stakeholder participation including its institutional framework. The process covers both structural and non-structural measures. When the process is defined within a project cycle, it can be framed in six stages as follows:

- Identification.
- Feasibility study.
- Detailed planning, design and stakeholders institution building.
- Implementation and trial operation.
- O&M.
- M&E.

1. ***Identification***

The identification stage included early participation of all level stakeholders for taking an inventory of problems/constraints, full range of alternative actions as potential solutions, assessment and reconnaissance process.

2. ***Feasibility Study***

During the feasibility study stage, stakeholders' participation includes crystallizing the project concept and integrating the needs of all sub-sectors (using water), on the basis of a full range of environmental assessment and alternative studies.

3. ***Planning, Design and Institution Building***

During the detailed planning, design and institution building stage, stakeholder participation includes assisting the professional teams of the implementing agency to get the necessary local experience, insights and best-practice-examples for locating the water infrastructures in user-friendly way.

4. ***Implementation and Trial Operation***

Implementation includes pre-construction, construction and trial operation activities. During the implementation and trial operation stage, local stakeholder participation is to make sure that construction is done as per the detailed design.

5. ***Operation and Maintenance***

During the O&M stage, local stakeholders' participation will include active participation in water management/use and O&M of facilities on the ground. The participation will be in different ways according to the size, nature and complexity of water resources project/sub-projects/schemes.

6. ***Monitoring and Evaluation***

During the M&E stage, local stakeholders' participation involves identification of areas that need further improvement and to undertake those improvements. The issues to be covered at this stage will include the following:

- Physical progress of construction work – quantity and quality.
- Progress of membership of WUO.
- Progress of women participation in WUO.
- Progress of beneficiary contribution.
- Progress of agricultural production.
- Progress of fishery production.
- Progress of other activities undertaken by WUO.
- Participate in M&E surveys/activities planned by the implementing agency.

FUTURE PROSPECT OF PIM AND MEASURES PROPOSED FOR IMPROVING PIM

The ownership of water vests in the state, the individual has only water use rights. Bangladesh is characterized by the absence of well-defined water use rights. Besides, there are different claimants to this resource with different objectives. Hence during water shortage periods, conflicts do and will arise among different claimants. The conflicts in this sector are three folds, among different categories of users, between users and managers, and among different managers or planning and implementing agencies. At present, mechanisms for resolution of conflicts among stakeholders are weak and inadequate. There is a little or no coordination among the various agencies involved in water use. Moreover, their responsibilities are not clearly specified and known to each other. The need, therefore, is to evolve a framework of guidelines and legal provisions, which can be evoked, as necessary, for avoidance/prevention and resolution of conflicts among water sector stakeholders. Such a framework will have to be based on a participatory approach and transparency and accountability in whole process, involving all stakeholders (users and managers) at appropriate levels. In addition, clear-cut guidelines will need to be framed to define the nature and type of coordination between local government bodies and central government agencies involved in water management. This will ensure a strong mechanism for both avoidance and resolution and conflicts. Based on the

circumstances stated above, PIM will be strengthen in future implementation of water management projects.

Good governance is a prerequisite for developing a just and cohesive society. The following "drivers" help create an ambience of good governance through transparency, accountability, and participation of all members of society, especially the disadvantaged segments including women and the poor. In addition, human capability and appropriate institutional and legal frameworks need to be developed to foster democratic values and practices. The following are among the key areas to focus on the context of governance drivers.

i) State of community participation in watershed management;
ii) Political commitment of efficient water management;
iii) Level of public awareness regarding water conservation and management;
iv) State of public-private partnership in water resources management at the grassroots;
v) Capacity of the institutional framework for water planning and management;
vi) Extent of involvement of local government bodies in planning and managing water sector projects;
vii) Involvement of women in water resources management;
viii) Involvement of youth in water resources management;
ix) Efficiency of decision-making frameworks;
x) Status of regional cooperation in harnessing and managing common water resources; and
xi) Efficiency in the implementation/projects/programs.

Much greater emphasis will have to be given to a bottom-up approach, the involvement of NGOs and private sector and to social and environmental issues, rather than just technical and economic factors in the planning and selection of irrigation development activities and projects. People's participation, with its extensive consultation process at all levels, combined with effective inter-agency coordination, will have to be the means by, which effective bottom-up planning can be achieved. The people will have to be offered to identify their water-related needs, problems and constraints and suggest and seek suggestions for future water resource development. These would include institutional and legal options as well as technical options.

Based on these findings, the planners would then formulate a range of development options for presentation and discussion. The aim would be to give the participants the full details and implication of each option.

CONCLUSION

It is clear from the past experience that water management cannot be carried out effectively if the local stakeholders are not involved in the process. Their active involvement is needed at all stages of the project cycle starting from identification to O&M of water resource schemes. The Government of Bangladesh has issued the "Guidelines for Participatory Water Management", which has been prepared within the framework of the NWP, 1999. These guidelines indicate how the local stakeholders, representatives of the local government organizations, private sector and the public sector agencies will work together for participatory water management in Bangladesh.

The local stakeholders, elected representatives, officials of the implementing agencies, academicians, development partners and others involved in participatory water management would share their experience for future improvement of irrigation development schemes.

Successful implementation of the PIM schemes calls for a phenomenal change in the organizational setup of the implementing agencies at the grassroots level. The people must be made receptive to the change of policies and methodologies of the irrigation management schemes based on concept of stakeholders' participation.

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2. REPUBLIC OF CHINA

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INTRODUCTION

The origin of participatory irrigation practices in Taiwan can be traced back to hundreds year ago since the Ching-Dynasty. Some famous historical irrigation canals in Taiwan were named after its constructor. Farmers gather their own money and land for their own irrigation needs. Canals and ponds were constructed by the farmers themselves for food production. Organization was also formed by the farmers for management of these irrigation facilities. Nevertheless, there were events of water diversion conflicts among different farmer groups at the upstream and downstream. Today, irrigation associations formed by the farmers are the basic irrigation management institution in Taiwan.

PARTICIPATORY IRRIGATION MANAGEMENT: PRESENT STATUS

There are now 17 irrigation associations in Taiwan with comprehensive irrigation network and facilities, their own staff, and budget. Some irrigation associations even own reservoirs. The irrigation association collects membership fees from its members and supply water to their farms for irrigation needs. The associations build and maintain their water-distributing infrastructure and manage irrigation with their own personnel as private sectors. The membership fee is collected on area basis. The president of the association is elected by the farmers and is responsible for all the administration and the management of the association. A legislative body consisting of councilors is also elected by the farmers. This council supervises the operations of the association. In order to be eligible for election, the candidates for the president and the councilors should hold membership of the association. The collection of membership fee has been discontinued since 1990. The government subsidizes this financial deficiency by its annual budget. This change increases the government subsidy to the irrigation operations (Table 1 and Figure 1).

The organization chart of a typical irrigation association is shown in Figure 2. There is a chief engineer and a general manager under the president of the association. The Engineering Division does all the engineering work to keep the irrigation system functioning. Such work includes designs, constructions and maintenance of distribution canal system and related control structures. The management division is responsible for the irrigation planning, scheduling, operation and management. The Financial Division handles the budget, accounting, and manages the properties of the association.

The command area is divided into workstations, each with an average area of 2,000 ha. A workstation is then subdivided into 10-15 working groups. The working group is the basic operational unit of the irrigation association. The staff delivers water to the check gate of the

group and the farmers themselves undertake the responsibility of distribution from there. The existing irrigation and drainage facilities in Taiwan, as of 1999, are listed in Table 2.

Table 1. Budget for Irrigation from Government

Year	Budget (US$ million)	Percent of Total Government Budget
1986	20.4	0.10
1987	21.3	0.10
1988	45.8	0.18
1989	60.5	0.15
1990	92.5	0.24
1991	113.2	0.24
1992	145.4	0.26
1993	156.1	0.25
1994	172.7	0.27
1995	184.1	0.27
1996	191.5	0.29
1997	180.7	0.26
1998	180.9	0.25
199		
200		

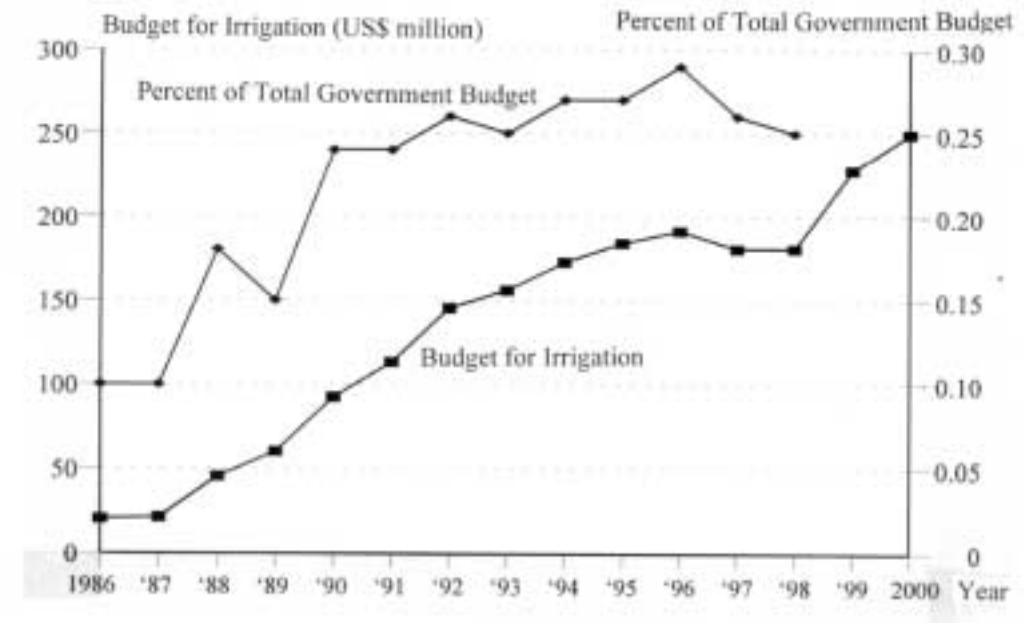

Figure 1. Budget for Irrigation from Government

THE EXTENSION OF PIPELINE IRRIGATION

Traditionally, paddy rice was the most important crop in Taiwan. However, because of the change of living style, the consumption of rice decreased tremendously in the last decade. High cost of labor and low market value caused the shift of some paddy fields into

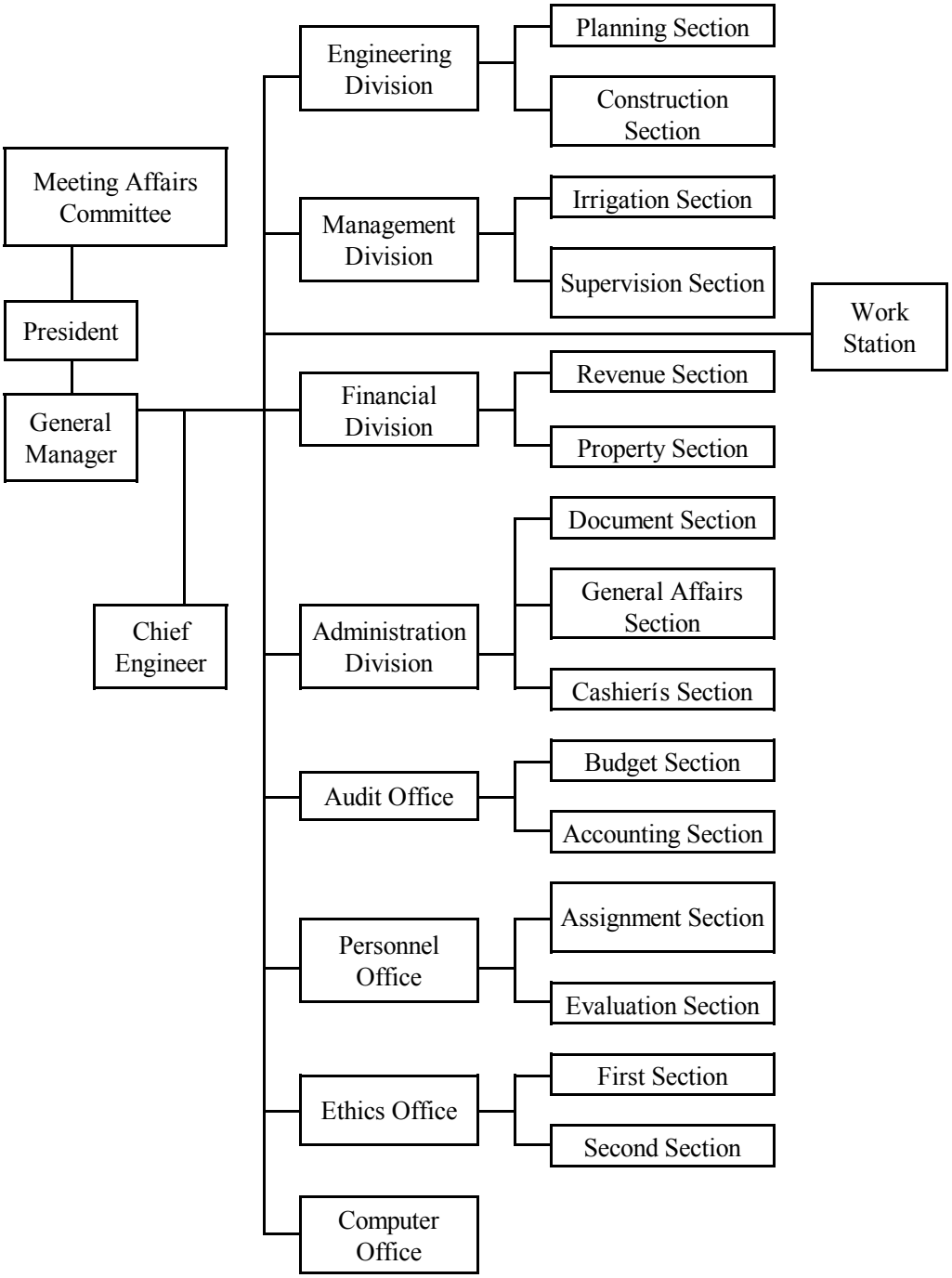

Figure 2. Organization of the Irrigation Association in Taiwan

crops with higher economic values like orchards. The irrigation needs and practices for upland crop like orchards are much different from that of paddy. Pipeline irrigation is a more efficient way for upland crop, especially in slope land area where most of these high value crops are cultivated in Taiwan. Over 20 years back, the government started promotion projects for pipeline irrigation such as sprinklers, perforated pipes and trickle. The farmers are eligible to apply for subsidies with a proper pipe system design.

Table 2. The Existing Irrigation and Drainage Facilities in Taiwan

Type	Item	Number	Length (m)	Unit
Irrigation	Leading canal	474	296,087	
	Main canal	1,038	4,092,164	
	Lateral	2,415	4,640,057	
	Sub-lateral	4,505	4,898,917	
	Ditch	59,018	31,761,939	
	Total	67,450	45,689,164	
	Lining canal	5,404	21,734,102	
Drainage		31,535	23,091,212	
Structures	Headwork			1,886
	Gate			34,405
	Bridge			36,286
	Drop			19,743
	Siphon			5,894
	Culvert			59,902

The government gives the farmer an allowance up to 49 percent of the total expenses to facilitate a pipeline irrigation system. This project has been carried out continuously for over 20 years and proved to be a very successful participatory irrigation practices. The government will not subsidize the farmers unless they show their will for irrigation system improvement. The farmer has to hire a contractor to design the pipeline irrigation system first and then apply for subsidy. Sometimes the engineering personnel of the irrigation association will do the job for the farmers. The government will not give the farmers allowance until they finish the construction and the system is well functioned. The extension of pipeline irrigation makes the marginal land productive and improves the farmers' incomes (Table 3). In some areas, the use of pipeline irrigation system reduces the water needed for irrigation because it has a higher application efficiency. Multi-objective pipeline systems are now commonly seen in Taiwan. Such systems, for example, combine the use of the sprinkler system for irrigation as well as fertilizer and pesticide applications especially for orchards, tea etc.

IRRIGATION IN TAIWAN: THE PAST, THE PRESENT, AND THE FUTURE

Food production was the only and most important objective of agriculture in Taiwan. Exports of agricultural produce earned tremendous foreign exchange and became the solid foundation for todayís industrial development in Taiwan. Almost all the cultivated land in

Taiwan is irrigated. Most of the paddy fields are located within the command areas of irrigation associations and are irrigated by the associations.

Table 3. Benefit from the Extension of Pipeline Irrigation

(Unit: NT$ per year)

Crop		Installation Cost	Irrigation Cost	Produce Value	Benefit	Improvement
Tea tree	Furrow	5,000	77,000	460,000	378,000	-
	Perforated	26,500	57,400	520,000	436,100	58,100
Wax	Furrow	0	4,220	600,000	595,780	-
	Perforated	12,800	2,460	724,500	709,240	113,460
Guava	Furrow	0	13,500	392,645	379,145	-
	Sprinkler	11,500	6,660	615,725	597,565	218,420
Asparagus	Furrow	0	11,058	162,000	150,942	-
	Perforated	3,910	7,993	205,500	193,597	42,655
Onion	Furrow	0	25,340	260,000	234,660	-
	Perforated	5,427	19,460	333,400	308,513	73,853
Carrot	Furrow	0	24,325	315,000	290,675	-
	Perforated	4,767	19,750	360,000	335,483	44,808

Reservoirs, diversion weirs, and wells are used for water supplies. For the farms outside the command areas fed by the surface water, groundwater is usually used for irrigation. The irrigation associations have served the agricultural production for decades but are now facing a major challenge of water supply shortage.

The water supply in Taiwan becomes more and more deficient than ever, mainly due to the rapid growth of population, and commercial and industrial activities. As it is more difficult nowadays to develop new water supply sources because of lack of dam sites and the environmental concerns, there is an urgent need for improving water management efficiency. The water supply, usually, is not steady and water shortages do occur from time to time. Since the agriculture sector holds the major portion of the total water right (about 78 percent in Taiwan), other sectors such as municipal, commercial and industrial usually turn to agriculture for temporally water loans during a drought. It is then necessary to increase the efficiency of irrigation management or even to stress the crops to cut down the irrigation demand during the drought.

As the food supplies become more sufficient in Taiwan, food production will no longer be the single purpose of irrigation, especially in the next century. The food production will be limited to the amount required for self-sufficiency. The irrigated area and irrigation demand are decreasing (Table 4 and Figure 3, Table 5 and Figure 4). For future development, the agriculture must be balanced among the triangle of food production, environmental protection and improvement, as well as the everyday living of the society. For example, canals will be integrated with the regional drainage systems and esthetics will be an important issue for the reformation of the canal network.

The State-of-the-art Irrigation Planning: Geographic Information System (GIS)

A substantial amount of data on soil, crop, weather, and water distributing network, etc., are being used in irrigation planning. Most of these data are spatially distributed. Maps are

the traditional tools for spatial data handling. Although maps give people spatial presentation of this spatial information, there are problems using paper maps for spatial analysis. Paper maps are difficult to store and manage, and maps of different scales cannot be overlaid for spatial pattern analysis. GIS is an answer for these needs of spatial data handling and analysis. With topology and attribute data management, GIS can solve most of the difficulties that may occur when using paper maps. Arc/Info and Arc/View GIS software from ESRI etc., are used for more efficient irrigation planning.

Table 4. Irrigated Areas in Taiwan

(Unit: Ha)

Year	Paddy	Upland	Total
1992	448,944	219,265	668,209
1993	463,557	206,552	670,109
1994	421,595	226,020	647,615
1995	452,486	220,149	672,635
1996			
1997			
1998			

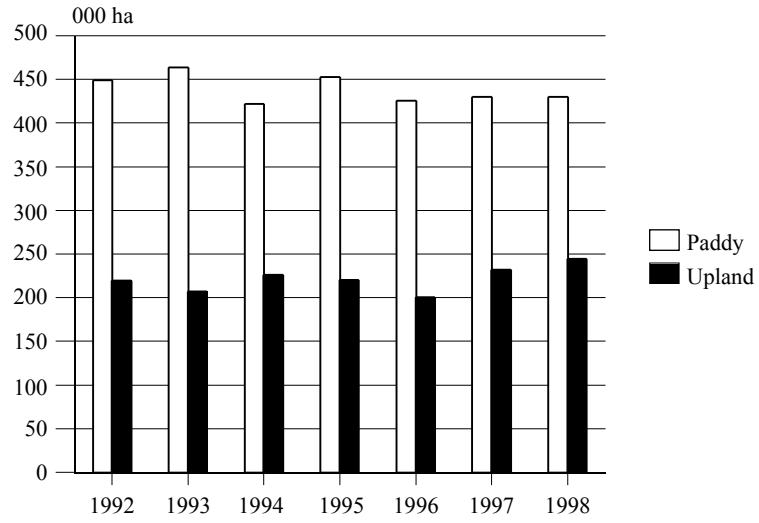

Figure 3. The Irrigated Area in Taiwan (1992-1998)

Table 5. Water Used by Agriculture Sector in Taiwan

(Unit: Million mt)

Year	Irrigation	Aqua-farm	Livestock	Total
1982	14,048	2,225	78	16,351
1983	13,461	2,383	88	15,932
1984	12,617	2,380	93	15,090
1985	12,559	2,361	93	15,013
1986	12,371	2,431	99	14,901
1987	12,155	2,566	105	14,826
1988	11,776	2,793	107	14,676
1989	11,941	2,916	107	14,964
1990	12,128	3,149	116	15,393
1991	10,332	3,093	128	13,553
1992	10,303	3,064	134	13,501
1993	9,713	2,801	136	12,650
1994	9,941	3,097	140	13,178
1995	11,180	3,138	146	14,464
1996	10,199	3,145	151	13,495
1997	10,789	2,583	134	13,506
1998	10,674	1,460	109	12,243

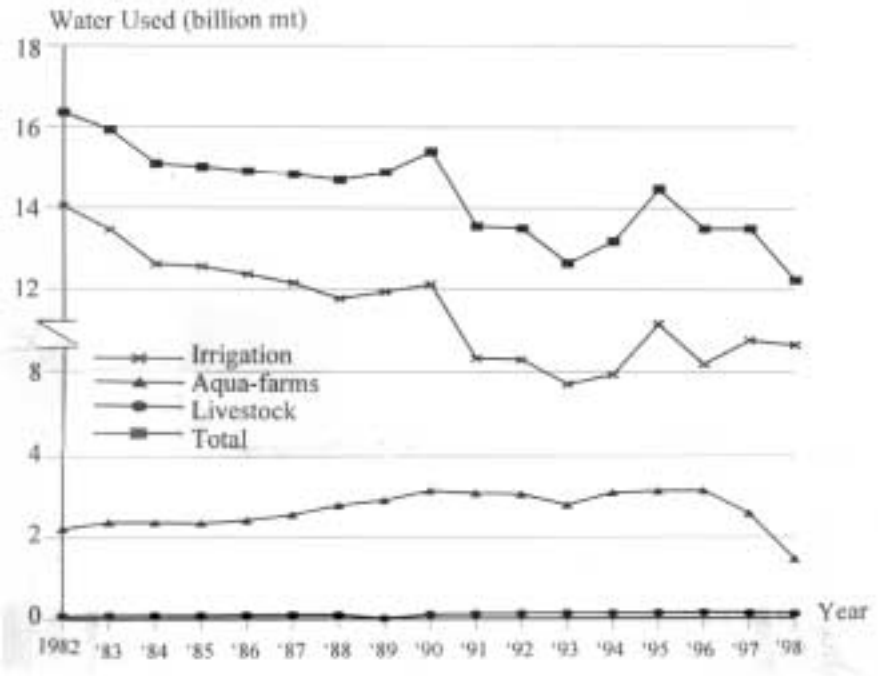

Figure 4. Water Used by the Agricultural Sector in Taiwan

Decision Support System (DSS)

Other than data, there are estimating models involved in the demand estimation process for irrigation management. Different models lead to different results. In Taiwan, other than the need for an efficient irrigation management, there is a demand for water resource reallocation from the shortage of water supplies. The water reallocation among different water use sectors is a highly controversial issue. The final decision usually comes from negotiations and compromise. It may need to study different scenarios and to switch demand-estimating model from one to another for comparison. A DSS is an instrument that enables the operator or manager of a water resources system to investigate the influence of factors or of decision alternatives that are not included in a model (Nathan Buras, 2000). A DSS consists of three major components: the database, the model base, and the interfaces. The decision-maker may set up scenarios through the user interface, and examines the possible impacts generated by the models from the model base for better decisions. In a negotiation or planning processes, different candidate models from the model base may also be used to examine the discrepancy for final reconciliation. Since the data involved in regional irrigation demand planning are mostly spatially distributed, the DSS so built is referred as a Spatial DSS (SDSS). An SDSS for agricultural demand planning will be presented in this paper. With all related data and models built in, it will be an efficient tool for better demand planning by setting up different scenarios and revealing the impacts under those scenarios.

Geographic Database

Maps and database relevant to irrigation demand planning are co-prepared. The geo-database consists of distribution maps of soil, cropping pattern, weather characteristics, canal network, and administration boundary. The command area of the largest irrigation association is used as the target area and the GIS is used for better capture of the spatial variation of data.

The Framework of SDSS for Irrigation Planning

The framework of the SDSS for irrigation planning consists of three major components: the database, the model base, and the Graphic User Interface (GUI). The GUI facilitates the setup of the scenarios. The user may easily change the cropping pattern through the help of map display and dialog system. The system will report the distribution of areas for different cropping patterns before and after the change made. Irrigation demands are then computed by the estimating model assigned and details reported by administration areas.

Regional irrigation demand planning is a very important issue for irrigation management especially when the water supply is limited. Adjustments should be made to cut down the irrigation demands. There are many alternatives that will produce similar demand but with different impacts. With a decision support tool better decisions may be achieved with minimal impact to the farmers and farming.

Figure 5 illustrates the concept and framework of SDSS related to irrigation planning.

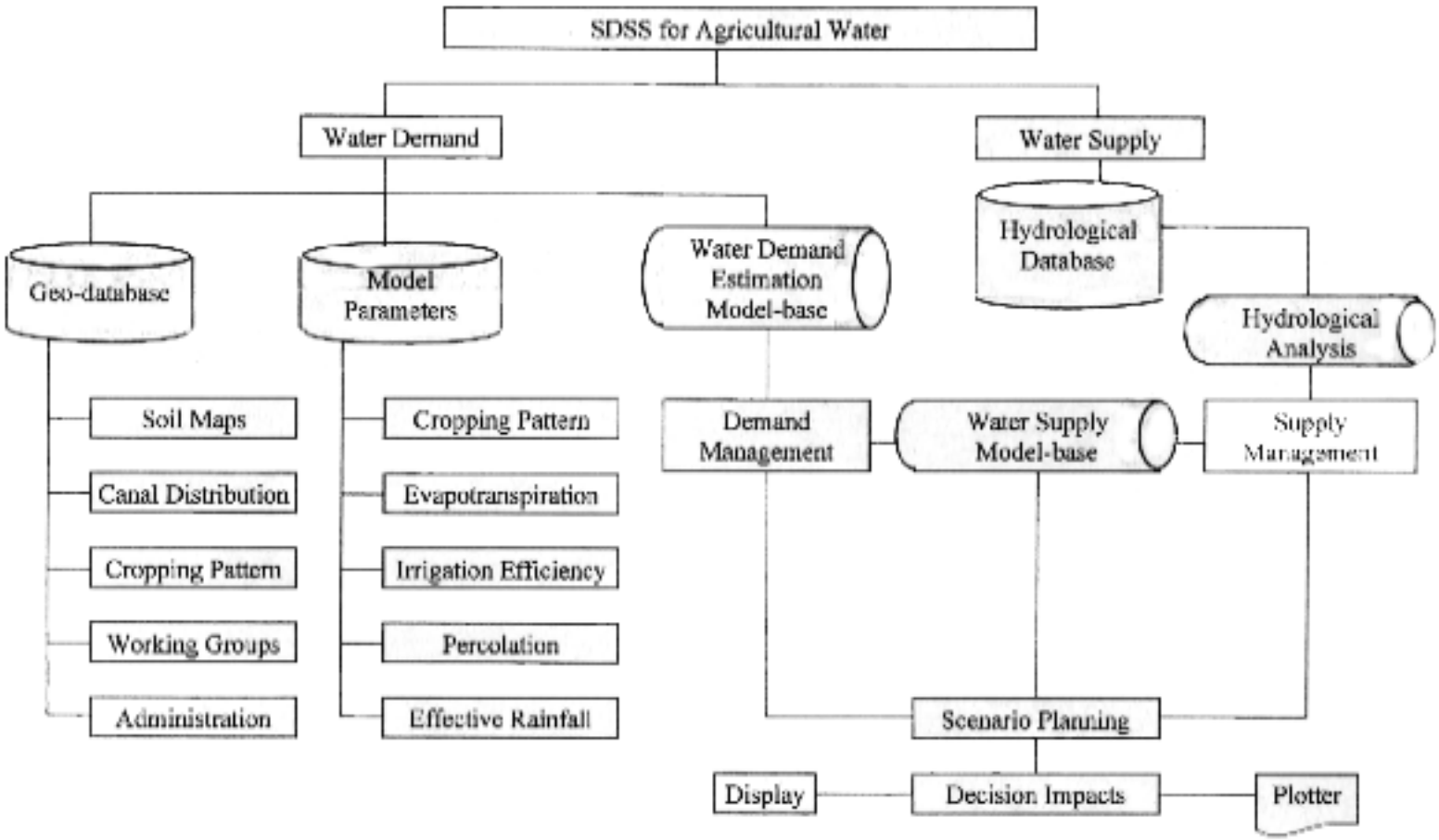

Figure 5. The Framework of the SDSS

3. FIJI

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INTRODUCTION

The Republic of Fiji is an island nation located in the Southwestern Pacific. The country consists of approximately more than 300 islands and has a total land area of 18,333 km^2. Islands vary in sizes from the two large masses of Viti Levu (10,425 km^2) and Vanua Levu (5,556 km^2) to tiny, one or two-ha islands clustered around the group. The larger islands are dominated by steep mountainous country deeply incised by rivers and streams. In Viti Levu steep mountainous areas comprises 67 percent while Vanua Levu comprises of 72 percent. Thus much of the surface run off following heavy rain over steep slopes produces eroding capacities of water. The steep slopes also lead to frequent landslides.

The government pursued an inward-looking economic development policy with a strong emphasis being given to import substitution, self-sufficiency and economic diversification. The political turmoil of 1987 was re-enacted during the recent events, which has had a greater impact to the economy. The country is still recovering from its repercussions, which will take two to three years to eventually arrest the decline in the economy.

The country has long been suffering from the "twin curses" of rapid urbanization and its very narrow economic base. Today the country's rural area has shrunk to just 50 percent of the total population. This is significant, since the figure shows a rather big percentage drop from the 1986 figure of 62 percent and follows a decreasing trend of more than 2.0 percent annually (Bureau of Statistics, *Census Report*, 1986). From an increasing urban population, the normal string of socio-economic problems of squatting, increasing crime rates, malnutrition, increasing pressure on the urban basic amenities and unemployment, amongst the many, are experienced. Fiji now encourages youth projects to: a) keep this age group within the rural area; and b) create economic activities so as to create employment in the rural sector.

AGRICULTURE AND NATURAL RESOURCES SECTOR

About 19 percent of GDP and 70 percent of exports are attributed to natural resource activities (agriculture, forestry, fisheries and mining). In addition to this is the contribution of tourism which, to a large degree, is a natural resource-based industry. Although climatic extremes and volatile commodity prices affect these sectors, Fiji's economic development for the foreseeable future will remain largely natural resource-based. The agriculture and fisheries sub-sectors provide backward and forward linkages with the other sectors of the economy, accounts for 50 percent of the total formal employment and generates three quarters of the export earnings.

Sugar

Sugar remains fundamentally important to the Fiji economy; sugarcane occupies over 50 percent of arable land. The industry directly employs 13 percent of the labor force, contributes around 9 percent of GDP and generates some 30 percent of total domestic exports.

The economic impact of the drought in 1997 and 1998 is an indication of how dependent the economy is on the sugar industry. With two successive years of low sugar production the economy contracted by 4 percent, despite a very strong performance of the tourism, garments, and yaqona sectors.

In a normal year around four million mt of sugarcane is harvested producing around 450,00 mt of sugar. The sugarcane is grown by some 23,000 farmers. Around 75 percent of these farmers are ethnic Indians, the vast majority of which are on leasehold land. Sugar enjoys premium price above world market, and disruptions to that, as effected by the recent political events will have severe impact on the economy.

Non-sugar Agriculture

The agriculture sector was subject to a comprehensive review by the ADB in 1996. The findings of this study are published in the Pacific Studies Series: "*Fiji Agriculture Sector Review – A Strategy for Growth and Diversification*". This study concluded that Fiji's competitive advantage in agriculture lies in the export of high value products to niche market and in traditional food production.

Despite the severity of the 1997/98 drought, the value of non-sugar agricultural exports continued to grow. This continued growth confirms the competitive advantage Fiji has in these products. In 1998, taro exports approached F$14.3 million (F$9.4 million in 1995) and yaqona exports reach F$36 million (F$2.4 million in 1995), while the value of ginger exports stood at F$4.8 million. During the course of 1998, over 390 mt of papaya, mango and eggplants passed through the industry-owned and -operated quarantine treatment facility at Nadi Airport. This produce had an estimate f.o.b. value of F$1.3 million. Fruit exports would have been significantly greater had not the Australian market remained closed due to quarantine restrictions.

The 1996 Review attributed the improved performance of the sector to the move towards "private sector-led agriculture development" that commenced in 1989. A facilitating role for government was identified. However, in this respect it was concluded that "the re-allocating of existing resources and focusing and coordinating efforts will be largely sufficient to achieve the necessary changes to secure the future of Fiji's' agriculture sector" (ADB, 1996, p. 54). The 1996 Sector Review was accepted by the Cabinet and its findings were embodied in Fiji's Strategic Plan, where the goal for the agriculture sector is defined as "sustainable rural livelihoods, through efficient food security and competitive exports" (Parliamentary Paper No. 20, p. 22). The policy objectives for the sector in the Strategic Plan are listed as follows:

> "*Accelerate agricultural diversification in areas of competitive advantage (high value niche exports and traditional food crops). Private sector-led development, with government and other agencies playing a facilitating role*".

THE CDF PROGRAM: A MAJOR POLICY REVERSAL

Despite this recent history, 1997 saw a major reversal in Fiji's agricultural policy back to "government-led" agricultural development. A four-year (1997-2000) investment program, known as the Commodity Development Framework (CDF), was initiated. An allocation of F$69 million capital expenditure over a four-year period was approved for this program in the 1997 budget. This represented a quadrupling of Ministry of Agriculture, Fisheries and Forests (MAFF)'s capital budget. The commodity focus as coconuts, ginger, taro, yaqona, fruits, vegetables, dairy, beef, sheep and seaweed. Significantly a substantial budgetary allocation was made to rehabilitate the failed NATCO to act as MAFF's marketing arm. The rationale for this large increase in public expenditure on agriculture was to "jump start" the sector. Since so many people rely directly or indirectly on agriculture for their sustenance and income it was felt that direct support for agricultural development would be an effective way of stimulating employment.

The CDF program is important for two main reasons:

(i) It reflects the policy shift of the government from intervention to deregulation and export-led growth. While this policy shift emphasizes privatization, the thrust of this program is directed at evoking market-oriented responses in the bid to encourage and develop the private sector.
(ii) CDF can presumably be considered in terms of diversification, which should be the basis of agricultural development in Fiji. The case for diversification is emphasized not only by the need to move away from reliance on sugar, either to the main mono-product export, but also the fact that the performance of tourism is erratic.

IRRIGATION POLICY

Irrigation is about the supply and demand for water as a variable input into the crop production. Irrigation policy is essentially to deal with the role of the state in promoting or providing irrigation facilities or infrastructure. It is also about policy choices that exist with respect to alternative irrigation technologies, the management of large-scale irrigation schemes, and alternative methods for recouping from farmers the cost of providing them with irrigation through irrigation rate.

Irrigation may be defined as the use of human technology to increase and to control the supply of water for crop production. Irrigation policy is linked to:

(i) Input policy, due to input complementarity;
(ii) Credit policy, due to the increased working capital requirements of irrigated crops;
(iii) Mechanization policy, because it involves some of the same issues of technology choice;
(iv) Land reform, because irrigation schemes often involves changes in land tenure or land resettlement;
(v) Market policy, since a workable market infrastructure must exist to handle the sale of output from an irrigation scheme;
(vi) Price policy, since irrigation may make farmers more responsive to price changes; and

(vii) Research policy, since the priorities of research are likely to be predicted in part on the overall proportion of irrigated farmland and on future irrigation plans.

Organization Management within MAFF

The Land and Water Resource Management Division was created within the MAFF in 1972, initiative for developing irrigated rice project, including facilitating rice cultivation in general under rainfed condition. Initially, two main projects were taken up for rice irrigation, namely Lakena Irrigation Project in the Central Division and Dreketi Irrigation Project in the Northern Division, where also some minor projects like Dama, Coboi and Naruwai Irrigation Projects too were taken up. All these projects were implemented under pumping criteria where water was pumped from river or creeks and used for irrigation via artificial channels and drains. Dreketi Project had been converted to gravity irrigation under Australian aid, where a weir had been constructed across Naibulu creek and water lead into the irrigation channels by gravity.

Participation

According to Rahnema (1992:117) the word participation and participatory appeared for the first time in the development jargon during the late 1950s. The social activists, field workers and developers joined the development bandwagon in the hope that they could help the oppressed unfold, like a flower from a bud, had some against a reality which was totally different from the earlier expectations. This led them to attribute most of the failures to development projects to the fact that the populations concerned were kept out of the process related to project design, formulation and implementation. With their great majority, they started to advocate the end of 'top-down' strategies of action and the inclusion of participation and participatory methods of interaction was realized as an essential dimension for the development process.

Furthermore, Rahnema (1992) points out that some practitioners referred the participatory development concept as 'popular participation' so as to save development from the prevailing social crises and to give new stand for enabling the grassroots population to regenerate their life spaces.

Fals-Borda as one of the founders of Participatory Action Research (PAR) views it as 'a methodology within a total existential process', that means at 'achieving power and not merely growth for the grassroots population'. According to Oriando Fals-Borda, it is a special kind of poor-people's-power which belongs to the oppressed and exploited classes and recoups and their organizations, and is the defense of their just interests which enables them to advance towards shared goals of social change within a participatory system.

Irrigation in Central Division

Currently there are two major irrigation projects in the Central Division namely Navua East and Navua West Irrigation Schemes. Navua East Irrigation Project commenced in 1985 under Agricultural Development Program financed partially by ADB and aimed at developing 750-ha rice irrigation. A major objective of the Wainikavika Dam is to provide irrigation water to enable double cropping. So far irrigation facilities have been developed 300 ha.

The Wainikavika has been constructed up to second stage and has 3 million m^3 storage capacity irrigating 750 ha. Headworks consist of earthen dam built of homogenous clay

concrete spillway, sluice gates and outlet channel. The project is in operation, supplying water to 300 ha of rice fields that have been developed.

Drainage infrastructure is already in place for 750 ha through 32 km of drains, 8.5 km of seawall and four outfall structures. 300 ha developed so far include 14 km of canals, 52 canal structures and a subterranean siphon pipeline across Navua River.

The Navua West Irrigation Scheme comprises 110 ha of rice field and was initially irrigated by water pumped from the Navua River. After completion of Navua River siphon in 1991 and restoration in 1993, irrigation of Navua West Scheme is provided by water from Wainikavika Dam. Apart from the maintenance works involved in the siphon and other general maintenance work such as weeding and desilting of canals and drains are carried out as a routine.

Irrigation in the Northern Division

The Northern Division Irrigation Project commenced in early 1980s under government funding. By mid-1980s funds were supplemented under AIDAB, which provided more than F$5 million till 1992. So far four irrigation schemes have been completed at a cost of F$8 million and covering an area of more than 1,419 ha.

Irrigation schemes consist of irrigation and drain canals, canal structures, field structures and various other infrastructure. These components facilitate to convey irrigation water from dam reservoir; river or other source of used water to areas where crops require irrigation; such as rice paddies and vegetable plots.

In order to continue efficient supply of water for irrigation, routine maintenance of canals and various other infrastructures must be carried out on time. Moreover, associated drainage system also needs to be maintained for continued drainage efficiency so as to enable agricultural production without threat of damage due to water-logging, flooding and saline water intrusion. Similarly, irrigation access roads require repair and grading. Other special infrastructure such as dam, spillway, siphon, pond, pump and others have specific maintenance requirements.

Furthermore frequent natural disasters such as cyclones cause flooding resulting in heavy situation in drains and irrigation canals and as well as neglect of maintenance due to lack of funds in past years. Hence, timely maintenance is indispensable for efficient irrigation and optimum agricultural production.

Even though farmers are levied with irrigation rates, revenue collected from such rate go directly to central revenue.

The Extension Division currently coordinates participation of farmers in operation and maintenance irrigation projects. Meetings and workshops are being conducted to assist farmers organizations in an attempt to train farmers to undertake operation and maintenance of irrigation projects in the future.

Problems and Constraints

Some general constraints to irrigated agriculture, with special reference to farmer participation are listed below. This is followed by the concluding section on suggestions for the future.

i) The deteriorated state of infrastructure, which had been in operation for over 20 years with no major rehabilitation;

ii) More part-time farmers than full-timers;
iii) Financial constraint on part of farmers is high due to high cost of production (high input costs);
iv) Market price not attractive;
v) The overstretched extension resources in terms of personnel and equipment given the task to perform; and
vi) Imported rice is cheaper and therefore, the food security is affected.

CONCLUSION

It is to be admitted that Fiji still belongs to the groups of developing countries. As such, there is much that the government can and should learn from other countries, developed or developing. A useful exercise in this regard is sharing international experience such as the present seminar, which enable participants from many countries to exchange experiences on irrigation management. It is important to realize that the benefits of irrigation are a function of soil properties, crop varieties, fertilization and cultural practices. Therefore, farmers should be trained on these variables to make the irrigation more fruitful and develop the sense of project ownership. It is suggested that the future strategies should take into consideration the following:

Future Direction

i) Obtain maximum production from limited area (more/unit area);
ii) Introduction of gravity-fed schemes to reduce costs;
iii) Strengthen extension work to increase awareness of farmers to plant more rice;
iv) Both farmers and staff training;
v) Formation of farmer groups to take over and maintenance of irrigation projects; and
vi) Farmers' organization and group management of irrigation scheme.

4. INDIA (1)

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INTRODUCTION

Despite the significant advancement accomplished on agricultural front and macro-economic contributions in the past, the irrigation sector faces existing and emerging challenges from both within and outside. Since the dawn of Independence, the importance of water resources development was accorded due recognition and massive irrigation projects were created. It is unequivocal that irrigation is the major instrument in achieving self-sufficiency in food production in India. However, the per capita availability of water per year in India is abysmally low (2,200 m^3) compared to Japan (65,000 m^3), North America (62,000 m^3) and Russia (17,500 m^3). India is endowed with 4 percent of world's water wealth but the manifold demands imposed by the exploding demographic pressure may further reduce the per capita availability by 50 percent in 2025. Thereby, India may become a water-scarce country. The Water Resource Commission (WRC) estimated that the water requirement for agriculture sector will be two-fold and for other sectors such as domestic and industries seven-fold in 2025 at the current rate of water use. Therefore, there will be an acute inter-sectoral competition for water sharing. This will make agriculture a more precarious enterprise and necessitate a comprehensive planning for irrigation in India. The prime requisite for efficient use of any resource is to conserve it and to make it available at the site of use. But the optimum benefits from irrigation water are seldom realized. Hence there is an urgent need to improve the system performance through efforts like Participatory Irrigation Management (PIM).

PRESENT STATUS OF IRRIGATION DEVELOPMENT

In general, as much as 50 percent of the water released at the head of irrigation projects is lost in transmission to the farmers' field (Prihar, 1995). Consequently, many irrigation schemes are operating sub-optimally. The irrigation efficiency of the major projects is less than 35 percent. Only 20-40 percent of the irrigation water released from the reservoir is effectively used for crop production (Reddi and Reddy, 1999). The yield of food grains under irrigation is only 2.5 mt/ha as against the potential of 4.5 mt/ha (Reddi and Reddy, 1999).

There is a spiraling trend in the lacuna between potential created and potential utilized in major and medium irrigation projects. The potential created in the country increased from 26.26 million ha in 1956 to 89.44 million ha in 1997, with the gaps between the potential created and that utilized increasing from 1.22 million ha in 1956 to 8.75 million ha in 1997 (Table 1). In 1990, the potential created for the surface water resources was about 75,853 thousand ha, whereas its utilization was only 43,897 thousand ha (Table 2).

Table 1. Plan-wise Position of Irrigation Potential Created and Utilized

(Unit: Million ha)

Plan		Potential Created					Potential Utilized				
		Major and Medium	Minor			Total	Major and Medium	Minor			Total
			Surface Water	Ground-water	Sub-total			Surface Water	Ground-water	Sub-total	
At the end of:											
I Plan	(1951-56)	12.20	6.43	7.63	14.06	26.26	10.98	6.43	7.63	14.06	25.04
II Plan	(1956-61)	14.33	6.45	8.30	14.75	29.08	13.05	6.45	8.30	14.75	27.80
III Plan	(1961-66)	16.57	6.48	10.52	17.00	33.57	15.17	6.48	10.52	17.00	32.17
Annual Plan	(1966-69)	18.10	6.50	12.50	19.00	37.10	16.75	6.50	12.50	19.00	35.75
IV Plan	(1969-74)	20.70	7.00	16.50	23.50	44.20	18.69	7.00	16.50	23.50	42.19
V Plan	(1974-78)	24.72	7.50	19.80	27.30	52.02	21.16	7.50	19.80	27.30	48.46
Annual Plan	(1978-80)	26.61	8.00	22.00	30.00	56.61	22.64	8.00	22.00	30.00	52.64
VI Plan	(1980-85)	27.70	9.70	27.82	37.52	65.22	23.57	9.01	26.24	35.25	58.82
VII Plan	(1985-90)	29.92	10.99	35.62	46.61	76.53	25.47	9.97	33.15	43.12	68.59
Annual Plan	(1990-92)	30.74	11.46	38.89	50.35	81.09	26.32	10.29	36.25	46.54	72.86
VIII Plan*	(1992-97)	32.83	n.a.	n.a.	56.60	89.43	28.37	n.a.	n.a.	52.32	80.69

Source: Gupta, *et al*., 2000.
Note: * Provisional.

Table 2. State-wise Ultimate Potential and Utilization of Surface Water

(Unit: 000 ha)

State	Potential			Utilization up to the End of the VIIth Plan		
	Major and Medium	Minor	Total	Major and Medium	Minor	Total
Andhra Pradesh	5,000	2,300	7,300	3,411	1,253	4,664
Assam	970	1,000	1,970	186	379	565
Bihar	6,500	1,900	8,400	3,146	1,358	4,504
Gujarat	3,000	340	3,340	1,272	181	1,453
Haryana	3,000	50	3,050	2,083	39	2,122
Jammu and Kashmir	250	400	650	154	349	503
Karnataka	2,500	900	3,400	1,415	713	2,128
Kerala	1,000	800	1,800	595	390	985
Madhya Pradesh	6,000	2,200	8,200	2,196	942	3,138
Maharashtra	4,100	1,200	5,300	1,938	847	2,785
Orissa	3,600	1,000	4,600	1,651	586	2,237
Punjab	3,000	50	3,050	2,633	43	2,676
Rajasthan	2,750	600	3,350	1,970	409	2,379
Tamil Nadu	1,500	1,200	2,700	1,290	842	2,132
Uttar Pradesh	12,500	1,200	13,700	7,166	991	8,157
West Bengal	2,310	1,300	3,610	1,701	1,225	2,926
Others	445	696	1,141	74	326	400
Total	58,425	17,136	75,561	32,881	10,873	43,754

Source: Central Water Commission (CWC), 1992.

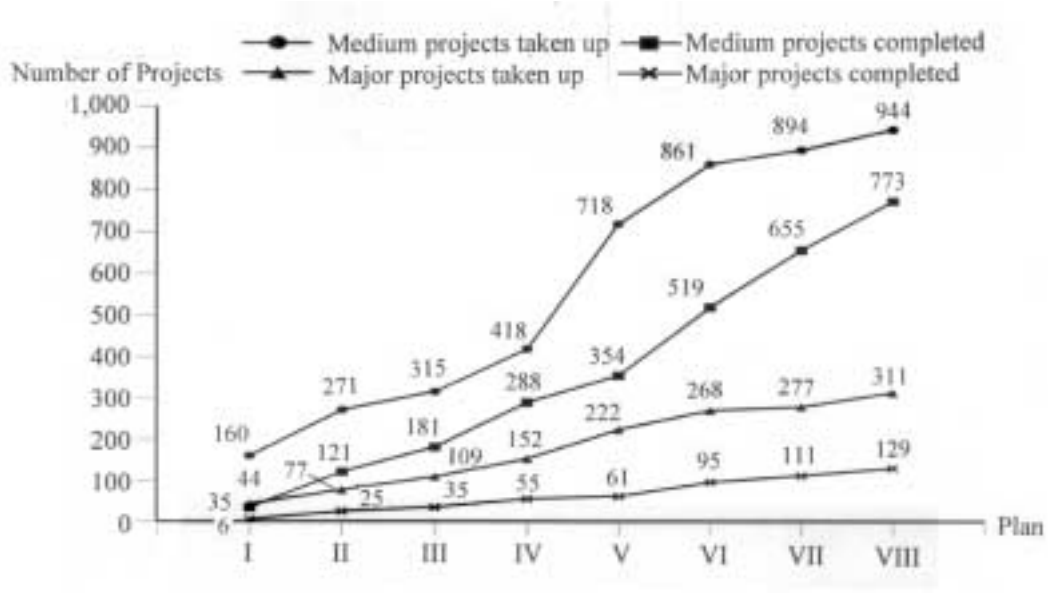

Figure 1. Major and Medium Projects Taken Up and Completed

The details on some major irrigation projects and their irrigation potential are presented in Table A-1 in Appendix. The number of major irrigation projects completed increased from six during the Ist Plan to 129 during the VIIIth Plan. The corresponding figures for medium projects are 44 and 773, respectively (Figure 1). There was a close parallel between growth of irrigation potential and food production (Figure 2). The canal irrigation is the direct source of livelihood for the large rural mass.

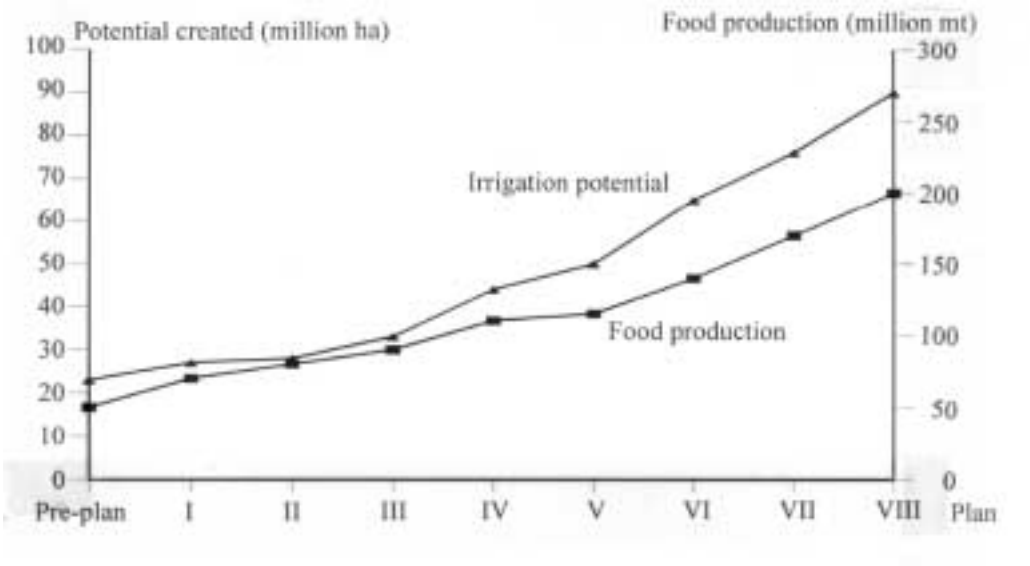

Figure 2. India: Growth of Irrigation Potential and Food Production

The estimates of the Indian National Committee on Irrigation and Drainage (INCID, 2000) on water resources in India are depicted in Table 3.

Table 3. Water Resources in India

Particulars	Quantity of Water (km^3)
Average annual precipitation	4,000
Average precipitation during monsoon	3,000
Natural runoff (surface and groundwater)	1,953
Estimated utilizable surface potential	690
Groundwater resource	432
Available groundwater resource for irrigation	361
Net utilizable groundwater resource for irrigation	325

Source: INCID, 2000.

The sources of irrigation are rivers, tanks and wells. There were about 500,000 tanks in the country in 1950-51, of which about 46,800 had a command area of less than 40 ha each. The area irrigated under tanks in 1975 was only 3.56 million ha. In Tamil Nadu, there are 39,202 tanks irrigating 928 thousand ha of land, which is as much as one-third of the net area irrigated in the State. These tank systems vary in size from small ones irrigating 10 ha to large

ones feeding 5,000 ha (Venkataswamy, 1994). Recently the area under tanks command has fallen by 22 percent due to multifarious factors like improper maintenance, siltation, encroachment etc.

Open wells have been in use since time immemorial. They are more common in the red soils of southern India. Their yields are about 70,000-2,30,000 lit/day. The number of dug wells, shallow tube-wells and public tube-wells was 14.3 million in 1990. In 1983-84, the area irrigated was 51.5 million ha, of which the area accounted for by canals was 38.3 percent; by wells, 39.3 percent; by tanks, 6.2 percent; and by other sources, 16.2 percent. In the Punjab State, there has been a substantial increase in the area under irrigation due to increase in number of tube-wells. More than 60 percent of the total 93 percent of the irrigated area is covered by tube-well irrigation (Pasricha, 1998).

India has a large number of major rivers well distributed over the entire area. The average annual potential in different rivers of India is estimated at 1,880 km^3 (Table 4). India is among the foremost countries in the world in exploiting its river water resources. From less than 300 large dams existing at the beginning of planned development, the number of dams constructed has spiraled to about 4,300.

Table 4. Water Resources Potential in the River Basins of India

Name of the River Basin	Average Annual Potential in the River (km^3)	Percent Expected Storage to Average Annual Flow
Indus (up to border)	73.31	23
a) Ganga	525.02	16
b) Brahmaputra and others	597.04	11
Godavari	118.98	35
Krishna	67.79	5
Cauvery	21.36	38
Pennar	6.86	40
East flowing rivers between Mahanadi and Pennar	16.95	17
East flowing rivers between Pennar and	17.72	9
Mahanadi	66.88	37
Brahamani and Baitami	36.23	48
Subernarekha	10.79	30
Sabarmati	4.08	41
Mahi	11.83	47
West flowing rivers of Kutch, Saurashtra including Luni	15.10	52
Narbada	41.27	52
Tapi	18.39	77
West flowing rivers from Tapi to Tadri	109.01	12
West flowing rivers from Tadri to Kanyakumari	89.84	13
Area of inland drainage in Rajasthan desert	-	-
Minor river basins draining to Bangladesh and Myanmar	31.00	-
Total	1,879.45	20

Source: Gupta, *et al*., 2000.

As a result the total live storage capacity of dams and reservoirs completed in the country has since gone up to about 177 billion m^3 in 1995. The storage development in the country during the plan period is given in Figure 3 (Indian Water Resources Society [IWRS], 1998).

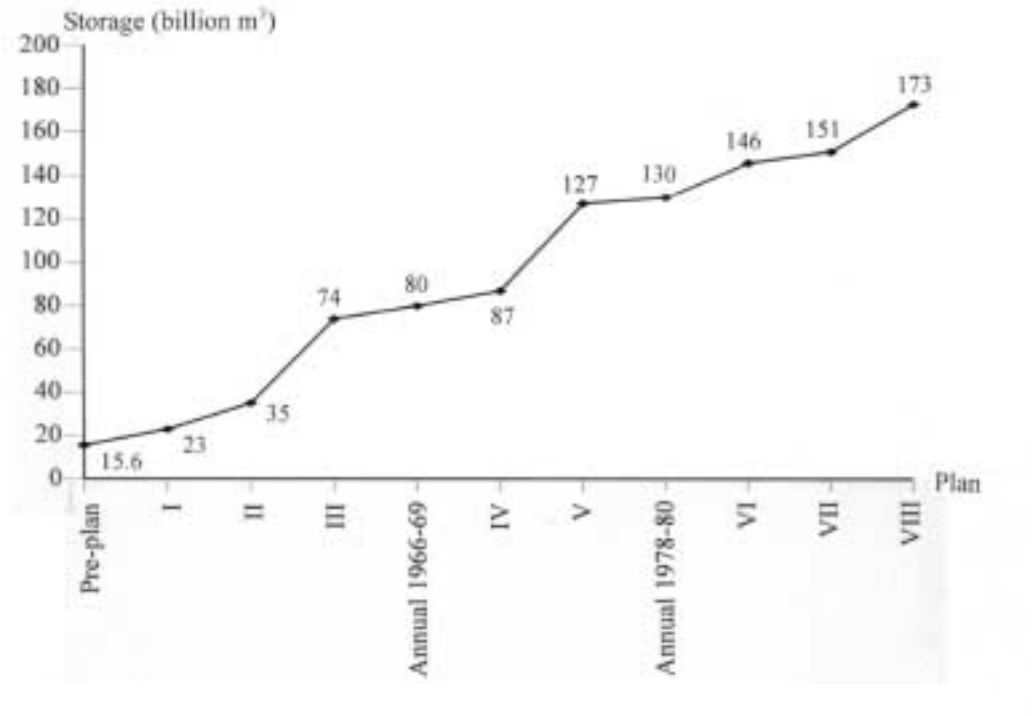

Figure 3. Creation of Storage During Plan Development

The groundwater potential of various States in India is given in Table A-2 in the Appendix. The balance groundwater resource for further development in future approximates 24.6 million ha m/year. The details on net area irrigated by various sources in different States in India include: East, 8,375 thousand ha; North, 18,779 thousand ha; South, 9,567 thousand ha; and West, 16,278 thousand ha (Table A-3 in the Appendix).

Enormous siltation of reservoirs is another bane of irrigation in the country which makes inroads into their sustainability. A number of multipurpose reservoirs are silting up more than three times as much as the design rates (Table 5).

PARTICIPATORY IRRIGATION MANAGEMENT

Bringing farmers into group action and involving them in planning of water management strategy, accommodating all their genuine needs will make them work voluntarily for the success of the system. It is in this context that the need for PIM is keenly felt. PIM is *'for the farmers'*, *'by the farmers'* and *'with the farmers'*. For obtaining optimum benefits from the existing irrigation projects, all beneficiaries under it should actively participate in decision-making process of water utilization, maintenance and management. In the Indian context PIM can be addressed in terms of informal and formal organizations.

Table 5. Siltation of Reservoirs

Name of the Reservoir	Catchment Area (km^2)	Capacity (thousand ha m)		Annual Rate of Silting (mt/ha)	
		Gross	Dead	Design Rate	Observed Rate
Hirakud	82,652	814	232	3.78	9.42
Bhakra	58,876	934	205	6.43	9.21
Tungabhadra	25,832	377	7	6.43	9.81
Gandhi Sagar	21,873	651	83	5.41	9.03
Panchet	9,816	150	180	3.70	15.00
Maithan	5,206	136	2	2.43	19.65
Ghod	3,629	22	7	5.41	22.86
Dhantwad	2,862	46	8	5.41	8.92
Mayurakshi	1,792	61	7	5.41	24.64

Source: Reddi and Reddy, 1999.

Present Organizational Setup of Irrigation Administration

1. ***Informal Water Users' Association***

The present system of water management in the country does not provide for collective efforts in self-governance by the users. In most irrigation projects, farmers' involvement is lukewarm.

Traditionally the role of water users in operation and maintenance (O&M) of irrigation sources has been informal and community based, especially in the State of Tamil Nadu. Considering tanks alone, *'Kudimaramathu'* (maintenance and management by farmers) was the common traditional informal arrangement that existed. This practice was made mandatory by the British through the enactment of Madras Compulsory Act 1958. With drift of time the farmers' interest in the system attenuated and attempts to resuscitate the system failed. Most of the tanks have informal associations during scarcity periods and these associations have proved viable where local leadership is strong. The structure of an informal water monitoring organization (*Neermaniyam*) is shown in Figure 4.

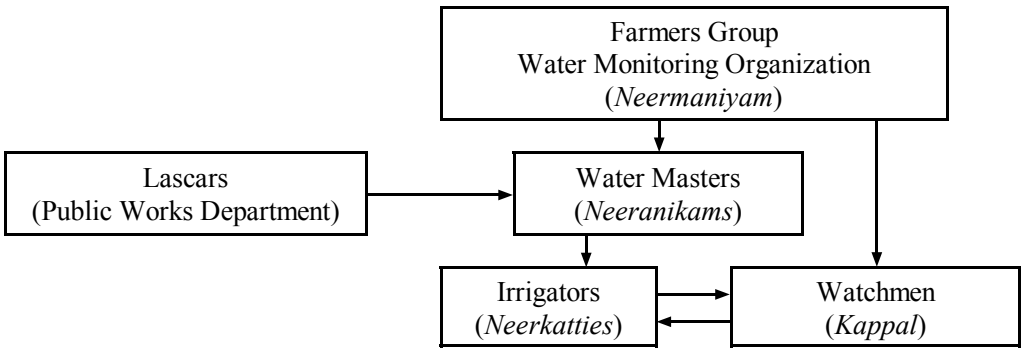

Figure 4. Structure of Informal Water Monitoring Organization

Source: Rajagopal, 1995.

It is an informal farmers group with one or two organizers. This group controls the organization and collects nominal fee from farmers fixed by collective decision. Water masters (*Neeranikam*) work in an area of 40 ha and distribute water among different water outlets after receiving from the *lascars* (Public Works Department [PWD]). Irrigators (*Neerkaths*) irrigate the field. The area of operation per irrigator is five ha for double crop wetlands and 10 ha for single crop wetlands.

There is a group of watchmen to vigil over cattle intrusion and pilferage of crop produce. Watchmen also work in liaison with irrigators for the upkeep and maintenance of watercourses.

2. ***Formal Water Users' Association (WUA)***

The Command Area Development Program, initiated in 1974, envisaged the participation of farmers' organization as vital to run micro system. The Sixth and Seventh Plans reiterated the need for farmers' participation in irrigation management. The National Water Policy of 1987 and the Committee on Pricing of Irrigation Water (1992) also underscored the farmers' participation in management of irrigation systems. Despite the recognition of the importance of farmers' participation the progress in this direction has been tardy.

WUA is a three-tier system of water monitoring organization. The unit for the association is one sluice ayacut (command) area and all the landowners in the area will be the members of this association and they will elect the executive committee and the office bearers. The second tier, the farmers' council (FC) comprises an irrigation division, the area of which may vary from 1,000 ha to 2,000 ha. The President and General Secretary of the farmers' association will be the ex-officio members of this council, which will have five office bearers elected by the general body. The management of the irrigation division will vest with the FC. The third tier, which is an apex body, is the farmers' federation (Figure 5).

The general body elects the executive committee; the President and General Secretary of the FC shall be ex-officio members. This federation shall also have an advisory council. The main functions and responsibilities of the WUAs are:

- To monitor, regulate and distribute the irrigation water on an equitable basis among the farmers in the sluice;
- To maintain on-farm development (OFD) structures constructed below the outlet point; and
- To solve the irrigation disputes or problems that may arise from time to time (Palanisami and Paramasivam, 2000).

The work of the Department of Agricultural Engineering (AED), Tamil Nadu, in the area of Command Area Development (CAD), act as a catalyst in formation of the three-tier WUA. The efforts of the Department are unique in Tamil Nadu in two aspects compared to other States:

- Formation of WUA is done with intensive contacts by the proper organizational setup; and
- Disseminating the merits of rotational water supply (RWS) in conjunction with OFD works (Ramaswamy, *et al*., 1996).

The areas identified by the AED for different commands are given in Table 6.

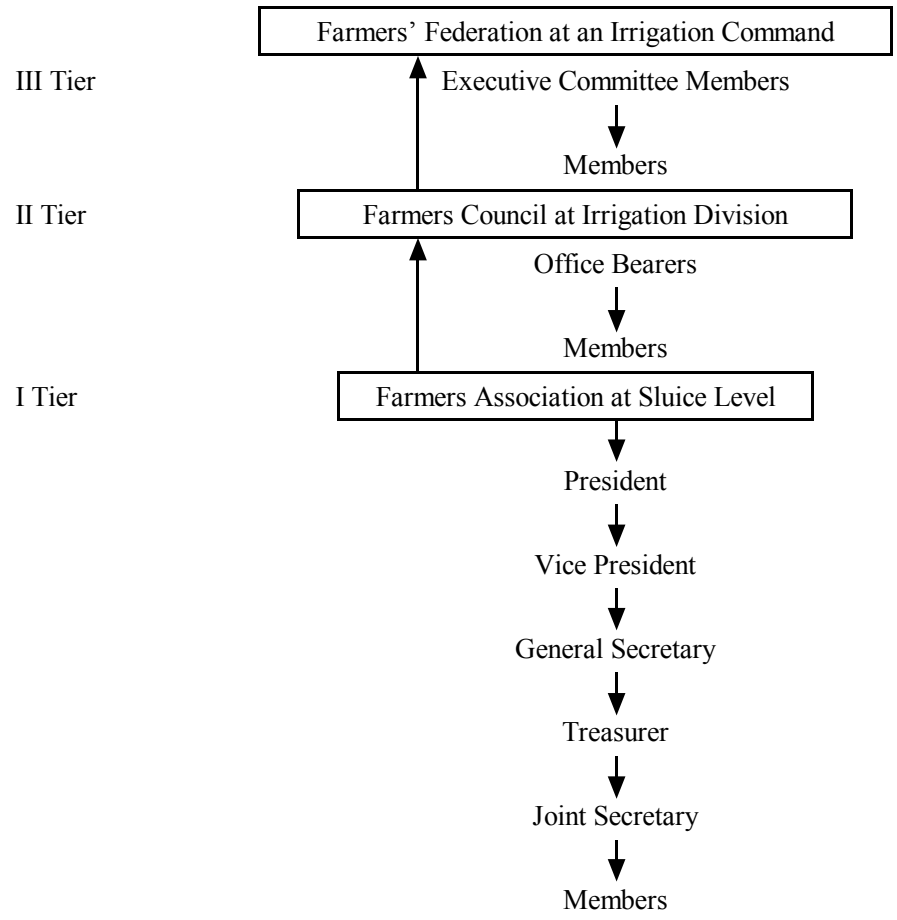

Figure 5. Structure of a Formal Water Monitoring Organization

Source: Krishnaswami, 1992.

Table 6. Commands Identified by the AED, Tamil Nadu, India

Name of the Command	Cultivable Command Area (ha)	Year of Commencement
Cauvery	600,000	1967-68
Sathanur Reservoir	18,157	1979-80
Periyar Vaigai	69,532	1981-82
Lower Bhavani	83,770	1982-83
Parambikulam Aliyar	100,612	1985-86
Total	872,071	

Source: Anonymous, 1993.

The WRO of PWD has established 135 farmers' association at irrigation tanks (non-system) level (Anonymous, 2000). It is estimated that only 862,563 ha are being managed by WUAs in the various States (Palanisami and Paramasivam, 2000) accounting for only 1.62 percent of the total irrigated area. Table 7 provides an overview of the extent and performance of WUAs in a few selected States of India. In Tamil Nadu, about 72,363 ha are being managed by WUAs formed by AED through Command Area Development Program (CADP) (Krishnaswami, 1992). This is only about 1.96 percent of the total irrigated area of the province (Table 8).

Table 7. Number of WUAs in Selected Indian States

State	Number of WUAs	Area Covered (ha)
Andhra Pradesh	32	17,388
Assam	30	15,000
Bihar	1	12,197
Gujarat	477	48,500
Karnataka	196	38,400
Kerala	3,432	137,280
Madhya Pradesh	67	62,800
Maharashtra	118	48,095
Orissa	52	27,580
Tamil Nadu	1,395	72,363
West Bengal	10,000	37,000

Source: Palanisami and Paramasivam, 2000.

Table 8. Farmers' Associations and Councils Formed in Ongoing CADP of Tamil Nadu by AED

Command	Councils Formed	Associations Formed		Number of Farmers Benefitted
		Number	Area (ha)	
Cauvery	15	273	30,348	22,015
Lower Bhavani	7	771	21,411	21,296
Periyar Vaigai	7	240	16,545	24,255
Sathanur	9	96	3,003	4,067
Parambikulam Aliyar		15	1,056	668
Total	38	1,395	72,363	72,301

Source: Krishnaswami, 1992.

CONSTRAINTS TO PIM

A farmer will join and work with WUA, if the costs that he has to incur are lower than the benefit envisaged. An assumption implicit in this is that the irrigation agency will supply water in adequate quantities during different growth phases of the crops. But the reality is the phenomenon of underutilization or mismanagement of utilization. Farmers have no confidence that they will get water when they need and there is no penal measure, if water is not delivered

on stipulated dates. There is no volumetric pricing or rationing of water or incentive to efficient use of water.

Many a time overuse of water culminates in water-logging. The current water rate structure in public systems is cheaper than that of privately managed irrigation system. Profit from irrigated farms is only 2.25 times that from rainfed farms and expenditure is two times higher. The net benefit per ha per farm works out to only Rs.476, which is too low an incentive to take to irrigation (Patil, 1994). Available evidence indicates that irrigation does not help to increase productivity and there is no linear relationship between irrigation and agricultural productivity. An economic study of the *Jayakwadi* irrigation project conducted by the Marathwada Agricultural University, Maharashtra, shows that under the state-of-the-art in agricultural production now prevalent, irrigated food grain production is uneconomical from the irrigators' standpoint (Patil, 1994).

The management of real water managers in the field namely, farmers and the inter-relationships with the requirements and the distribution agencies are not recognized specifically to each irrigation projects especially under CADP. This arises because attention is usually concentrated on hydrological, engineering, agricultural and economic aspects in all the irrigation projects. Factors like size and homogeneity of group, the motivation of farmers and the conducive environment of the farmers are not taken into cognizance.

The National Water Policy of 1987 lays more stress on domestic use of water. The demand for water in urban areas for domestic and industrial purposes and in the rural areas for irrigation is increasing in the upstream regions compared to downstream. The disparity in the distribution among the former is a source of concern in the rural sector.

Another deterrent is the tail-enders' problem, wherein the fields of the farmer at the tail-ends within the potential localized areas do not receive water. In fact about 18-20 percent of the localized areas at the tail-ends do not receive irrigation water in most of the projects. The in-discipline of the users is also another causal factor for the malady of the system. The farmers in the upper reaches by virtue of their advantageous positions draw more water illicitly and convert irrigated dry areas into wet areas, depriving thus the legitimate share of the tail-end farmers. In order to irrigate the land in the shortest time possible, the farmers in their indiscretion cause damage to the sluices and effect breaches in canals. The shuttering arrangements are wantonly removed, despite the Department replacing them every time.

The *panchayats* do not accord necessary recognition as stipulated in the 11th schedule of the Panchayat Act 1994 for the existing WUAs for their autonomous functioning.

The malady and failure of many WUAs is ascribable to lack of: (a) policy and legal support from the government; (b) authority and power to the WUAs; (c) financial support to the WUAs; and (d) cooperation and support from the irrigation agencies (Singh, 1987). The misplaced apprehension that the O&M costs besides increased water rates will have to be borne by them deter many farmers from taking to the system.

The heterogeneity in terms of caste, creed and class acts as a hindrance to the functional cohesion fundamental for the formation of an association.

In addition, lack of an enabling law for the establishment of WUAs is also a major impediment in the introduction of PIM. There is need to have a separate legislation for the formation of WUAs.

Notwithstanding that irrigation development in the country has strengthened the economy considerably, it has also to some extent subjected pockets of land to water-logging, soil salinity and alkalinity. According to an estimate an area of 2.46 million ha is affected by water-

logging, 3.06 million ha by soil salinity and 0.24 million ha by alkalinity in irrigation commands (IWRS, 1998).

FUTURE PROSPECTS OF PIM

1. A *discriminant function model* used with seven selected variables viz., size of holding, age, education, location of farm, ability to self-regulate, protection of right and satisfaction with the existing rotation system for water distribution emerged with a high predictive value (70 percent) indicating the pragmatism of harnessing such factors in prospective planning for formation of WUAs. Further, the significant influence of the location of the farm clearly revealed that the farmers who were favorably located in the pipe outlet command, given other things, were more likely to opt for an association of farmers for water distribution. Thus the supply of the water formed the major monitoring parameter for bringing farmers together either formally or informally (Hugar and Sastry, 1998).
2. Besides providing right amounts of water at right time and at right place, attaining high water efficiency requires that the crop yields be maximized with given amount of water. It is therefore, essential to allow improved agronomic practices to combat the constraints to high yield. Mulching, fertilization and combinations thereof have been documented to substantially augment crop yield and thus elevate water use efficiency. Currently, technology concerning optimal irrigation scheduling and agronomic practices for increasing water use efficiency of crops is dismally modest (Prihar, 1995).
3. Various conferences, workshops and feedback from different stakeholders of PIM reveal the following as the critical issues to be tackled specific to each canal command or river command areas in Tamil Nadu with required modifications (Anonymous, 1992).
   (i) Extent of jurisdiction of the FCs: The hydrological boundary of a distributory determines the actual area coming under each FC. From experiences, it is gathered that the distributory command area may range from 1,000 ha to 2,500 ha under each FC. However, the manageable area for effective and efficient functioning of the FC with active involvement of majority of farmers will be 500-1,250 ha. The activity of FC will be strengthened if certified seeds and other agricultural inputs are channeled through the FC. Marketing and cold storage facilities of agricultural produce by cooperative method with active involvement of FCs are to be promoted.
   (ii) Prerequisites for taking up responsibility of water distribution by the Councils:
      a. Water flow measuring devices should be installed at the interface and the percentage of discharge in cusecs can be marked with color reference;
      b. The details of canal *Poramboke* (government/common lands) in the council area shall be provided to the councils for its management;
      c. Necessary financial assistance shall be given, as many farmers are economically weak; and
      d. Local people representatives for Assembly/Parliament and knowledgeable farmers may be appointed as Advisors at Federation level.
   (iii) Handing over the irrigation management system to the FCs: Many FCs are prepared to take over the onus of O&M of irrigation systems. But, prior to this, rehabilitation of the system should be carried out properly in such a way that the

designed quantity of water is ensured at the point of delivery. The entire system especially the infrastructure should be rehabilitated in such a way that the tail-end farmer of the system also gets required and assured quantity of water at the right time. The pre-conditions include:

a. WRO and AED should cooperate with the councils and technically guide them till the councils become capable of self-governance;
b. Copies of command area maps, list of landowners, details of irrigation structures and all other records available with WRO should be handed over to the councils;
c. Each council should be provided with an Irrigation Community Organizer(s) for carrying out the day-to-day functioning of the councils;
d. All encroachments in the canal common lands should be evicted before handing over the system to the farmers; and
e. A memorandum of understanding shall be signed by all the stakeholders clearly defining the responsibilities.

(iv) Extent of legal and financial support required by the FCs after taking over the responsibility of irrigation management:

a. The councils should be vested with legal powers to demand and draw the available water in the concerned reservoirs;
b. The councils will have the power to finalize the irrigation management activities;
c. FCs should have the powers to include or delete any area in their jurisdiction without affecting the existing system. The councils should also be empowered to arrest illegal tapping and pollution of rivers/canals at the upstream side;
d. Powers should be conferred to cultivate in the common lands and to mobilize the revenue for councils' activities;
e. Rights to grow trees along canal banks and to avail the benefits of the usufructs;
f. A percentage of the water cess collected by the revenue department may be given to the councils to augment their financial requirements; and
g. Councils should be empowered to implement the above suggestions through a joint management committee. Necessary modifications may be made based on the experiences during the first five years.

4. One-time endowment development grant by the government and periodic contribution by the beneficiaries based on acreage should be given to WUAs for the creation of capital assets. The income derived from this can be used to meet the association's needs for tank-based works (Palanisami, *et al*., 1999).
5. Technical know-how should be provided by Irrigation Department or other technical staff for efficient crisis management. Special positioning of agricultural officers (irrigation) in the country also merits consideration.
6. To encourage formation of WUAs, the government may usher in incentive policies such as priority for infrastructure modernization. Irrigation water may be provided only in bulk rather than to individual farmers, to motivate and organize farmers through the cadre of trained organizers.

7. It is essential to have an uniform approach in funding the farmers' organization for undertaking the O&M responsibilities. There is disparity in the present approach. Under Water Resource Consolidation Project (WRCP), as per the World Bank norms, each farmer beneficiary has to contribute a sum of Rs.250/ha as his share capital to meet the cost of O&M activities from the annual interest accrued. But in case of CADP being implemented in the adjoining irrigation system of the same region, a one-time grant of Rs.500/ha is provided. This disparity or differential treatment needs to be re-examined.
8. In Tamil Nadu, nearly 80 percent of the irrigation water utilized is appropriated for rice cultivation alone. Of this water the crop utilizes physiologically only 1-3 percent. It is evident therefore that implementation of improved technology for more effective utilization can minimize the total water earmarked for this crop and enlarge the extent of irrigated area.
9. There is a need for support of the print, visual and electronic media for effective diffusion of the technology. The multitudinous benefits of PIM should be disseminated through seminars, workshops, group discussions, wall posters, notices, leaflets, folders, debates, all propaganda etc. Moreover, multi-tier training to policy-makers, irrigation management functionaries and farmers should be organized (Rajagopal, *et al*., 1993).
10. Institutional support: High level committee should be set up to formulate policies for the implementation of PIM and review policy issues from time to time.
11. Irrigation management turnover (IMT): To provide the desired irrigation service to the individual farmer, it is essential that the management of irrigation be transferred from government to NGO. IMT is the strategy by which the farmers arrogate to themselves the responsibility of rehabilitation of the irrigation system, management and distribution of water by conjoint effort. IMT shall guarantee sustainability, equity and productivity (Palanisami, *et al*., 1999).

Against the backdrop of diminishing water resources and mounting water scarcity, the concept and practice of PIM has assumed a critical role in irrigation management. WUA, an adjunct of PIM serves as the fountainhead of an assortment of benefits. But then the establishment and functioning of WUAs is confronted with constraints. Impartial and in-depth analysis of these deterrents and implementation of appropriate strategies will make the practice of PIM more viable and vibrant.

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5. INDIA (2)

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INTRODUCTION

India is an agrarian society. Its 65 percent population depends on agriculture. Agriculture is the largest industry in the country. Though the share of agriculture in national income has gradually dropped from 57 percent in 1950-51 to 29 percent in the year 1995-96, it still forms a major share of the national income in India and is the backbone of Indian economy. Apart from this, it is also crucial for providing food security to its present one billion population, which would be stabilizing at 1.5-1.8 billion in 2050. To feed this population, India will need about 450 million mt of food grains at the present level of utilization. Per capita land availability in India is only 1.6 ha, which is very low as compared to 3.8 ha of Pakistan, 31.5 ha of France and 187 ha of United States. In the future, per capita land availability would reduce further due to growing population. The only alternative for achieving targeted food production is to increase productivity of different crops, which is still very low in India as compared to the developed countries in the World. This can be achieved by adopting more advanced and better agricultural practices and using advanced technologies in irrigated agriculture. Thus to boost agriculture production in India, irrigation is an important input. Fortunately, India is rich in land and water resources and it has capacity to feed its growing population provided it manages the land, irrigation is an ancient practice in India.

Religious epics described wells, canals, ponds and dams, which were useful for the community. Historically, their successful operation and maintenance was the responsibility of the State. Construction of wells, ponds, dams etc. was considered holy work in ancient times. Evidences shows that during Indus Civilization, there was a well-developed irrigation system in the form of minor irrigation works to irrigate small fields. With some technological changes, these tanks are still in use in India. Later on, to fetch the needs of population during the medieval period, small canals were constructed and water from small streams was directed into them through the construction of check dams etc. Gyasuddin Tuglak (1220-25) was the first ruler who encouraged construction of canals and Feroj Tuglag (1351-86) is considered as the biggest canal builder before the 19th century. Irrigation is considered as a main force behind the development and extension of Vijay Nagar Kingdom in South India in 15th century. During the British Rule, modernization and extension of irrigation development was taken up. Major works of river water transfer such as Upper Ganga Canal, Krishna and Godavari delta irrigation system etc., were started during the British Rule. Sindhu river irrigation system and other important canal systems such as Lower Swoth, Lower Sauhag and Para, Lower Chinab and Sidnai canals were completed during the British Rule.

At the time of independence, net irrigated area of the Indian subcontinent was 28.2 million ha. Due to sudden developments related to the division of India, irrigated area was divided between Pakistan and India. India got 19.4 million ha of irrigated land while Pakistan got 8.8 million ha. Major canal systems, including Stalaj and Sindhu systems, went to Pakistan. Similarily fertile Ganga-Bramhputra delta of East Bangal (now Bengladesh) also went to Pakistan.

INDIA'S WATER RESOURCES

Total geographical area of India is about 329 million ha having diverse geographical and climatic conditions. Geographically, India can be divided in to five different regions:

1. Northern hilly region;
2. Great planes;
3. Central uplands;
4. Peninsular area; and
5. Costal area and Islands.

Due the large-scale variations in its climate and geography, Indiaís climate has become very complex. Annual precipitation, which is the main source of water in India, varies with time and space. Total precipitation in India is 4,000 billion m^3 (BCM) in which monsoon rain between June to September is about 3,000 BCM. Average natural flow is about 1,869 BCM, which is equal to 4 percent of worldwide freshwater supply. Variation of water in space is very significant. Though average per capita availability of water in India is 2,200 m^3, average availability in Bramhputra Basin is maximum i.e. 18,400 m^3, while per capita availability in river system of Tamil Nadu is only 380 m^3. Average per capita availability in India would come down to 1,500 m^3 if Bramhputra basin is left out. Basin-wise per capita availability of water in India is shown in Figure 1.

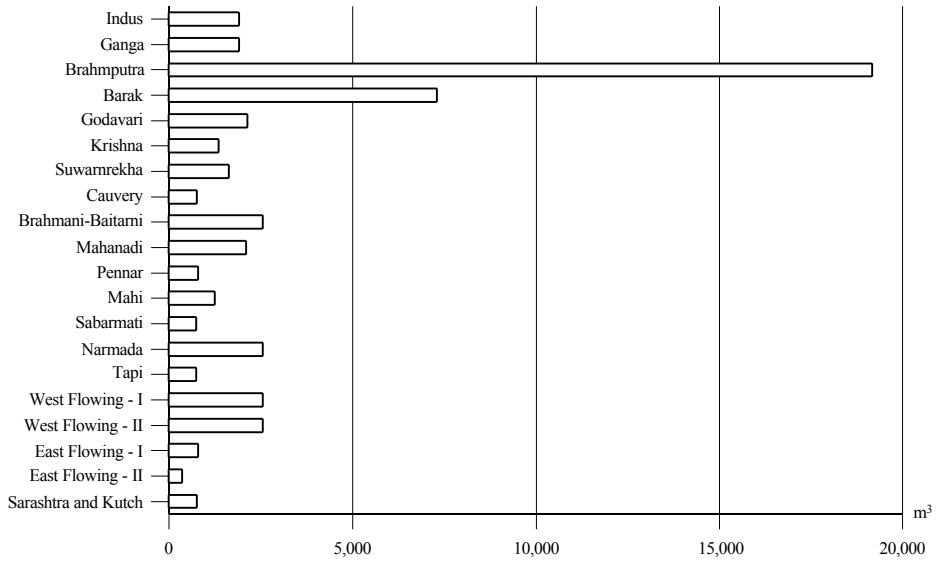

Figure 1. Basin-wise Per Capita Water Availability

India's Water Potential

India's river wealth is very rich. It has got 12 major basins having an aggregate catchment area of about 256 million ha. Apart from this, there are 46 middle level basins with an aggregate catchment area of about 25 million ha. Other water storage structures such as tanks and ponds benefit about 7 million ha of land. Brahmaputra, Satlaj, Chinab, Ganga, Yamuna, Ghagara, Gandak and Gomti etc. are major rivers of Northern India. Narmada, Betawa, Chambal, Mahanadi etc. are major rivers of Central India. Krishna, Godavari, Cauvery etc. are the major rivers of Southern India. Total average annual surface water flow in Indian rivers is 1,869 BCM out of which 690 BCM is utilizable.

Reusable groundwater potential in India is about 432 BCM. Groundwater availability in Ganga Basin is maximum i.e. 171 BCM. State-wise, the maximum availability of groundwater is in Uttar Pradesh, which is about 84 BCM. Keeping in view the complex distribution of water resources and localized restrictions, present average utilizable water potential of the country is the following:

Category	Quantity (BCM)
Surface water	690
Groundwater	432
Total	1,122

The assessed ultimate irrigation potential of India is 139.893 million ha, out which 58.46 million ha is attributed to major and medium irrigation and 81.428 million ha; 17.378 million ha surface water and 64.05 million ha groundwater is attributed to minor irrigation.

DEVELOPMENT OF IRRIGATION FACILITIES: GROWTH OF IRRIGATION POTENTIAL

India has been leader in exploiting its river water sources in the world and with the beginning of planning era in the year 1951 its irrigation potential increased from 22 million ha to 89.44 million ha at end of Eighth Plan i.e. 1996-97.

Sector-wise potential created during different plan periods is shown in Table 1. Ninth Plan (1997-2002) targets for creation of irrigation potential are 17.05 million ha out of which 9.8 million ha is from major and medium irrigation and 7.24 million ha is from minor irrigation.

Investment on the Development of Irrigation Facilities

Plan-wise investment on the development of irrigation facilities is shown in Table 2, which indicates that minor irrigation, specially from groundwater source has played a significant role in the development of irrigation facilities though investment in minor irrigation sector is far less than the major and medium irrigation sectors.

Up to the end of the Eighth Plan (up to 1996-97) about 56.61 million ha of irrigation potential is attributed to minor irrigation in which a total investment of Rs.277,764 million have been made while only 32.83 million ha. is attributed to major and medium irrigation sector in which Rs.432,973.9 million have been invested. One more significant aspect of investment pattern is that the government investment in major, medium and minor irrigation sector has been almost doubled in Eighth Plan, as compared to Seventh Plan but institutional

Table 1. Growth of Sector-wise Irrigation Potential

(Unit: Million ha)

Sector	Ultimate Irrigation Potential	Created			IXth Plan Targets
		Up to the End of VIIth Plan (1985-90)	Up to the end of Annual Plan (1990-92)	Up to the end of VIIIth Plan (1992-97)	
Major and medium irrigation	58.46	29.92	30.76	32.83	9.81
Minor irrigation	81.43	46.60	50.35	56.63	7.24
Surface water	17.38	10.98	11.46	10.87	n.a.
Groundwater	64.05	35.62	38.89	45.76	n.a.
Total	139.89	76.52	81.11	89.46	17.05

Table 2. Plan-wise Investment on Development of Irrigation Facilities

(Unit: Rs. million)

Sector	Up to VIth Plan	VIIth Plan (1985-90)	Annual Plans (1990-92)	VIIIth Plan (1992-97)	Total	IXth Plan (1997-2002) Proposed
Major and medium irrigation	150,620	111,072.9	54,591.5	216,689.5	532,973.9	429,742.3
Minor irrigation	80,430	61,793.0	30,300.7	105,240.3	277,764.0	93,698.4
Government sector	n.a.	31,183.5	16,804.8	62,823.4	n.a.	n.a.
Institutions sector	n.a.	30,609.5	13,495.9	42,416.9	n.a.	n.a.
Total	231,050	172,865.9	84,892.2	321,929.8	810,737.9	523,440.7

sector investment has not shown the same growth rate. Apart from this, the proposed investment on major and medium irrigation during Ninth Plan is much more as compared to minor irrigation projects. It is about 82 percent in Ninth Plan while it was only about 67 percent in Eighth Plan.

Utilization of Irrigation Facilities

Out of total irrigation potential of 89.438 million ha created up to the end of Eighth Plan, only 80.691 million ha have been utilized so far. This indicates that there is a significant gap of 9.7 percent between irrigation potential created and utilized.

Irrigation potential created and utilized up to Seventh Plan was 76.55 million ha and 68.588 million ha, respectively which means that about 10.37 percent of potential created was unutilized. Up to the end of Eighth Plan potential created and utilized was 89.43 million ha and 80.69 million ha, respectively meaning thereby that about 9.77 percent of potential created was unutilized. This shows that the gap between potential created and potential utilized has been marginally reduced during Eighth Plan.

Sector-wise percentage utilization of potential created up to Seventh and Eight plans is shown in Table 3. It is clear that the gap in potential created and utilized is much more in major and medium irrigation projects than minor irrigation projects, which calls for addressing management aspects more effectively and properly. Though another positive observation from the above is that there is a slight improvement in potential utilization of major and medium irrigation projects during Eighth Plan as compared to Seventh Plan while from minor irrigation projects it almost remained same.

Table 3. Percentage Gap Between Potential Created and Utilized

(Unit: Million ha)

	Major and Medium Irrigation			Minor Irrigation		
	Potential Created	Potential Utilized	Percentage Gap in Utilization	Potential Created	Potential Utilized	Percentage Gap in Utilization
Up to VIIth Plan	29.912	25.467	14.86	46.524	43.042	7.48
Up to VIIIth	32.831	28.368	13.59	56.610	52.323	7.57

Major and Medium Irrigation Projects

The ultimate irrigation potential of the country from major and medium irrigation projects has been assessed as 58.46 million ha, of which 32.83 million ha have been exploited up to Eighth Plan. The plan-wise progress of creation of irrigation potential through major and medium irrigation projects and expenditure incurred are shown in Table 4. One of the major problems with the major and medium irrigation projects in India had been their non-completion in time due to scarcity of resources, opposition from community etc. Probably, for rapid irrigation development, ambitious plans have been prepared without assessing resource capacity and other associated issues such as rehabilitation, environment concerns etc.

The result was that several major and medium irrigation projects could not be completed in time. Unexpected delays in the completion of some major irrigation projects had resulted in cost overruns and escalation of their estimated cost. During Eighth Plan Government of India started new scheme of Accelerated Irrigation Benefit Program (AIBP) to help the States out from this problem of financial crunch.

Table 4. Investment on Major and Medium Irrigation Projects and Potential Created

Period	Outlay Expenditure (Rs. million)	Potential During the Period	Created Cumulative (million ha)
Pre-plan period	n.a.	9.70	9.70
First Plan (1951-56)	3,800	2.50	12.20
Second Plan (1956-61)	3,800	2.13	14.33
Third Plan (1961-66)	5,810	2.24	16.57
Annual plans (1966-69)	4,340	1.53	18.10
Fourth Plan (1969-74)	12,730	2.60	20.70
Fifth Plan (1974-78)	24,420	4.02	24.72
Annual plans (1978-80)	20,560	1.89	26.61
Sixth Plan (1980-85)	75,160	1.09	27.70
Seventh Plan (1985-90)	111,070	2.22	29.92
Annual plans (1990-92)	54,590	6.82	30.74
Eighth Plan (1992-97)	216,682.3	2.09	32.83
Ninth Plan (1997-2002)*	429,742.3	9.81	-

Note: * Target.

Minor Irrigation

All groundwater and surface water schemes having Cultural Command Area (CCA) up to 2,000 ha (individually) are classified as minor irrigation schemes. Groundwater development is primarily done through individual and cooperative efforts of the farmers with the help of institutional finance and their own savings. Surface water minor irrigation schemes are generally funded from the public sector outlay.

The ultimate irrigation potential from minor irrigation schemes has been assessed as 81.428 million ha. Up to the end of Eighth Plan, the cumulative irrigation potential created through minor irrigation schemes has been 56.61 million ha. Irrigation potential created and utilized under minor irrigation during various plan periods is given in Table 5. As for groundwater-based minor irrigation structures, the data show that the State of Uttar Pradesh is the biggest exploiter of groundwater in the country. Out of total number of 4.776 million shallow tube-wells, 2.343 million are in Uttar Pradesh.

Flood Control

The country faces floods of varying magnitude almost every year. The magnitude of flood depends on varying climate and rainfall pattern in the areas. Whereas the floods in the Brahmaputra and Ganga regions are more frequent and pose serious problems. Floods are also common in other river basins like Mahanadi, Brahmani, Baitarni and Godavari etc. Of the countryís total geographical area of 329 million ha, about 40 million ha has been assessed as the area prone to floods, out of which 32 million ha can be protected. So far an area of about 16.02 million ha has been provided with a reasonable degree of flood protection by means of embankments, town protection work etc. Plan-wise investment on flood control is shown in Table 6.

Table 5. Irrigation Potential Created and Utilized under Minor Irrigation During Various Plan Periods

(Unit: Million ha)

Plan	Cumulative Potential	Utilization
At the end of the pre-plan up to 1951	12.90	12.90
Up to First Plan (1951-56)	14.06	14.06
Up to Second Plan (1956-61)	14.75	14.75
Up to Third Plan (1961-66)	17.00	17.00
Up to annual plans (1966-69)	19.00	19.00
Up to Fourth Plan (1969-74)	23.50	23.50
Up to Fifth Plan (1974-78)	27.30	27.30
Up to annual plans (1978-80)	30.00	30.00
Up to Sixth Plan (1980-85)	37.52	35.25
Up to Seventh Plan (1985-90)	46.61	43.20
Up to annual plans (1990-92)	50.35	46.54
Up to Eighth Plan (1992-97)	56.61	52.32
Up to Ninth Plan (1997-2002)*	7.243	-

Note: * Target.

Table 6. Investment on Flood Control

Plan Period	Outlay/Investment (Rs. million)	Plan Period	Outlay/Investment (Rs. million)
First Plan (1951-56)	140	Annual plans (1978-80)	2,280
Second Plan (1956-61)	490	Sixth Plan (1980-85)	5,960
Third Plan (1961-66)	860	Seventh Plan (1985-90)	9,420
Annual plans (1966-	440	Annual plans (1990-92)	5,120
Fourth Plan (1969-74)	1,720	Eighth Plan (1992-97)	20,290
Fifth Plan (1974-78)	2,990	Total	49,710

Growth in Irrigated Area and Potential for Further Expansion

With the increased exploitation of water resources the irrigated area also increased continuously since First Five-Year Plan. Reported area of the country for land utilization is 304.8 million ha out of which net sown area is 142.22 million ha and gross sown area is 186.56 million ha. Net irrigated area is 53.5 million ha and gross irrigated area is 71.51 million ha. It means that out of net sown area, only 37.6 percent is net irrigated area and about 62.4 percent is not irrigated, indicating that there is an ample potential for further expansion of irrigated area in the country. However, there may be some agro-climatic and geographical constraints. Gross irrigated area in the country is 38.3 percent of the gross sown area. This implies that there is tremendous scope to increase intensity of irrigation further. Among major States, the percentage of irrigated area is maximum in Punjab followed by Haryana, Uttar Pradesh, Bihar, Jammu/Kashmir and Tamil Nadu.

In rest of the States, the percentage of irrigated area is less than 50 percent of the cultivated area.

Nevertheless, in India, water is unevenly distributed in time and space. Northern Indian States like Punjab, Haryana, Uttar Pradesh, Bihar etc. are very rich in water resources.

Surface and groundwater potential is maximum in Ganga basin followed by Brahmaputra. While resource potential of Brahmaputra is difficult to tap due to geographical conditions, Ganga basin has good potential for expansion and that is why Uttar Pradesh has maximum irrigated area in the country. Up to now, India has tapped easily exploitable irrigation potential, and further expansion is difficult. For example, inter-basin transfers etc. may be necessary, which will require huge financial resources and efforts.

Another important aspect is that total assessed irrigation potential of India is only 139.89 million ha while cultivated area is 142.215 million ha at present. It indicates that whole of the cultivated area cannot be irrigated according to present assessment. However, the gross irrigated area is only 71.510 million ha, which is about 51 percent of the ultimate irrigation potential leaving about 68.38 million ha. for further expansion of irrigation facilities.

Impact of Irrigation on Farm Productivity

With the expansion of irrigation facilities in India, use of other agricultural inputs such as improved and high-yielding varieties of seeds, fertilizes and pesticides etc. had increased considerably, resulting in considerable increase in farm production and crop productivity. At the time of independence, the food production was 51 million mt. Now it is about 200 million mt. Increase in food production with the increase in irrigated area is shown in Table 7. From Table 7 it is clear that there had been a considerable increase in food production as well as in average productivity since 1950-51 due to extension of irrigation facilities.

Table 7. Growth in Irrigated Area, Food Production, and Productivity

Year	Irrigated Area (000 ha)	Total Area (000 ha)	Production (000 mt)	Average Yield (kg/ha)
1950-51	18,317	97,321	50,825	522
1955-56	20,626	110,560	66,850	605
1960-61	22,080	115,581	82,018	710
1965-66	24,032	115,103	72,347	629
1970-71	30,558	124,316	108,422	872
1975-76	34,114	128,181	121,034	944
1980-81	37,614	126,669	129,589	1,023
1981-82	38,448	129,138	133,295	1,032
1982-83	40,206	125,095	129,519	1,035
1983-84	40,115	131,163	152,374	1,162
1984-85	40,628	126,673	145,539	1,149
1985-86	41,675	128,023	150,440	1,175
1986-87	40,484	127,195	143,418	1,128
1987-88	42,909	119,696	140,354	1,173
1988-89	43,671	127,674	169,922	1,331
1989-90	44,526	126,507	170,627	1,349
1990-91	45,459	127,835	176,390	1,380
1991-92	46,283	121,871	168,373	1,382
1992-93	48,259	123,148	179,483	1,457
1993-94	49,900	122,754	184,260	1,501
1994-95	-	123,548	191,093	1,547
1995-96	-	123,437	185,048	1,499
1996-97	-	124,509	199,321	1,601

Productivity of major crops in India is shown Table 8, which indicates that crop productivity of major crops, has continuously increased with the extension and development of irrigation facilities. Almost all the major crops registered manifold increase in their productivity since 1950-51. Even the wheat crop, registered about 300 percent increase in yield. However, these levels of yield are very low as compared to some of the developed countries of the world as shown in Table 9. For example, the average productivity of rice in the world is 3,730 kg/ha. In some part of the world, like Europe, Australia, Egypt, it is 7,600 kg/ha, 8,300 kg/ha and 8,200 kg/ha, respectively, which is comparatively very high.

Table 8. Crop Productivity of Some Major Crops

(Unit: Kg/ha)

Crops	1950-51	1980-81	1990-91	1996-97	Percentage Increase since 1950-51
Rice	668	1,336	1,740	1,879	181.29
Wheat	663	1,630	2,281	2,671	302.87
Jowar	54.95	104.31	116.81	110.88	101.78
Bajra	25.95	53.43	68.94	79.05	204.62
Maize	547	1,159	1,518	1,698	210.42
Gram	482	657	712	810	68.05
Groundnut	775	736	904	1,155	49.03
Rapeseed and	368	560	904	1,013	175.27
Sugarcane	33,422	7,844	65,395	66,523	99.04
Cotton	88	152	225	266	202.27

Table 9. Average Productivity of Main Crops in Some Countries of the World

(Unit: Kg/ha)

Country	Wheat	Maize	Rice
China	3,759	5,173	6,062
India	2,671	1,698	1,879
Egypt	5,638	6,954	8,241
Japan	-	-	6,191
Philippines	-	7,975	2,856
Russia	1,396	-	2,762
U.S.A.	2,442	7,975	6,860
U.K.	8,113	-	-
France	7,134	8,357	-
World	2,541	4,117	3,730

This shows that there is ample scope in increasing the crop productivity in India by adopting modern technologies in irrigated agriculture.

There is a significant variation in the productivity of different crop among different States of India as shown is Table 10. From this table, it is clear that level of productivity in Punjab is very high as compared to rest of India. This is certainly due to high percentage of irrigated area, i.e., 92.94 in Punjab as compared to rest of the country.

Table 10. Productivity of Two Main Crops in Major States of India

(Unit: Kg/ha)

States	Rice	Wheat
Madhya Pradesh	1,093	1,755
Maharashtra	1,689	1,460
Manipur	2,149	-
Meghalaya	1,075	1,452
Mizoram	1,543	-
Nagaland	1,321	2,500
Orissa	1,375	1,320
Punjab	3,132	4,235
Rajasthan	843	2,740
Sikkim	1,377	1,741
Tamil Nadu	2,712	-
Tripura	2,011	1,950
Uttar Pradesh	1,862	2,659
West Bengal	1,997	2,390
India	1,879	2,671

Another salient feature of crop productivity in India is that crop yields are generally higher by one-third or half in the tube-well irrigated (groundwater irrigated) areas than canal irrigated areas as is clear from Table 11. This is primarily due to the fact that groundwater offers greater control over the supply of water than the other sources of irrigation. As a result, groundwater irrigation encourages complementary investment in fertilizers, pesticides and high-yielding varieties leading to higher yield.

Table 11. Productivity of Some Main Crops by Source of Irrigation

(Unit: Kg/acre)

Crop	Canal	Public Tube-well	Purchased from Tube-well	Own Tube-well
Wheat	672	747	784	896
Rice	522	709	784	859
Corn	261	299	373	785

Problems of Irrigated Agriculture, Change in Policies and Relevant Strategies

Despite the massive investment in irrigation and in spite of impressive growth of agricultural production, the development is also associated with a host of problems, which appear to create a shadow of doubt about its future potentialities and sustainability. Analysis of irrigation development reveals that it is beset with the problems of increasing disparities and growing inefficiencies with which the systems are operated.

These problems are clearly related to the pattern of investment and creation of network of irrigation system as well as to the organization of water management institutions for such systems created. Despite reasonable extension of irrigation in India during the last several decades and the large production and employment gains that it had made possible, most of

India's irrigation system are known for their under performance. Continuing under performance, needles to say, results in to a significant loss to the country, both in terms of production and employment.

Problems of Major and Medium Irrigation Systems

For the purpose of discussion it is better to distinguish the problems that arise in the construction phase from those arise during the operation and maintenance phase.

Problems of construction phase are:

a. Cost and time overruns (may be due to inadequate project finance);
b. Rehabilitation of the project affected people;
c. Faulty design; and
d. Environmental degradation.

The problems that arise in the operation and maintenance phase, which accounts for most of the drawbacks of Indian irrigation are:

a. Underutilization of irrigation potential;
b. Inequity in irrigation;
c. Lack of dependability of irrigation;
d. Indifferent quality of irrigation;
e. Wastage of irrigation water;
f. Water-logging, soil salinity and alkalinity;
g. Sustainability of irrigated farming; and
h. Financial losses and pricing of water.

These problems are inter-linked. Number of problems that occur in operation and maintenance phase is a fall out of the problems faced during the construction phase. For example, underutilization of irrigation potential is the result of declaring irrigation schemes commissioned without developing its command area properly. This also leads to unequal distribution of water, lack of dependability of irrigation and indifferent quality of irrigation.

Wastage of water due to losses in the system and over-irrigation is another major problem. According to an study conducted in Northern India, losses in main canal and branches, distributaries and watercourses are 17 percent, 8 percent and 20 percent, respectively, totaling to about 45 percent. Irrigation efficiencies in India are as low as 30-40 percent. Introduction of modern irrigation systems such as drip and sprinkler on a large scale is immediately required to reduce wastage of water and improve irrigation efficiencies.

Water-logging, and soil salinity and alkalinity are yet another problems in irrigated agriculture in India and their extent in some major Indian states are shown in Table 12. Sustainability of irrigated farming is a serious concern, mainly due to lack of comprehensive approach to land and water management in India. And, lastly, the problem of financing irrigation management is of such a magnitude that it has overshadowed all other problems.

Table 13 shows canal water rates in different States of the country. It is clear that many States have not revised their water charges since many years. Moreover, the percentage recovery of working expenses has declined from 64.16 percent in the year 1974-75 to less than 10 percent in the year 1987-88 as is clear from Table 13.

Table 12. Extent of Water-logging Salinity and Alkalinity in Irrigation Projects

(Unit: Ha)

State	No. of Projects Affected	Water-logging	Salinity	Alkalinity
Andhra Pradesh	4	266,400	5,000	22,040
Bihar	3	362,670	224,300	-
Gujarat	7	89,408	1,214,165	-
Haryana	3	229,840	-	-
Jammu and Kashmir	0	1,500	-	-
Karnataka	9	24,543	-	-
Madhya Pradesh	1	4,260	-	-
Maharashtra	1	6,000	-	-
Orissa	1	196,260	-	-
Punjab	1	200,000	1,008,000	1,211,300
Rajasthan	-	179,500	7,000	-
Tamil Nadu	-	18,000	20,120	27,480
Uttar Pradesh	-	35,200	483,000	-
Total		1,613,581	2,961,585	1,260,820

Table 13. Canal Water Rates for Irrigation in Major States

(Unit: Rs./ha)

States	Range		Few Crop-specific Rates			Year Rates Revised Last
	Minimum	Maximum	Paddy	Wheat	Sugarcane	
Andhra Pradesh	99	222	222	-	370	1986
Bihar	30	158	89	-	158	1983
Gujarat	40	830	110	110	830	1981
Haryana	17	99	74	61	99	1975
Karnataka	37	556	99	-	556	1985
Maharashtra	65	1,000	-	-	750	1989
Madhya Pradesh	15	297	59	76	-	1991
Orissa	6	185	40	-	-	1981
Punjab	14	81	49	29	-	1974
Rajasthan	20	143	-	74	-	1982
Tamil Nadu	6	65	49	-	62	1962
Uttar Pradesh	7	327	143	143	237	1983
West Bengal	74	593	125	-	-	1977

Problems Related with Minor Irrigation Scheme

Unlike major and medium irrigation schemes, the minor irrigation schemes, particularly based on groundwater, are mainly privately owned, operated, and maintained. The inevitable outcome of such ownership and operation is higher degree of utilization compared to the major and medium irrigation. Share of groundwater in minor irrigation as well as its importance in

agriculture and in the economy of the country have already been discussed. Since groundwater constitutes to be the main source of minor irrigation, further discussion is confined to groundwater alone.

Over the past three decades, government policies, especially subsidized credit and rural energy supplies have encouraged rapid development of groundwater resources. These policies have, to a large extent, been successful. In most part of the country, where groundwater resources are available, wells are common and irrigate large areas. But this has had a price and, at present, problems are encountered. Rapid development, however is seen. Some of the major problem related to the groundwater development in India are given below:

a. Overdraft;
b. Fluctuation in water level due to over pumping;
c. Groundwater pollution;
d. Environmental concerns;
e. Water quality; and
f. Competition and allocation between different users.

Due to overdraft number of critical and over exploited blocks are continuously increasing (Table 14). An overall increase of 51 percent and growth rate of 5.5 percent in dark and critical areas have been observed between 1984-85 and 1992-93. If this trend continues, roughly 1,532 blocks or 36 percent of the 4,248 blocks in the listed States will be dark or critical by the year 2017-18.

Table 14. Over-exploited and Dark Blocks, 1984-93

State	1984-85	1992-93
Andhra Pradesh	0	30
Bihar	14	1
Gujarat	6	26
Haryana	31	51
Karnataka	3	18
Madhya Pradesh	0	3
Punjab	64	70
Rajasthan	21	56
Tamil Nadu	61	97
Uttar Pradesh	53	31
Total	253	383

Fluctuation in water level due to over pumping may affect the drinking water supply and water quality. Similarly reduction in base flow of streams due to declining water levels has serious environmental concerns. Reduction in base flow of Sabarmati River in Ahmedabad and Gomti River in Lucknow cities are the classical example of this. It is often unrecognized that groundwater and surface water being the integral part of the same hydrologic system, component of groundwater management is critical to maintain in stream flows. Furthermore water-logged areas may affect the adjoining overdraft areas causing serious environmental concerns.

CHANGES IN POLICIES AND RELEVANT STRATEGIES

Fund Allocation

In general, agriculture and allied sectors have been continuously given top priority in fund allocation. The percentage outlay for agriculture and allied sectors has remained almost constant during various plans as is clear from Table 15. However, the share of funds allocated to the irrigation sector has been progressively going down over the successive five-year plans as is clear from Figure 2. At the 1980-81 price levels, the allocation of irrigation sector was 24 percent of the total outlay for the First Plan. During the Seventh Plan it was 9 percent and during the annual plans of 1990-92 it was just 7 percent. This is mainly due to shift in strategy toward rainfed agriculture because vast area in India is still not irrigated. The strategy adopted during the Eighth Plan was to complete the ongoing project first. In Ninth Plan also the share of major and medium irrigation has been increased to 82 percent from 67 percent during Eighth Plan. Clearly the emphasis is on early completion of ongoing major and medium irrigation projects.

Table 15. Investment in Agriculture and Allied Sectors, Including Irrigation, During First to Eighth Plans

	I	II	III	IV	V	VI	VII	VIII
Investment	600	950	1,754	3,674	8,741	26,131	48,099	96,168
Percentage of Total Plan Size	31	20	20	23	22	24	22	22

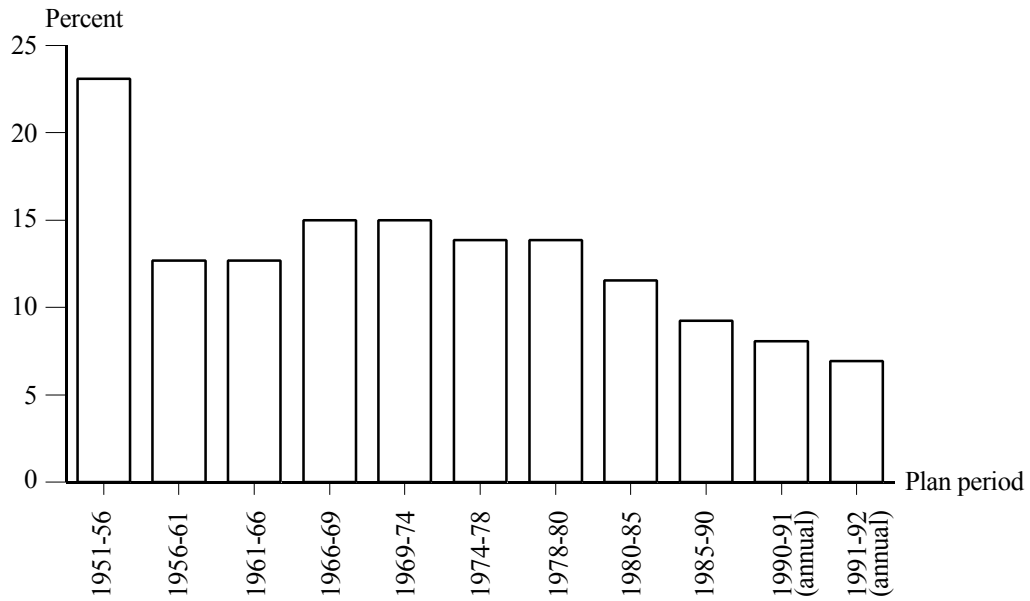

Figure 2. Irrigation Investment as a Percentage of Total Investment, 1951-92

Development to Management

1. ***Field Management of Irrigation Facilities***

Rapid expansion of irrigation facilities took place during post independence period but afterward it was realized that utilization of irrigation potential is not keeping pace with increase in irrigation potential. To increase utilization of irrigation potential, Command Area Development (CAD) Program was launched during 1974-75 for early completion of micro system for the distribution of water, provisions of inputs like seeds, fertilizers, pesticides and other infrastructure facilities and dissemination of technology among farmers. With further shift in policy towards management, survey and reclamation of water-logged and saline areas has also been added to the CAD Program and recently the concept of Participatory Irrigation Management (PIM) has also been incorporated. Progressive coverage of CAD Program is shown in Table 16, which indicates that the number of projects covered under CAD Program has increased from 60 to 217. Plan-wise investment on CAD Program is shown in Table 17.

Table 16. Progressive Coverage under CAD

Year	Numbers of Projects	
	Added in the Year	Cumulative
1974-75	60	60
1979-80	16	76
1983-84	29	105
1985-86	31	136
1987-88	4	140
1990-91	25	165
1991-92	4	169
1992-93	7	176
1993-94	16	192
1994-95	6	198
1995-96	4	202
1996-97	11	213
1997-98	14	217

Table 17. Plan-wise Investment Made in the CAD

Plan	Outlay/Investment (Rs. billion)
Fifth (1974-78)	1.22
Annual (1978-88)	0.88
Sixth (1980-85)	5.21
Seventh (1985-90)	14.28
Annual (1990-92)	6.93
Eighth (1992-97)	25.10
Total	53.62

2. ***Management of Groundwater***

While a systematic effort was made to manage surface water properly, no sincere effort was made in case of groundwater. This may be primarily due to the fact that the groundwater development is in the hands of thousands of private farmers and government control over them is virtually negligible. But now groundwater in India is at crossroads. Past development efforts have successfully lead to extensive development of groundwater. The challenge now is to make the transition from development to sustainable management of the resource base.

This is a complex task, but in view of the importance and role of groundwater in irrigated agriculture and crop productivity, India cannot escape from it. Thus the core groundwater challenge facing India is the shift from development to management. This fact has been well recognized and some of the steps taken in this regard are following:

a. Reorientation of approach to groundwater management.
b. Creation of legal and regulatory mechanism: Under Environment Protection Act, 1986, Government of India has already constituted Ground Water Authority (GWA) for the purpose of control and management of groundwater. States are also preparing their own groundwater legislation for the regulation and control of groundwater development and management. Act for formation of Water User' s Association (WUA) is also under preparation in various States.
c. Reformation of institutional structures and operations, which emphasize participatory management. For example with 73rd and 74th amendment giving more power to elected *Panchayat Raj* institutions, many States are transferring groundwater management to village level *Panchayats*.
d. Introduction of techniques and incentives for sustainable groundwater management, which includes conjunctive management, end use conservation, land use planning, groundwater recharge etc.

3. ***National Water Policy***

With the adoption of National Water Policy by National Water Resource Council in the year 1987, major shift toward integrated and more comprehensive development of water resources was introduced for better and integrated management of water resources. It is the basic policy document giving direction for water management in India. The policy emphasized that planning and the development of water resources should be governed by national perspective and benefits based on integrated and multidisciplinary approach. The policy recognizes drainage basin as the basic unit of planning for development of water resources and it calls for appropriate measures to optimize the utilization of this resource not only for the benefit of the people living in the basin, but also for the transfer of surplus water to meet the requirements of areas which experience shortage of water. It also pledges to involve farmers in the management of irrigation system, to develop groundwater and surface water as a unitary resource, to recover the cost of maintenance, to develop master perspective plan, to intensify training and research efforts, to develop a national information system on water resources etc.

The Union and State governments are taking necessary follow-up action on the recommendation of the policy. Government of India has formed National Water Board and National Commission for Integrated Water Resources Development Plan for the implementation of policy. The Government of Kerala, Orissa, Uttar Pradesh, and Tamil Nadu have framed State Water Policy. The Governments of Arunachal Pradesh, Daman and Div, Lakshadweep, Maharastra, Haryana, Bihar, Meghalaya, Rajasthan, Nagaland, Mizoram, Andhra Pradesh, Jammu and Kashmir, Punjab, Himanchal Pradesh, Karnataka, Pondicherry

have initiated action to follow the policy guidelines. Almost all the States are preparing perspective master development plans for irrigation development, legislative frameworks for regulation, control and management of water resources.

4. ***Some Other Important Policy Documents***

The Irrigation Management Policy aims at maximizing production with PIM. The policy envisages that the lower distribution systems of canals should be handed over to farmerís organization for operation and maintenance in a phased manner, limiting governments responsibility to upper distribution like main canals and branches. Policy also envisages basic structural change in the government. agencies.

The Policy Document "An Approach to Organizational and Procedural Changes in Irrigation Sector" also aims of restructuring the Irrigation Departments. The draft "Water Information Bill" aims at providing statutory support for the development of a water resources information system and envisages the appointment of a Statistics Authority by the government concerned for the purpose of collecting water-related data.

The draft "National Policy for Resettlement and Rehabilitation" (R&R) of persons affected by reservoir projects has attempted broad national level guidelines for the most important aspect of R&R in reservoir projects.

The draft "National Policy Guidelines for Water Allocation Amongst States" is yet another important policy document, which could benefit the complicated process of equitable water allocation between the concerned States of inter-river basins.

All the above policies address many of the important issue facing the water resources sector at present.

Cost Recovery

Presently the existing major and medium irrigation systems in India are State-managed. Besides management, the State has direct responsibility for the maintenance of all surface irrigation systems in India, right from the main storage down up to the field channels. Evidence of steady declining performance of the existing irrigation systems due to sheer neglect of financial parameters being noticed in the recent years had been a cause of worry. As already stated, many States had not revised irrigation charges since many years and up till now the policy and concept of almost all the major States had been that irrigation is a social service and it is State's responsibility to bear its cost. This lead to heavy overhead cost due to creation of huge departments with inefficient staff for the operation and maintenance of major and medium irrigation systems. Ultimately Central and State governments have realized that this would affect the financial sustainability of these systems. Now great emphasis is being given by Central and State governments to revise the irrigation charges so that at least operation and maintenance cost is fully recovered.

IRRIGATION ADMINISTRATION IN INDIA

Irrigation Administration of Government of India

Since water is a State subject, the role of Central Government in implementing the water resources development programs is essentially of a catalytic nature. Ministry of Water Resources, Government of India, is responsible for laying down policy guidelines and programs for the development and regulation of country's water resources.

For the orderly administration of the water resources and imparting its various functions, Ministry has required number of attached and subordinate offices. Organizational chart of irrigation administration in the country is shown in Figure 3. Functions of different wings of the Ministry of Water Resources is described below in brief.

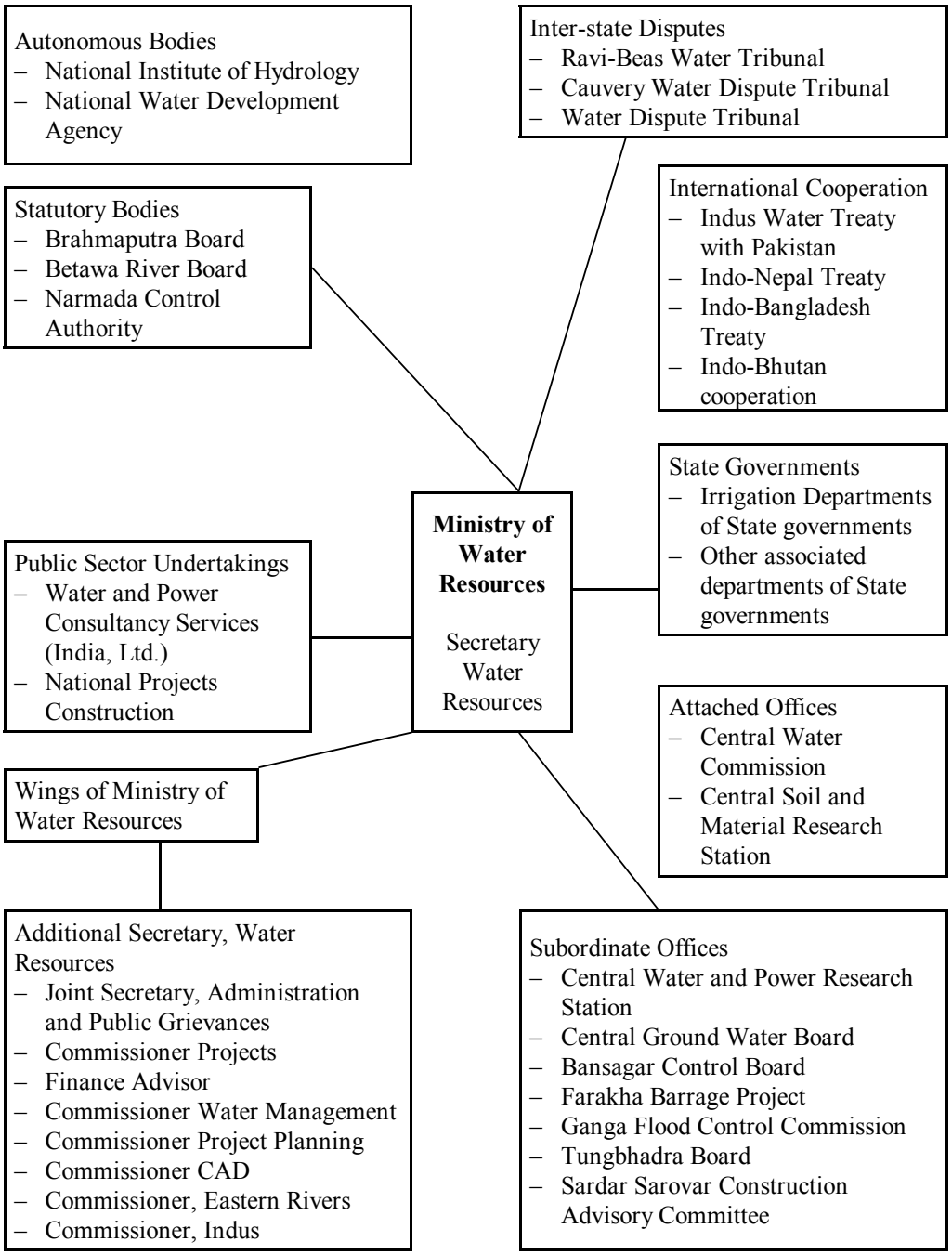

Figure 3. Organizational Chart of Irrigation Administration in India

Ministry of Water Resources

1. ***Administration Wing***

It is responsible for cadre management in the Ministry as well as in its attached and subordinate offices, training of officers and staff, all matters relating to groundwater development, annual report and annual action plan of the Ministry, Parliamentary Consultative Committee, vigilance, redressing public grievances and monitoring the implementation of reservation policy.

2. ***Finance Wing***

It is mainly responsible for monitoring expenditure on various plans/non-plan schemes, giving advice on financial proposal, preparation of budget, work measurement studies and audit objections.

3. ***Policy Planning Wing***

All policy matters relating to the development of water resources, preparation of five-year plans, annual plans, 20-point program, other administrative matters relating. It also looks after the external assistance for multipurpose projects.

4. ***Projects and Minor Irrigation Wing***

The Projects Wing is responsible for policy matters concerning inter-state issues, disputes about waters of inter-state rivers administrative and technical matters relating to public sector undertakings under the Ministry, matters relating to irrigation and multipurpose projects in various States.

5. ***Eastern River Wing***

This wing deals with matters relating to Ganga and Brahmaputra basins and in particular, international aspects of development of water resources and sharing with Bangladesh, Nepal and Bhutan. All matters concerning flood management and sea erosion of the entire country are handled in this wing.

6. ***Indus Wing***

This wing is mainly responsible for implementation of Indus Waters Treaty with Pakistan.

7. ***Command Area Development Wing***

It is concerned with the implementation of centrally-sponsored CAD program. The responsibilities of the CAD wing include monitoring the progress of the works under the program promoting PIM; training of farmers and officials in CAD-related activities, action research programs and adaptive trials etc.

8. ***Water Management Wing***

It is responsible for monitoring of the World Bank-assisted projects, namely National Water Management Project, Water Resources Consolidation Project and the Hydrology Project.

Irrigation Administration in the States of India

In India, water being a Stateís subject, development of water resources is virtually done by respective State governments. While Ministry of Water Resources and its different organizations are mainly responsible for overall planning for water resources development and management including technical guidance and financial assistance, it is the State which actually executes the plans of Government of India. So the real players for water resource development

in India are States and hence irrigation administration in respective Indian States becomes very important.

Every State in India has an Irrigation Department mainly for major and medium irrigation projects which is generally headed by Minister of State Government assisted by a secretary and generally supported by an engineer-in-chief with required number of chief engineers, superintending engineers and executive engineers. But minor irrigation schemes are taken up in the States by various departments and organizations under different programs and because of their being minor in nature and very large in number, it becomes very difficult to locate even the correct organization dealing with the program. So the description of irrigation administration in Indian States is beyond the scope of this paper.

PROMOTION OF PIM IN INDIA: RECENT DEVELOPMENTS

By 2050, India is projected to add 519 million people. Although in India there are still some opportunities for developing water resources, restoring the balance between water use and the sustainable supply will depend primarily on demand-side initiatives such as stabilizing population and raising water productivity. And here PIM or involvement of stakeholders in management of water resources becomes important. Up till now management strategies in India were generally based on supply side initiatives but this cannot continue for long now and if India has to fetch its growing demand this strategy should be changed immediately.

Most of the problems India faces today in irrigation management are the result of non-participation of stakeholders in irrigation management. Water productivity cannot be increased unless subsidies, that foster inefficiencies, are eliminated, raise the price of water to reflect its cost, shift to more water efficient technologies, and more water efficient crops etc. This is not possible without people's participation. But this is not an easy task in India, because needs and opportunities vary greatly, often at local level, management approaches need to be flexible and capable of adopting to reflect local conditions.

PIM is comparatively new concept in India. Sincere efforts to introduce PIM in irrigation administration in India started in this decade only and in real terms during last five years some concrete steps have been taken to introduce PIM in irrigation management, though they are not yet sufficient in Indian context.

Ministry of Water Resources emphasized the need of PIM in the year 1996. Similarly guidelines for Watershed Development Program, in which several water conservation and minor irrigation works are being taken up in India, have been revised and participatory management has been made mandatory. Ministry of Water Resources has taken several steps to promote the concept of PIM, as given below:

- Organization of nationals, State and project level conferences with the participation of officials, NGOs and farmers;
- Preparation of manual for implementation of PIM;
- Preparation of guidelines for amendments in Irrigation Acts of the State's to give legal status to WUA;
- Holding of training programs; and
- Provision of one time functional grant of Rs.500/ha to WUAs.

As a result, consciousness about the need for actively involving the farmers in the management of irrigation has increased. Government of Andhra Pradesh has passed the Andra Pradesh Farmer's Management of Irrigation System Act 1997 under which elections to more than 10 thousand WUAs have been conducted. The Government. of Goa has also amended its Command Area Development Act to provide for the establishment of WUAs. Government of Gujarat has taken up 13 pilot projects to study the modalities of implementation of PIM. Government of Uttar Pradesh is also amending its Irrigation Act for the formation of WUAs. Number of WUAs formed in various States and the area covered by them is given in Table 18.

Table 18. Number of WUAs and Command Area Covered

State	Number of WUAs (hydraulic level)	Approximate Area (000 ha)
Andhra Pradesh	10,292 (minor)	4,700.00
Assam	2 (minor)	1.00
Bihar	1 (distributory)	12.20
Goa	39 (minor)	4.59
Gujarat	71 (minor)	19.00
	405 (lift irrigation schemes)	
Haryana	554 (outlet)	110.80
Himachal Pradesh	875 (micro schemes)	35.00
Karnataka	193 (minor)	138.39
Kerala	3,712 (outlet)	148.48
Madhya Pradesh	65 (minor)	26.80
Maharashtra	142 (minor)	55.80
Manipur	62 (minor)	49.27
Orissa	53 (minor)	27.60
Rajasthan	35 (minor)	15.63
Tamil Nadu	328 (minor)	426.40
Uttar Pradesh	1 (minor)	0.25
West Bengal	10,000 (tube-well)	37.90
Uttar Pradesh	30,000 State tube-wells covering about 3 million ha have been handed over to village *panchayats*.	

With the efforts of Ministry of Water Resources, an NGO named Indian Network on Participatory Irrigation Management has also been set up, which will work for promotion of PIM through dissemination of ideas by holding conferences and workshops, organizing training and by publishing relevant literature. It will also act as an interface between government and non-government sector.

Empowering the People: Self-governance Through *Panchayati Raj*

The two historic and much talked about 73rd and 74th amendments to the constitution of India in 1992 envisaged a total change in the process of self-governance and planning. The objectives of the amendments were loud and clear - a better plan and its better implementation. The objective was sought to be achieved by giving a constitutional status to elected *panchayats*

with a broad profile of the functions assigned to them in the selected few sectors of development followed up by the devolution of powers, both administrative and financial to them by the State, commensurate with these functions. With these amendments, State governments are now handing over irrigation management to people at village level. For example, in State of Uttar Pradesh, biggest in term of creation of irrigation potential, about 30,000 State tube-wells have been handed over to village *panchayats*. Now these *panchayats* will operate, maintain and collect irrigation tax from these tube-wells. A Water Management Committee has been formed under the *panchayat* to look after this work. The Uttar Pradesh model of *panchayati raj* system is shown in Figure 4.

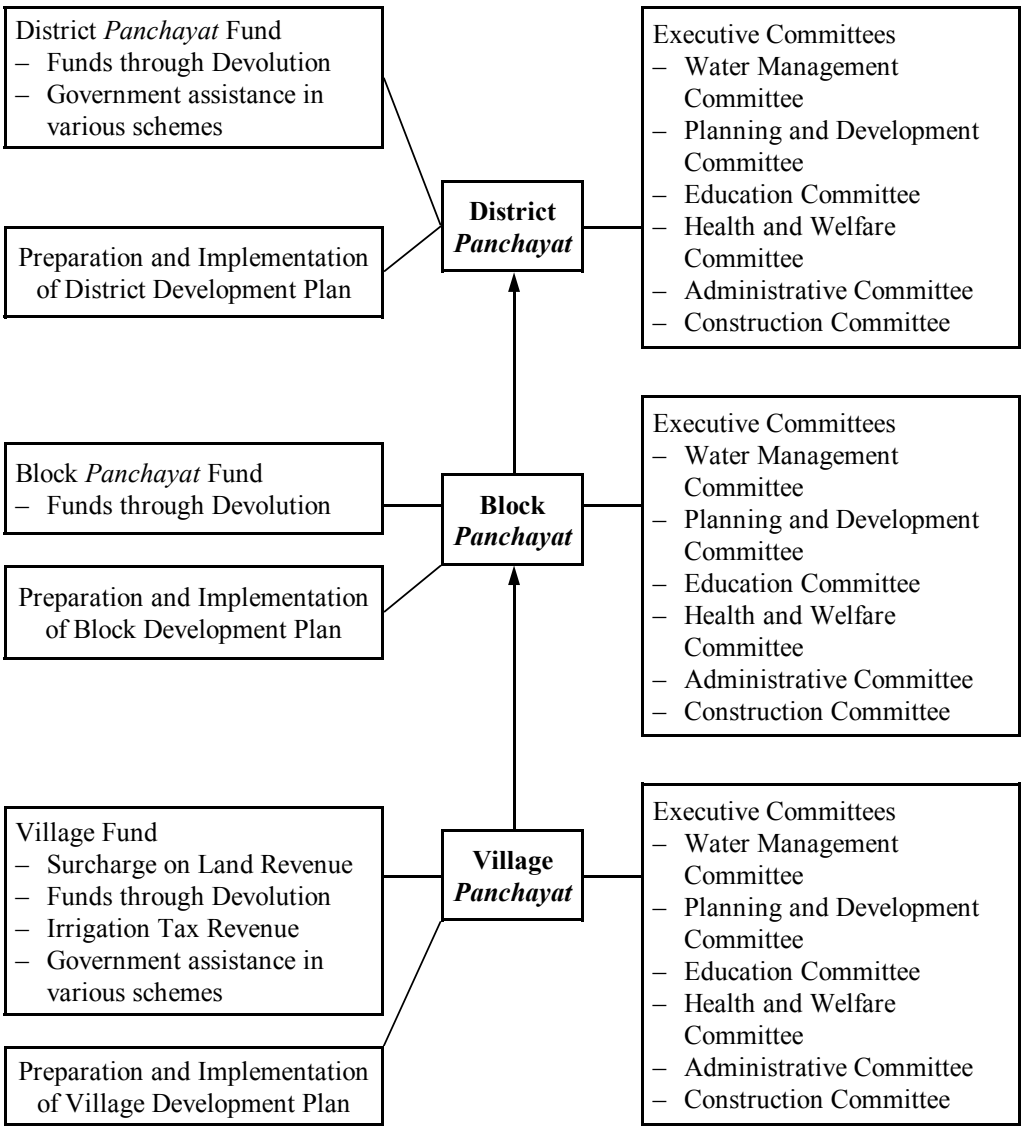

Figure 4. *Panchayati Raj* System in the State of Uttar Pradesh

PIM in Groundwater Development

The efforts of Ministry of Water Resources are mainly confined to promotion of PIM in major and medium canal commands. No sincere efforts have been made to promote PIM in groundwater irrigated areas, which are generally commanded by private tube-wells, and cover the major irrigated area in India. Though these tube-wells are operated and maintained by farmers themselves, their role in the management is confined to their own tube=wells. Management of resource base is not their concern and priority. Seeing the importance of groundwater in irrigated agriculture and agriculture productivity, over the coming decades, groundwater management will need to address the broad array of resource and allocation problem now emerging and solution of these problems will remain a dream without peopleís involvement.

PIM in Externally Aided Projects

In World Bank-assisted Water Resources Consolidation Project in the States of Haryana, Orissa and Tamil Nadu, PIM is an important component. These projects aim at improving the agriculture productivity through modernization and rehabilitation of existing irrigation projects by improving their operational efficiency through participatory management.

In the recently sanctioned US$1,300 million (about Rp.70 billion) Uttar Pradesh Water Sector Restructuring Projects by World Bank, greater emphasis has been given to PIM. The development objectives of this project are to increase productivity of water, to increase and retain agricultural productivity and to improve the living standards of the rural poor. In other externally added projects also, PIM is an important component.

A Specific Example of PIM: Netherlands-assisted Bundelkhand Integrated Water Resources Management Project (BIWRMP)

BIWRMP aims to bring about sustainable improvement in the livelihood of the rural population with attention to the needs of disadvantaged groups. The project works towards this objective by adopting a bottom-up approach, which emphasizes the need for strong, vibrant, village level organizations capable of planning and implementing projects activities. The project also includes the development of a responsive government structure with increased effectiveness to cater to the needs expressed at the village level. The process approach adopted by the project provides space to continuously incorporate learning from field experiences within the project.

This integrated project is being implemented by village committees, specially constituted for the purpose, through the involvement of a multidisciplinary team of three officers, one each from Minor Irrigation, Agriculture and Forest Department, deputed to the project in each district. Organizational arrangement of the project at divisional and district level is shown in Figure 5 and subsequent changes brought in to it are shown in Figure 6. Similarly the initial organizational structure and changes made in it for field level implementation are shown in Figures 7 and 8. The processes of flow of funds, micro plan formulation and money withdrawal are shown in Figures 9, 10, and 11, respectively.

It is clear from the Figures 5 and 6 that, after launching of the project, necessity of a State Level Steering Committee was felt to solve different problems and remove bottlenecks in the implementation of the project. Similarly, organizational change was incorporated for field level implementation by introducing support staff from concerned government departments as is clear from the Figures 7 and 8. This was primarily because of the ineffectiveness of

Artisan Guilds which were supposed to assist user groups in technical designing and cost estimating during micro plan preparation and construction works.

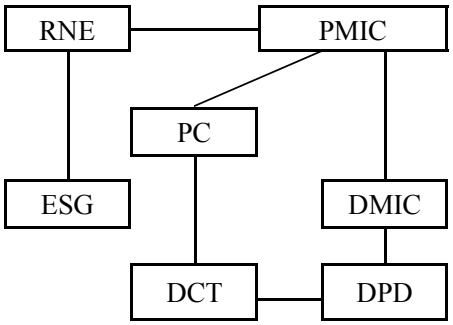

Figure 5. Initial Organizational Arrangement of BIWRMP

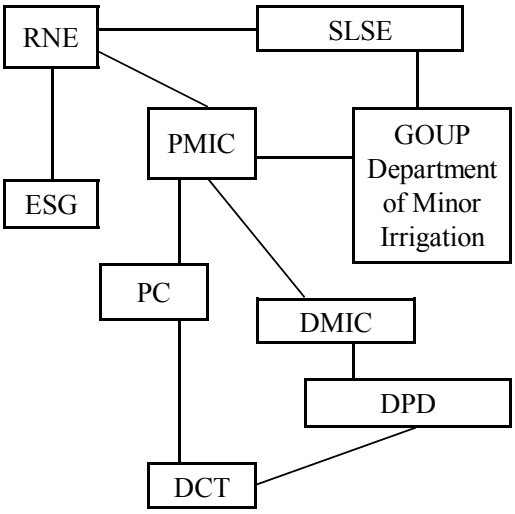

Figure 6. Changed Organizational of Arrangement of BIWRMP

Notes:
- RNE: Royal Netherlands Embassy;
- PMIC: Project Monitoring and Implementation Committee headed by Divisional Commissioner *Jhansi*;
- DMIC: District Monitoring and Implementation Committee headed by respective District Magistrates;
- PC: Project Coordinator;
- ESG: External support group;
- DCT: District core team;
- DPD: District Project Director/Chief Development Officer;
- GOUP: Government of Uttar Pradesh, India; and
- SLSE: State level steering committee headed by Additional Chief Secretary and Agriculture Production Commissioner, GOUP.

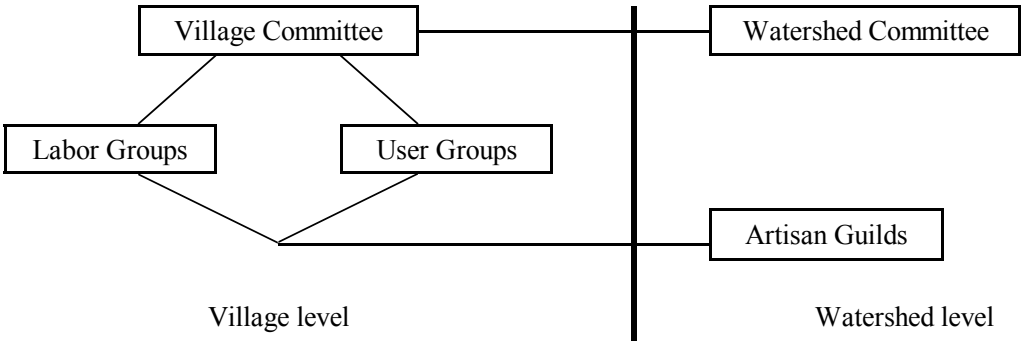

Figure 7. Initial Organizational arrangement for Field Level Implementation (BIWRMP)

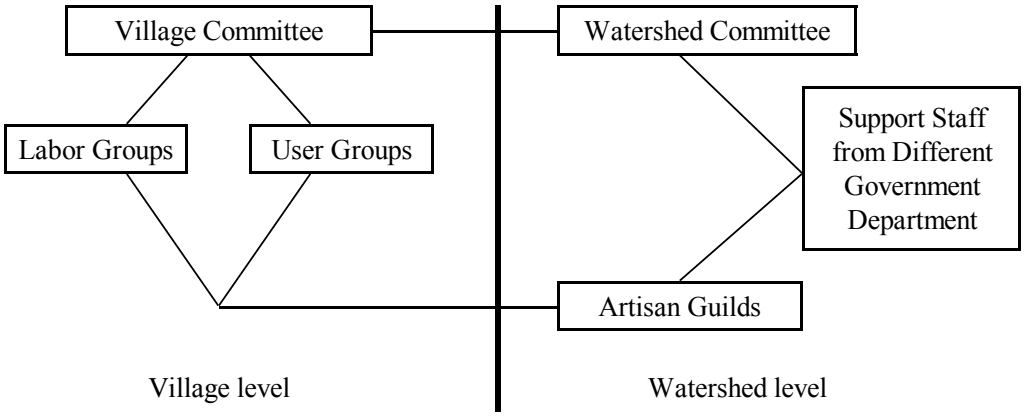

Figure 8. Changed Organizational Arrangement for Field Level Implementation (BIWRMP)

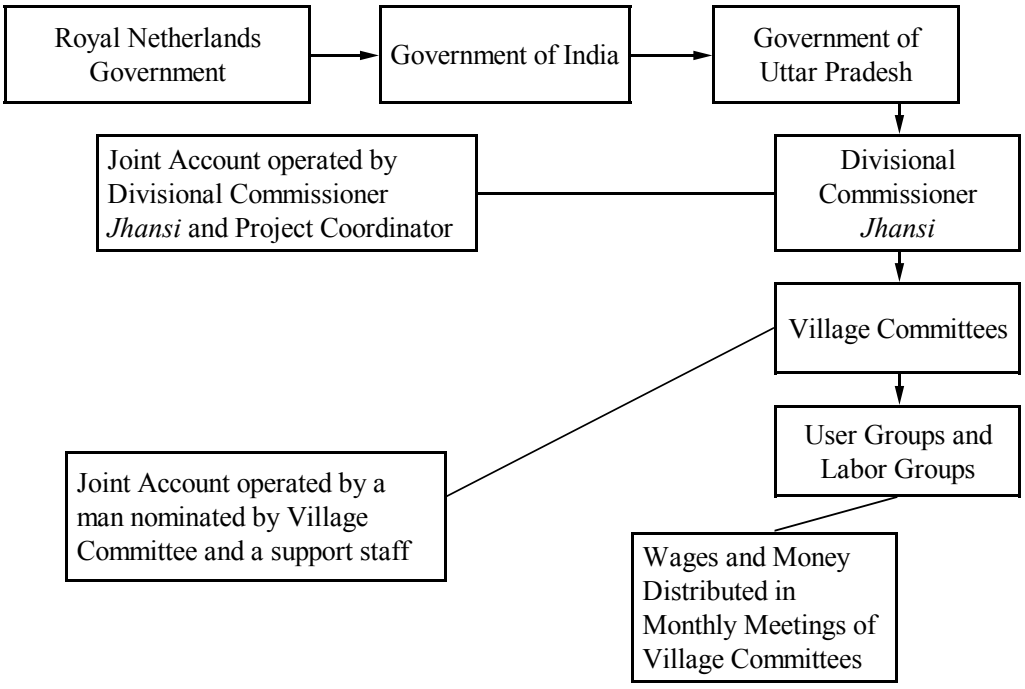

Figure 9. Flow of Funds (BIWRMP)

The project is still at the implementing stage and it is too early to draw conclusions about success or failure of the project. But seeing the progress of the project it is suggested that the methodology adopted in the project needs further examination and change. Initially, the project was formulated for 20 watersheds of 2,500 ha each, with an estimated cost of Rs.265.1 million.

But due to very-very slow progress in first three years, i.e. 1 May 1996 to 31 May 1999 of the pilot phase, its size has been reduced to two watersheds with an estimated cost of only Rs.54.2 million. The main reasons for slow progress was the delay in arranging finances for the project and arrangement of concerned government staff, unwillingness of government staff to work in the project, internal contradictions between people involved, lack of capacity building of all involved etc.

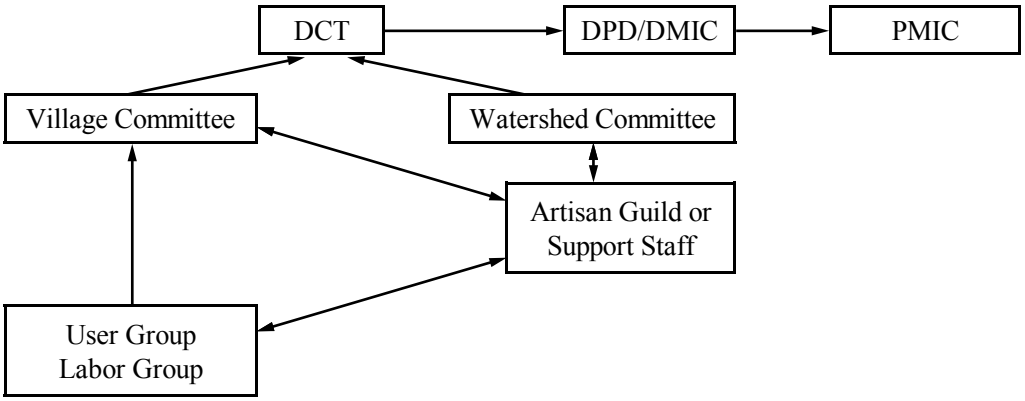

Figure 10. Micro Plan Formulation and Approval (BIWRMP)

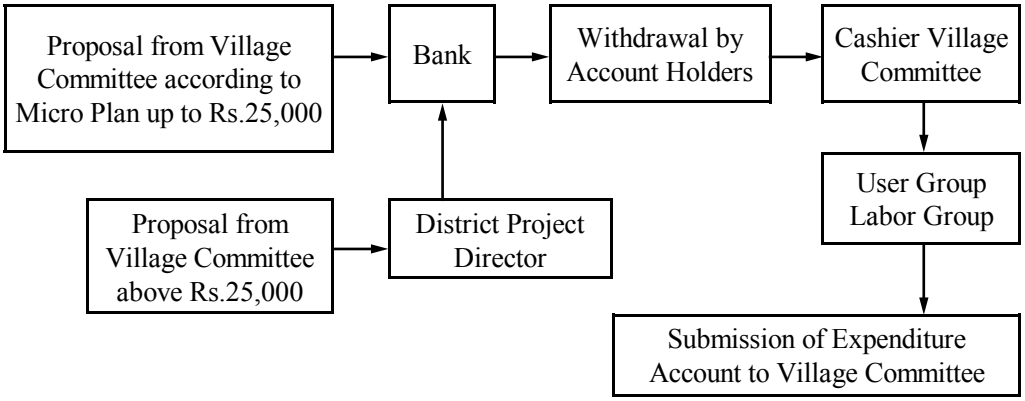

Figure 11. Money Withdrawal Process (BIWRMP)

NGO/Voluntary Organizations in PIM

NGOs and voluntary organizations can play a major role in effecting basic change in the management of water resources development in the country. In the tribal areas of Panchmahal district, Gujarat, a large numbers of irrigation cooperatives have been functioning for quite some time with support of Sadguru Water and Development Foundation. Similarly in Sriramsagar Projects of Andhra Pradesh, a voluntary organization, the Institute of Research, Development and Social Management has successfully formed Pipe Committees.

NGOs have undertaken commendable work in watershed development programs. A few examples of these are Ralegaon Shindi in Maharashtra, Sukhomajri near Chandigarh in Haryana and Village Randhan in Bundelkhand region of Uttar Pradesh. These NGOs and

voluntary agencies which can bring about the concept of group action between farmers so that they can operate and manage the system more efficiently.

During recent drought, in many areas of Gujarat, Maharashtra, Madhya Pradesh and Rajasthan, people, without waiting for government action have grouped themselves and solved water crises. Some examples are described below:

a. People of Saurastra in Gujarat without any help from government have recharged 250,000 abundant dug-wells by diverting rainwater into them.
b. People of Dewas town, Madhya Pradesh adopted a simple technique of rooftop rainwater harvesting and recharge to solve the water crises.
c. Saudhaya Parivar of Shri Pandurang Shastri of Maharashtra, successfully diverted rainwater from rooftops to hand pump borings for groundwater recharge from their own resources. They also constructed several check dams/*bundhis*/ponds for water conservation.
d. In Jamnagar district of Gujarat, people without waiting for a government initiative, launched a popular movement, collected money for desilting of reservoirs and engaged them selves in voluntary labor.

In fact, unprecedented water crisis in some part of above States has united people for community action.

FUTURE PROSPECTS OF PIM

In the recent past, many steps have been taken to introduce PIM in India. Adopting them and operationalizing them will go a long way in better water resource management in the country. Until now, the progress of participatory management had been very slow in India due to various reasons, principal among them is the attitude of government staff in water resources sector who apprehend of losing their powers or even losing their jobs.

Lack of resource literacy of the stakeholders is another major factor responsible for the slow progress of PIM in India. Lack of conducive legal environment for the growth of WUAs is yet another reason for slows progress of PIM. But the ground has been made for PIM and people are coming forward now to take up the initiatives and responsibilities. If the government agencies will not come forward, they will be sidetracked by peopleís might. As already discussed, puzzled with the inaction and inefficiencies of the government, people without waiting for government action, came forward and managed their water resources. With further increase in water crises in future, more and more people will come forward for community action for the management of water resources.

Thus future prospect of PIM in India are very good but its sustainability will depend on evolving suitable PIM models acceptable to socio-political environment of the country, resource literacy and awareness, will of political leadership and change in the attitude of government agencies. In a socio-political environment like India, where individual interests overshadow national and social interests in general, it will take some time to finally evolve suitable PIM models.

Some of the steps needed to effectively manage organizational change for improved PIM are discussed below:

(i) Policy initiatives to effect organizational changes for improved PIM have already been taken and it has been pledged to bring organizational changes in irrigation establishments, which encourage and support PIM. But progress in this regard, especially in States is very slow. To enhance this, Government of India may circulate model guidelines and ask the States to complete the task within stipulated time otherwise central grant will be withheld.

(ii) National Water Policy envisages basin approach and establishment of basin authorities for integrated planning and management of water resources. For this also, a time-bound program for the constitution of basin authorities should be designed and implemented.

(iii) Enhancement of the process of enactment/amendment in laws for formation of WUA to give complete authority and responsibilities to regulate and operate water supply systems, fix irrigation charges to recover the cost etc. Halfhearted approach in this regard will not pay any dividend.

(iv) There are many success stories of PIM in India. There is a strong need to document these stories and evolve acceptable models of PIM so that other may follow the same.

(v) Resources literacy and awareness of stakeholders are important. Any organizational change should satisfy this need. Unless and until people know the issues involved and how to tackle these issues, they will not come forwarded for participatory action.

(vi) In India water is a State subject due to which States adopt different policies, often deviating from national perspective and goals. Similarly in States too, there are many departments, engaged in water development and management, often governed by individual interests ignoring holistic approach to water resource development. Though National Water Policy recognizes water as a national resource and envisages that its development should be governed by national perspective, but this has not proved to be sufficient to induce desired organizational change. When water is a national resource it should be the central subject. Now this is high time to amend the constitution for making water as a central subject and bring all the concerned agencies under one umbrella.

(vii) Finance is important is any system, economy or arrangement. If it is made mandatory that funds for operation and maintenance will be given exclusively to community organizations, concerned government organization will be forced to change their organization, which will then promote PIM.

(viii) PIM in case of groundwater is more critical and complex in India because, with large number of scattered wells and entrenched tradition of private use rights, needs and opportunity vary greatly, often at local level. Furthermore, groundwater management experience is a new area in India and solutions are not clear-cut, pilot management projects will initially be essential to guide the finalization of feasible management options and arrangements for PIM. Thus to begin with, an alternative participatory management framework prepared by Central Ground Water Board should be immediately implemented either through legislation or through administration. Although further investigation is required it may be adopted on pilot basis. This model arrangement is shown in Figure 12.

(ix) The capacity of State Ground Water Organizations (SGWOs) to operationalize participatory management approach should be enhanced. This enhancement should address socio economic and legal as well as the technical dimensions of management.

To do this it may be necessary for GWO to create in house cells having these capacities.

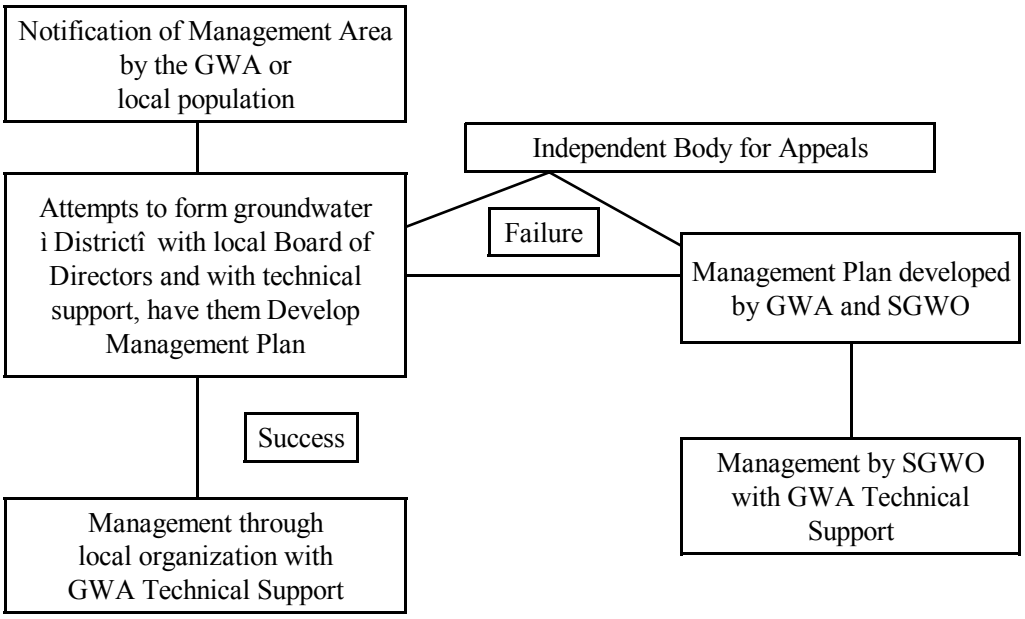

Figure 12. Alternative Management Framework for PIM

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6. INDONESIA

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INTRODUCTION

The new paradigm in agricultural development in Indonesia envisages that it can be carried out by farmers for their own benefit. The role of the government is facilitation, i.e., supporting, easing, and enabling farmers to undertake their business efficiently. The type of business is to be decided by farmers, and the government role is helping them in analyzing opportunities and risks, so they will be able to make their own choices rationally. This participatory approach, which implies that bottom-up planning will be the main characteristics of future planning mechanisms of agricultural development included irrigation development. In this regard, various measures that have been undertaken in the past and will be continued in the future are:

a. Planning and management authority of agricultural development and irrigation development is delegated to provincial and district government, whereas the ministry at the central level is responsible only for the macro plan.
b. Annual plan is a combination of bottom-up and top-down, with greater weight for the bottom-up portion, to ensure the conformity with local specific resources and aspirations.
c. Enhancing regional institution and human resource capabilities to formulate participatory agriculture planning, irrigation planning and services.

The new paradigm in agricultural development brings about changes in water values, from public goods to economic goods which has a social function. It may create a shortage of water availability on national level and competition in water use between irrigation and other sectors. Therefore, it is required to make a new policy on water management, so that the continuation of irrigation systems and the water rights for all water users are secured. In the past, development and management of irrigation had drawbacks, which were shown by low society participation, low efficiency and effectivity, and early damaged of irrigation network.

In the future, with the presence of law Nos. 22 and 25 of 1999, the role of regional authorities (especially districts) become very important, since they are given a wide range of authority to manage all development activities in their region including irrigation management.

CURRENT SITUATION OF IRRIGATION DEVELOPMENT IN INDONESIA

Growth in Irrigation Area and Potential for Further Expansion

At the early phase of the economic development, the Government of Indonesia had given a lot of attention to development and rehabilitation of infrastructure, such as roads and irrigation systems. The irrigation development was directly aimed to support agricultural development. In a broader context, water resources development should also be directed to support other strategic sectors such as industry, housing and, resettlement and transmigration.

Indonesia's population in 1999 reached 206.5 million at a growth rate of 1.68 percent per annum (1990-1997). Sutardi (1996) stated that the "Formulation of Irrigation Development Program (FIDP)" (1993) had estimated the necessity of increasing the paddy production by about 910,000 mt every year to meet the demand for growing population. In order to fulfil this demand, in addition to other efforts such as rice intensification program, a rice extensification program, i.e., construction of new irrigation schemes totaling an area of about 1.5 million ha is also required for the next 25 years. This is about 300,000 ha in every five years.

The FIDP study also estimated that the total water demand in 2020 would be 127 billion m^3 (BCM) compared to the natural basin runoff of 1,847 BCM. Demand for irrigation has the dominant share (74 percent of the total water demand) followed by the domestic, municipal and industrial demand (11 percent).

The FIDF study has also estimated the total potential area for irrigation development in 2020 at 10.8 million ha, based on the land suitability and water availability.

Government Expenditures/Investments in Irrigation Facilities

During the first three *Pelitas,* the concentration of development effort focused on Java because at the beginning of the *Pelitas* almost 75 percent of the irrigated land were located in this island. Gradually, the focus of development has shifted to off-Java areas, because of the limited area available in Java. During the Fourth *Pelita* (1984-89) the priority of irrigation development had centered on transmigration and rice-producing areas off-Java. It was realized, however, that the productivity of agricultural land outside Java area is relatively low and its economic infrastructure severely lacking. In addition, in contrast with Java, the development of new irrigation networks outside Java did not sufficiently induced farmers to develop irrigated lands for cultivation.

Since 1978, a credit program for irrigated area development was launched to stimulate farmers to undertake land clearing, leveling and land shaping. During the Third *Pelita* there was an increase of about 150,000 ha out of the potential irrigated area of 350,000 ha. But only about 40 percent of this new irrigated area had been developed through the credit program for land development during the Fourth *Repelita*. The effectiveness of this program, in many cases, remains constrained by difficult and time consuming credit application procedures, the unavailability of labor, the uncertain status of land ownership and the unavailability of irrigation at tertiary outlets.

The flow of government funds for irrigation investment is relatively easy to trace but returns to the government resulting from such investment is difficult to measure. One of the indirect sources of income is the tax on irrigation land where per ha taxes depend on assessments based on productivity of the land.

Because much of irrigation benefits are likely to be capitalized into land values, such a tax has the potential to reflect the benefits received from irrigation. However, continuous assessment is needed to update the land classes and strengthen the relation between tax

payments and irrigation benefits. Various efforts in this direction are being introduced such as implementing the new land reclassification and valuations system, based on the market value of land, an inventory of landholding based on aerial photography and, developing an efficient and effective tax management and collection system. With the present economic downturn, development priorities need to be further refined. There is a tendency from the government to expect increased participation of the local communities in financing irrigation development and management in addition to the land tax.

Programs for water resources development would be carried out by both the government and society. The total State budgets for water resource sector (State Ministry of Public Works/Ministry of Settlement and Regional Infrastructure [MSRI]) for period 1994/95-1999/2000 are presented in Table 1. This Table shows that the budget allocation for irrigation program was much bigger than total budget for agriculture and forestry development. Since the First Five-Year Development Plan, agriculture sector received a bigger portion of budget allocation and, agriculture or the produce food absorbs the biggest labor force (65-70 percent) and supply raw material.

Development of irrigation infrastructure had rapidly increased in 1970s with funding from loans and national budget. The main target of this development is food production. After State Ministry of Public Work/MSRI delegated the tertiary irrigation management to Ministry of Agriculture and Forestry, Ministry of Agriculture and Forestry allocated the budgets for tertiary irrigation development for fiscal year 1999/2000 of Rp.22.3 billion and Rp.112.03 billion for fiscal year 2001.

Each of provinces and districts also has their own budgets for tertiary irrigation management under decentralization, which was started in 2001. It was obvious that irrigation development, specifically surface irrigation, need high investments. FAO (1993) reported that capital cost for new irrigation capacity runs between US$1,500 and US$4,000 per ha for large projects, in China, India, Indonesia, Pakistan, the Philippines and Thailand. FAO also estimated that even medium-sized irrigation construction costs ranging from US$2,400 per ha in Asia to US$7,200 in Africa. Hence, the government should continue to participate in constructing new irrigation to support rice production. The achievement of rice self-sufficiency in 1984 indicated that all efforts were well organized and implemented through provision of cultivation technology, agriculture infrastructure and facilities of which one was irrigation, agriculture input (seed, fertilizer and agrochemical) and food price policy. But unfortunately since 1990s rice self-sufficiency could not be sustained due to some factors such as: unfavorable natural condition (long droughts and floods etc.), rice cultivation is less profitable (unstable market price) and, demand for rice is ever increasing due to high rate of population growth, etc.

In order to anticipate these conditions, Ministry of Agriculture and Forestry has launched a crash program in 1998 that was called *Gema Palagung* (Self-reliance Development for Rice, Corn and Soybean) and SPL INP-22 through "increasing of cropping area (PAT) and intensification quality (PMI)" which put emphasis on maintaining the sustainable food supply. The SPL-OECF (SPL-JBIC) program is implemented in 25 provinces covering 194 *Kabupatens* with new planning area targeted at 927.758 ha for three land topologies, i.e., irrigated area, swampy area, and dryland area.

Table 1. National Budget for Water Resources Sector (1994/95-1999/2000)

(Unit: Rp. million)

Program	1994/95 Actual	1995/96 Actual	1996/97 Actual	1997/98 Actual	1998/99 Actual	1999/2000 Actual
Irrigation Program	855,045	839,170	1,175,964	1,423,100	1,224,166	2,154,225
Raw Water Program	102,448	82,684	117,087	262,900	255,000	164,522
Flood Alleviation and River Management Program	337,449	303,431	291,805	466,500	445,500	1,023,742
Water Resources Development, Conservation and Management Program	269,627	405,361	374,653	244,200	236,000	957,449
Water Supply Development Program	496,182	693,699	-	-	-	-
Total budget for water resources system	2,060,751	2,324,345	1,959,509	2,396,700	2,160,666	4,299,938
Total budget for agriculture sector (A)*	1,645.5	880.9	1,299.8	1,828.9	1,371.9	1,774,800
Total budget for forestry (B)*	11.6	10.1	8.6	8.3	330.9	158,600
(A) + (B)*	1,657.1	891.0	1,308.4	1,837.2	1,702.8	1,933,400
Total budget for national development*	30,691.7	28,780.7	35,951.5	38,358.6	55,142.4	51,560,200

Source: State Ministry of Public Works/MSRI, 2000.

Note: * National Budget Planned, Issue 1999 and 2000 (all actual data).

Out of these planning area expansion, an additional production of about 2.1 million mt of GKG, 300,000 mt of corn, and 400,000 mt of soybean is expected. The total budget allocation for SPL-JBIC INF-22 was Rp.1,461 billion of which Rp.1,171 billion (80 percent) for infrastructure development on farm irrigation, and for other activities such as land cultivation, post-harvest aspects, training, and institution development.

Activities of this crash program are concentrated on the development of facilities and infrastructure, which can be partitioned into five groups of activities, namely:

(1) Agricultural infrastructure development such as drainage, water facilities, and farm road;
(2) The provision of agricultural machinery including pre- and post-harvest machinery in order to speed up land preparation and to increase product quality;
(3) Dissemination of farming technology;
(4) Strengthening of agricultural institutions; and
(5) The provision of consultancy services.

Through the provision of agricultural facilities and infrastructure, it is expected that the land utility will be optimized both through the increase of crop intensity and area planted and in agribusiness. Since that year to 2004, Ministry of Agriculture and Forestry will have a food security program and an agribusiness program. Out the three land types (irrigation land, tidal swampland and dryland), irrigation land has a big share for food production compared to the others.

Impact of Irrigation on Farm Productivity

Agriculture remains a key sector of the Indonesian economy, contributing 18.01 percent of GDP in 1998 and providing employment to some 65-75 percent of the labor force. Irrigated agriculture plays a very important role in the production of staple foods in Indonesia, especially rice. In 1996, the total area of paddy was 9,947,715 ha of which irrigated paddy was 7,137,700 ha or 71.7 percent and the remaining 2,810,015 ha or 28.3 percent were rainfed paddy, tidal swamp and upland paddy. At present, about 5,537,700 ha are irrigated under public sector management and about 1.6 million ha are operated under village irrigation systems, primarily managed by farmers themselves. The estimated area of paddy cultivation and the irrigated area by islands groups are given in Table 2.

Table 2. Irrigated Areas Based on Main Islands in Indonesia, 1996

(Unit: 000 ha)

Island	Area under Paddy*	Irrigated Area
Sumatra	2,418.8	2,254.1
Java	5,058.5	3,176.3
Bali and Nusa Tenggara	551.0	438.1
Kalimantan	780.3	202.8
Sulawesi	1,067.3	993.9
Maluku	111.8	66.5
Total	9,987.7	7,131.7

Source: Sutardi, 2000.
Note: * Estimated figure.

Food security and sustaining self-sufficiency in rice production and agribusiness program had been the major policy of the Government of Indonesia. Irrigated agriculture had been a major vehicle for increasing rice production. The main objective of irrigation development is cultivation of rice, the staple food of Indonesians. The self-sufficiency of rice had been achieved since 1984, but in recent years rice imports become necessary again.

Rice production in Indonesia in the 1980s was very impressive. During the period 1980-90, the production of paddy has increased from 29.65 million mt to 45.18 million mt and the harvested area has increased from 9,005 million ha to 10,502 million ha. During the period 1991-99, the paddy production increased from 44.69 million mt to 50.40 million mt, and area harvested increased from 10.50 million ha to 11.86 million ha. The increased of paddy areas and production also followed by an increase in the yield.

The yield increased from 3.29 mt per ha to 4.25 mt per ha (Table 3). On the average, rice areas grew 1.44 percent, production grew 1.32 percent and yield grew 2.76 percent for the last 20 years (1980-99). The increase in production was partly caused by the improvement of irrigation programs. However, the production growth of rice of 1.32 percent per annum is slightly below the population growth, which is 1.68 percent per annum, so rice import continue to grow.

Table 3. Area Harvested, Production and Yield of Rice, 1980-99

Year	Area Harvested (000 ha)	Production[1] (000 mt)	Yield[1] (mt/ha)	Rice Growth (percent)		
				Area	Production	Yield
1980	9,005	29,652	3.29	-	-	-
1981	9,382	32,774	3.49	4.19	10.53	6.08
1982[2]	8,988	33,584	3.74	-4.20	2.47	7.16
1983	9,162	35,302	3.85	1.94	5.12	2.94
1984	9,764	38,134	3.91	6.57	8.02	1.56
1985	9,902	39,033	3.94	1.41	2.36	0.77
1986	9,988	39,726	3.97	0.87	1.78	0.76
1987[2]	9,923	40,078	4.04	-0.65	0.89	1.76
1988	10,138	41,676	4.11	2.17	3.99	1.73
1989	10,531	44,726	4.25	3.88	7.32	3.41
1990	10,502	45,179	4.30	-0.28	1.01	1.18
1991[2]	10,282	44,689	4.35	-2.09	-1.08	1.16
1992	11,103	48,240	4.34	7.98	7.95	-0.23
1993	11,013	48,181	4.37	-0.81	-0.12	0.69
1994[2]	10,734	46,641	4.35	-2.53	-3.20	-0.46
1995	11,439	49,744	4.35	6.57	6.65	0.00
1996	11,570	51,102	4.42	1.15	2.73	1.61
1997[2]	11,140	49,337	4.43	-3.72	-3.45	0.23
1998	11,730	49,327	4.21	5.30	-0.02	-4.97
1999[3]	11,864	50,402	4.25	1.14	2.18	0.95
Total	208,160	857,527				
Average	10,408	42,877	4.12			

Source: Central Board of Statistics (CBS).

Notes: [1] Yield and production in terms of unhusked paddy; [2] 1982, 1987, 1991, 1994, 1998 were long drought years; and [3] preliminary figures.

Change in Irrigation Policy and Relevant Strategy

Sutardi (1996) stated that since 1969, the government had undertaken major programs in irrigation development which comprised of rehabilitation of existing irrigation works, expansion of service area in the existing schemes, construction of new irrigation systems, upgrading semi-technical irrigation systems to fully technical levels, introduction of special maintenance to upgrade the physical infrastructures, implementation of efficient Operation and Maintenance (O&M), launching of sustainable O&M program and, a subsidized credit facility for inputs and strengthening of Water User Associations (WUAs). The irrigation development included surface irrigation and drainage systems in lowlands and in swamp areas as well as groundwater irrigation. During PJP I (1969-94) period, about 1.44 million ha have been provided with new irrigation systems while 3.36 million ha of existing irrigation systems were either rehabilitated or upgraded through special maintenance. The estimated expenditure on irrigation development during PJP I period was US$10.06 billion of which 71 percent was funded through external loans.

In the framework of enhancing the sustainability of the irrigation agriculture, the government in 1987, developed a statement of policies for irrigation O&M. Under this, policies were established related to funding of O&M, cost recovery for irrigation O&M, institutional development and budgeting and programming for O&M along with an action plan. A change in government priorities towards irrigation O&M was initiated by increasing funding for O&M activities, setting up of WUA, strengthening of irrigation O&M institutions, initiating turnover program in which irrigation systems smaller than 500 ha area handed over to farmers organizations and implementing an Irrigation Service Fee (ISF).

Beginning in *Repelita* VI (1994) the country is implementing an irrigation decentralization program under which the O&M and management of all irrigation systems, will be transferred to the district. To support this policy, the government has implemented a cost recovery of O&M program termed ISF which is gradually being implemented in all provinces.

The O&M budget has increased by 243 percent in the past five years and is currently at Rp.27,000/ha of irrigated land. Further, the government has instituted a turnover program under which irrigation systems having less than 500 ha are being handed over to WUA for operation, maintenance and management. About 420,000 ha have been turned over in the past 10 years. This program will be continued in the future for larger schemes, i.e., between 500-1,000 ha with the assistance of the World Bank and ADB. The above initiatives in irrigation management are expected to support sustainability in irrigation. To sustain rice self-sufficiency the government is implementing a crash program in *Repelita* VI to improve about 1.6 million ha of village systems (a major portion of this improvement program, i.e., about 1.4 million ha of village irrigation system have been completed during the last three years since 1995). A similar crash program is also implemented to reclaim about 400,000 ha of swampy land in Central Kalimantan for agriculture.

THE PRESENT ORGANIZATIONAL SET-UP OF IRRIGATION ADMINISTRATION IN INDONESIA

Sutardi (1996) reported that in the Water Law No. 11/1974 the state has empowered the government to administer all water resources, including the natural resources contained therein. The government authorizes, to the central, regional or corporate bodies, to implement the government's power in administration of all water resources. This authorization has been

distributed to several agencies i.e., the Ministry of Mining and Energy, for groundwater administration and also for the development and management of hydroelectric power. The Ministry in charge of surface water resources is presently State Ministry Public Works/ MSRI, except for tertiary irrigation, which is under Ministry of Agriculture and Forestry. The quality of all natural resources and the environment is managed and administrated by the State Ministry of the Environment. Ministry of Agriculture and Forestry is in charge of watershed protection, and Ministry of Home Affairs is in change of administering ISF collection and formal establishment of WUA.

Sutardi (1996) also stated that by Ministry of Public Works Regulation No. 48/89, the management of water resources, based on government Regulation No. 22/82 is given to the regional government as 73 river basin units for co-management. Co-management means that the lower regional government executes services as planned by the government or upper regional government with the responsibility of instructing to the government. Two river basin units are managed by government owned corporations and 15 river basin units are still managed by central government because they cover more than one province or because they play a strategic role in the national economy. Planning and programming activities of water resources development through water resources projects have been done through the Ministry of Public Works with consultation of the BAPPEDAS (Regional Planning Board) and BAPPENAS (National Planning Board). The projects are implemented by a project implementation unit following de-concentration or co-management principles. The decentralization principle is also applied for O&M as well.

By the Presidential Decree No. 244/1994, the government has assigned the Ministry of Public Works with the duty of implementing government administration concerning public utilities and their development, which include the water resources. By the Ministerial Decree No. 211/1994, the Ministry of Public Works delegates the Water Resources Administration and Development to Directorate General of Water Resources Development (DGWRD).

Currently, some of the function of DGWRD i.e. tertiary irrigation for agriculture, delegated to Directorate of Irrigation Water Management, Ministry of Agriculture and Forestry. Meanwhile, according to Presidential Decree No. 12/2000, State Ministry for Public Work/MSRI will be responsible only for infrastructure water resources: dam, irrigation network, flood control structures, etc., which needs heavy budget allocation.

RECENT DEVELOPMENTS IN PROMOTING PARTICIPATORY IRRIGATION MANAGEMENT IN INDONESIA

As indicated before, in order to develop new irrigation facilities, a higher level of investment is required. There is a need for reviewing the policy of new construction of large-scale irrigation schemes in the context of present circumstances where the country is faced with economic crisis and difficulties of state funding for development activities.

Increasing demand for water necessitates the reallocation of water (to other sectors) from irrigation, which uses by far the largest share of available flows. Much of the water currently diverted into irrigation schemes returns through surface and groundwater flows. Reallocating water to different uses or locations requires taking account of these return flows. In principle, only the portion of water used consumptively should be available for reallocation. Further work is needed to develop an appropriate framework for regulating water reallocation in water-scarce basins. If equitable, legitimate procedures are not available for water reallocation, then

the risk is that reallocation will be done illegitimately, or by expropriation without compensation. To ensure that the farmers have secure access to water, farmers have created participatory institutions to regulate water allocation and relocation called Water User Association (WUA). Such institutions represent farmers' interest and protect their rights and access to water. Currently, there are 37,000 WUAs, but half of them are inactive. Moreover, the country requires about 100,000 WUAs.

Experience with WUA federations shows the potential for improving irrigation management by involving farmers at village level. The 1992 Ordinance of the Minister of Home Affairs No. 12 on "Guidance and Development of WUA" provided for the creation of forums for coordination among WUA. Federations (*gabungan*) have also been created as part of ISF, though mainly acting as channels for fund collection. Some turnover schemes covering hundreds of hectares and involving multiple villages have formed federation type structures where representatives of smaller units joined to manage turned over schemes. Often these built on either patterns of local level cooperation between villages. Existing village level irrigation activities often consist of a federated pattern of cooperation among farmers from different irrigation blocks and residential neighborhoods (*dusun*). Pilot projects in several provinces have explored the role of federations for improving management at the irrigation scheme and sub-basin level. Forming federations based on elected representatives of existing local level irrigation institutions, whether formal WUA, village-managed, or other more traditional or informal institutions, can be done relatively rapidly, after which a continuing process will be needed to build the capacity of such larger-scale organizations.

Efforts toward to the utilization of irrigation water efficiency should get high priority through WUAs, with the focus on increasing of cropping intensity in order to support expansion of cropping area. The successful of irrigation water management development in the future depends on farmers' participation as beneficiaries. Farmers who depend on irrigation water for their livelihoods have the strongest incentive to manage that water very carefully. This should be reminded by the government and stressed on farmer participation in the implementation of irrigation infrastructure development as well. Involvement of farmers in planning, implementation and monitoring is important. Concept of farmers' participation in irrigation sector development was known as Participatory Irrigation Management (PIM). It is being implemented in some developed countries such as Japan and initiated or adopted by developing countries like Philippines, India, and Sri Lanka.

PIM refers to the involvement of irrigation users in all aspect of irrigation management and at all levels. All aspects includes the initial planning and design of new irrigation projects or rehabilitation/improvement, as well as construction, supervision, financing, preparation of decision rules, O&M and monitoring-evaluation of the system. "All levels" refers to the full physical limits of the irrigation system (quarter, tertiary, main system canal), and up to the policy level in the capital city (inter-sectoral). And, management function, including the setting of policies, can and should have participatory dimension.

In relation to the food security and agribusiness program, Directorate of Irrigation Water Management, Ministry of Agriculture and Forestry has arranged various activities with involvement of farmers including rehabilitation of irrigation network, specifically for communal/village irrigation, development of water source utilization (surface and ground) through pumping, rain harvesting or water conservation, optimization of irrigation water and empowerment of WUA, as the basis for the development of farmers participatory approach.

FUTURE PROSPECTS FOR PIM IN INDONESIA

In the future, bottom-up planning will dominate irrigation management, since top-down approach in irrigation development is not in line with irrigation behavior which has socio-technical characteristics. With the top-down approach, the role of WUA in irrigation management is not developed as expected. The unsuccessful development of WUA in the past was partly due to limited budget and low quality of human resources involved in irrigation management. According to CBS, out of a 37.7-millions labor force in agriculture in 1996, 43.68 percent graduated from primary schools and 43.49 percent did not have primary education. It caused the implementation of O&M of irrigation sub-optimal.

The transfer of small irrigation from government to WUA since 1988 has not worked as expected, also due to lack of guidance from government to the farmers after period of transferring.

To make the irrigation systems viable, it is needed to rearrange duties and responsibilities between government and farmers in managing irrigation and the development of WUA. The new arrangement can empower farmers and enhance the investment by them. In such circumstances, the farmers could, and will become decision-makers in irrigation system management. However, the WUA should always pay attention to state and other water user interests.

In line with autonomy policy in Indonesia, which will be started in 1 January 1 2001, farmerís participation in irrigation will be stimulated through new irrigation management policy such as:

i) Redefinition of the duty and responsibility of WUA. The government will redefine duty and responsibility of WUA at national, provincial, district and the farm levels. WUA will be the single decision-maker in its working area in managing irrigation network.
ii) To develop WUA as an autonomous water institution.
iii) To transfer the management of irrigation to farmers. If the WUA has not been able to manage the irrigation, the government will guide the WUA until the WUA can stand alone.

Even the farmers have been able to manage their own irrigation, the government will continue to have the responsibilities in monitoring, evaluation (technical and budget audit) and will extend technical assistance and budget aid when the farmers are unable to do so.

Considering the heavy investment in irrigation done by government (to build, to operate and to maintain, to rehabilitate, to develop institution, etc.), the government will preserve water resources, and will prevent irrigated land conversion to non-agricultural purposes. To maintain the continuation of irrigation systems, the farmers and society in the region are expected to participate in each step of irrigation development.

When the farmer organizations are responsible for irrigation, they require authority to mobilize money and other resources from water users, and to control how this money is used. Under the current ISF program, fees go into an account under the district revenue office, and are used to fund works managed by the irrigation agency. The area covered by fees has expanded slowly, however, the collection rates are declining, and ISF accounts for only a tiny portion of O&M budgets. Bruns (1998) indicated that current ISF fees of Rp.15-30,000/ha

(approximately US$6-15/ha at pre-1997 exchange rates) are usually only a few percent of the value-added created by irrigation. Bruns suggested that the task of collecting and using ISF should be delegated to farmers, in the form of WUA.

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7. ISLAMIC REPUBLIC OF IRAN

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INTRODUCTION

The Islamic Republic of Iran, having a population off 65 million, and an area of 1,648,000 km^2 is located between latitudes of 25-39° N and longitudes of 44-64° E. The mean annual precipitation in Iran is about 416 billion m^3. The mean annual evapo-transpiration, deep percolation to alluvial aquifers, surface runoff within the country, and surface runoff from borders are 300 billion m^3, 25 billion m^3, 92 billion m^3, and 13 billion m^3, respectively. Therefore, a mean annual volume of 130 billion m^3 of water is potentially available (Anonymous, 1998).

A mean annual volume of about 51.30 billion m^3 from groundwater resources is being utilized in the country. The volume of regulative mater in the storage dams is 32 billion m^3, of which a mean annual volume of 18 m^3 is being utilized (Anonymous, 1999). The traditional utilization of normal flow is 20.50 billion m^3 and small water projects provide 2 billion m^3 (Anonymous, 1999). Therefore, a mean annual total volume of 40.50 billion m^3 from surface runoff is utilized. The mean annual water consumption from groundwater resources and surface flows is about 90 billion m^3. Out of 130 billion m^3 of potentially exploitable water, the remaining 40 billion m^3 of water goes out of access, annually. From 90 billion m^3 easy of access water, 94 percent is used in agriculture, 1 percent in industry and 5 percent as drinking water.

Based on the recent results of the General Census (1988), about 18.5 million ha of the area of Iran is used as arable lands, of which 5.8 million ha are used as irrigated lands, 2.0 million ha as irrigated orchards, and the remaining 10.7 million ha are utilized under rainfall conditions (Anonymous, 1999). During the Third Five-Year Program, the area of lands under irrigation will increase to 9.05 million ha.

The number of families who are working in agriculture sector is 3.3 million, 93.8 percent of them own 58.9 percent of arable lands and the mean area of their land is 3.83 ha which is mainly scattered in separate pieces. The agricultural land in Iran can be expand to 37 million ha (Anonymous).

THE GOVERNMENT INVESTMENTS AND EXPENDITURES IN IRRIGATION FACILITIES

Beneficiaries carry out renovation and reconstruction of "*qanats*", digging and equipping of agricultural wells through bank credit facilities. Small dams are reconstructed and

maintained by farmers and is supported by the government through bank loans and development credits. The government undertakes the necessary investments in constructing huge dams and irrigation and drainage facilities.

The number of big storage dams in Iran was 13 in 1979. This was increased to 77 by the year 1999 (Anonymous, 2000). From 1997 to 1999, 77 irrigation and drainage scheme has been exploited (Anonymous, 2000). The main irrigation systems cover an area of 1.2 million ha, and the area under the secondary irrigation systems is 450,000 ha. The renovated area under irrigation systems is about 350,000 (Anonymous, 1999).

During the Second Five-Year Program (1995-98), about Rl.1,720 billion were allocated to the accomplishment of projects of pressure irrigation systems and Rl.170 billion of governmental credits were spent on guidance and supervision of these projects (Anonymous, 1999). During the First and Second Five-Year Development Programs, different systems under pressure irrigation have been carried out and operated over an area of about 250,000 ha (Anonymous, 2000).

After huge investments by the Ministry of Power during 1996 to 1998, 3 billion m^3 of water was supplied. The expenditure of water was in the range of Rl.750/m^3. However, if the costs of dam maintenance, construction and maintenance of main irrigation systems and delivery system are also taken into account, the expenditure of water will amount to Rl.1,500/m^3 (Anonymous, 1999).

In the Second Economic, Social, and Cultural Development Program, 10 percent of construction and renovation budget was spent on water resources. In the Third Development Program from 2000 to 2004, 12 percent of construction credits is supposed to be spent on water resources (Anonymous, 2000). The total government investments (current and construction budget) in water resources sector from 1998 to 2000 are given in Table 1.

Table 1. Government Investment in Water Resources Development

(Unit: Rl. 000)

	1998	1999	2000
Water supply	496,764,300	1,234,229,600	1,253,461,000
Construction of irrigation and drainage systems	308,724,090	833,652,700	829,647,800
Operation and conservation of water resources	24,202,000	82,187,400	104,585,000
Water resources development studies	28,053,236	74,919,100	72,594,000
Total	857,743,626	2,224,988,800	2,260,287,800

Source: *The Budget Act of the Year 2000*, published by the Management and Planning Organization.

IMPACT OF IRRIGATION ON FARM PRODUCTIVITY

The annual water per capita has dropped from 7,000 m^3 in 1959 to 1,200 m^3 in recent years. About 90 billion m^3 of water is used in agriculture sector, of which more than 60 percent is wasted due to improper utilization (Anonymous, 2000). Water use efficiency in agriculture

sector is about 38 percent. The mean water consumption is 12,100 m^3/ha for irrigated crops (Anonymous, 2000).

The high volume water uptake has resulted in reduction of groundwater sources; consequently, the quality of water has also deteriorated. Therefore, the area under crop production as well as the area under crops per farm unit has decreased due to water scarcity and salinity.

There are many factors responsible for reducing the irrigation efficiency in the field; the most important ones are as follows:

i) Small and scattered pieces of agricultural land;
ii) Lack of proper irrigation systems and inadequate leveling;
iii) Lack of proper management in water utilization;
iv) Inadequacy of financial supports for government for construction, maintenance and operation of irrigation facilities such as, dams and irrigation and drainage systems. This is because the lack of involvement and participation of the beneficiaries;
v) Selling water to beneficiaries on area (ha) basis and with low price;
vi) Lack of supporting services in agriculture such as technical information dissemination to the farmers, crop production planning; and
vii) Lack of appropriate policy such as the lack of planning in importing and exporting agricultural productions.

In general these factors have also led to a drop in income and farmer interest in the agriculture sector. As a result, farmers do not use water efficiently and refuse to invest on irrigation facilities.

There has been at least 60-70 percent increase in production and 30-40 percent increase in the quality of production under pressure irrigation systems in some parts of the country (Anonymous, 1999). Moreover, consolidation and integration of agricultural land as well as mechanization and renovation of farms irrigation systems will have positive effects on optimizing the water efficiency. Better results have been obtained in some parts of the country where land integration and new irrigation systems have been put into practice (Anonymous, 1999).

CHANGES IN IRRIGATION POLICY AND RELEVANT STRATEGIES

The most important change in irrigation policies occurred 40 years back by carrying out pressure irrigation systems (Anonymous, 1999). During the period 1978-89 about 400 ha of agricultural lands had been equipped with pressure irrigation while the corresponding figure for the period between 1989 and 1993 was 19100 ha (Anonymous, 1999). By the end of 1998, about 330,000 ha were under pressure irrigation systems and in 1999, financial resources have been allocated and spent on developing and installing irrigation systems in 60,000 ha in the country.

The following articles of law have been approved in the water and agriculture sector of the Third Development Program to improve and develop agriculture in the country (Anonymous, 2000):

i) Necessary financial support will be considered in the annual budget to facilitate and carrying out the projects for water and soil, irrigation and drainage systems, and rehabilitation of "*qanats*" and springs.
ii) With respect to the recent drought and the necessity of optimum ad rational water utilization, organizing water users will be initiated on the basis of the stabilization of water price in agriculture.

THE ORGANIZATION OF IRRIGATION MANAGEMENT IN IRAN

The Ministries of Power and Agriculture are both responsible in water and irrigation affairs in Iran. A brief description of the organizational structure and functions of these Ministries is given below.

Ministry of Power

This Ministry is responsible for runoff control, construction of storage and diversion dams, establishment of irrigation and drainage systems, conservation, maintenance and operation of surface and groundwater resources and "delivery of water to agricultural fields". The organizational structure of the Ministry is shown in Figure 1.

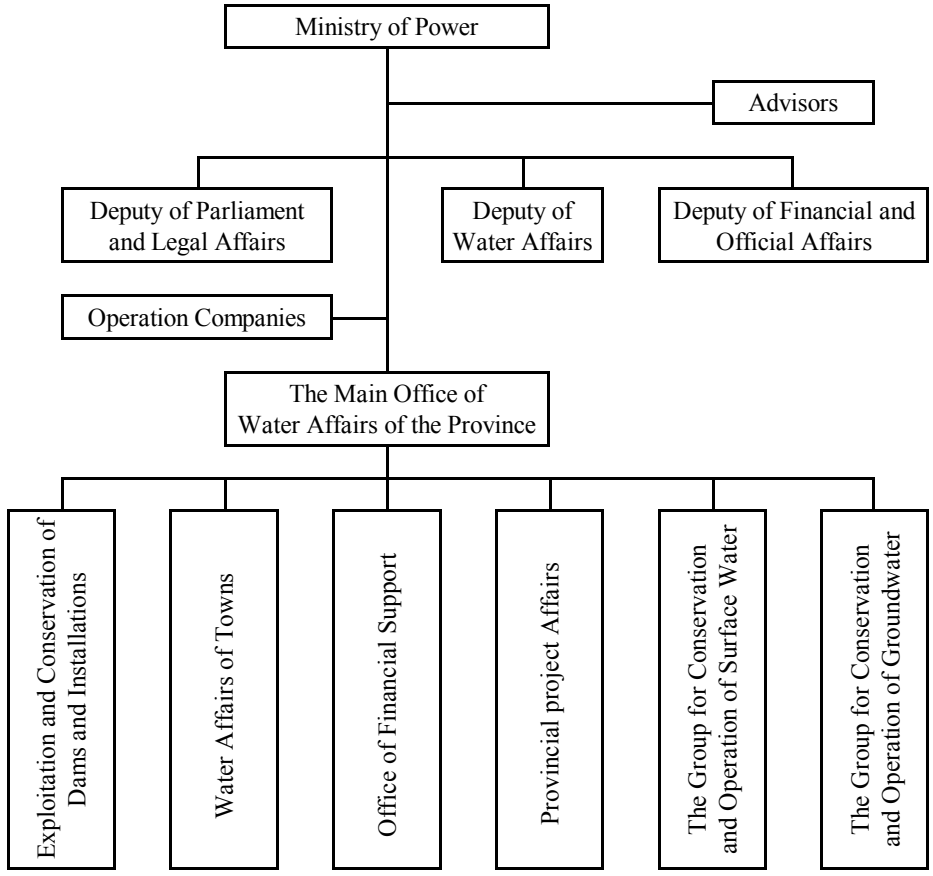

Figure 1. Organizational Structure of the Ministry of Power

On the basis of the defined duties, the operation companies are responsible for construction of secondary canals, maintenance and delivery of water from dams to agricultural lands. These companies are also responsible for the sale water to farmers. They can spend 60 percent of the income on renovation and maintenance of third and fourth class canals, although the income is not sufficient to cover all the costs due to low price of water. The Ministry of Power owns the remaining 40 percent of income spend on different related activities. The main canals are constructed by using government budget (70 percent) and bank loans and facilities (30 percent) to involve water users in the costs of construction.

Ministry of Agriculture

The Ministry of Agriculture is responsible for development and extension of irrigation systems in the field, carrying out small projects of water supply for agriculture, establishing rural production cooperatives, conservation and rehabilitation of *qanats* and springs, expansion and development of agricultural lauds, etc.

The organization chart related to the management of irrigation affairs of the Ministry of Agriculture is shown in Figure 2.

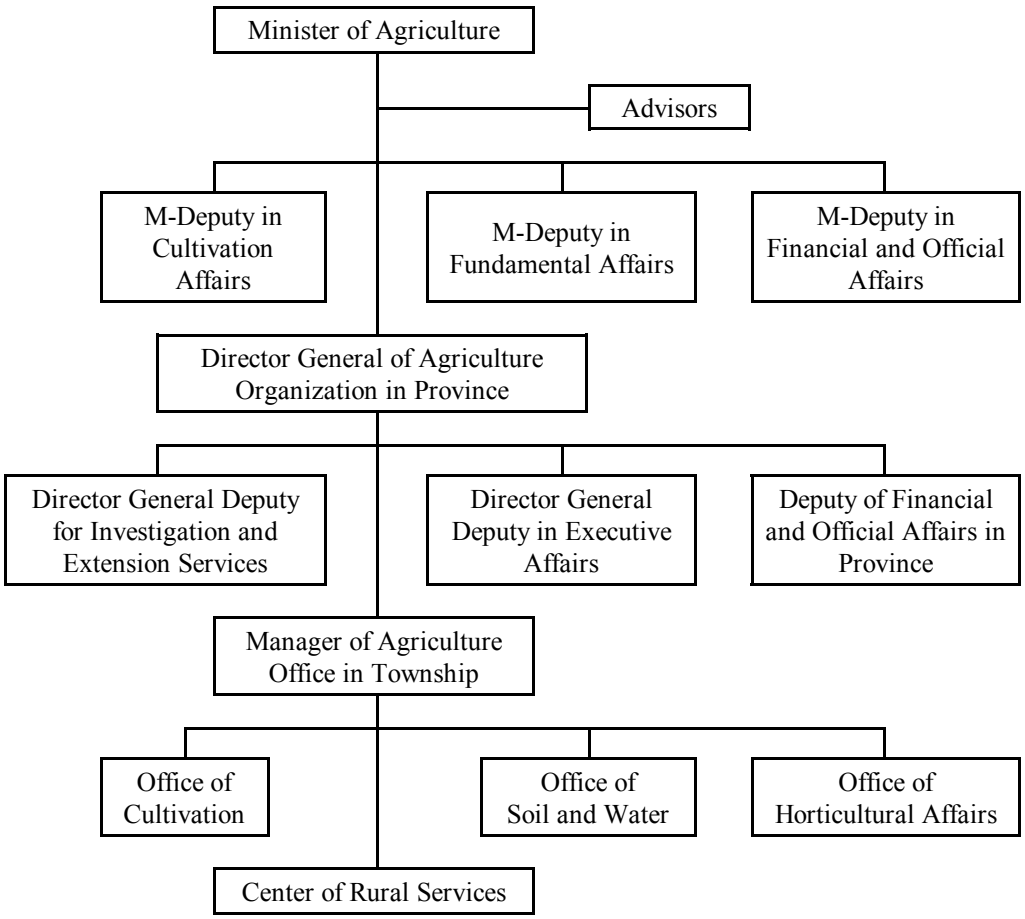

Figure 2. Organizational Structure of the Ministry of Agriculture

RECENT PROGRESS AND DEVELOPMENT IN PROMOTING PARTICIPATORY IRRIGATION MANAGEMENT

Until the early 1950, traditional management and organizations in the villages such as Boneh, Heraseh, Kateh, Khish, and similar organizations were responsible for the control, supply and distribution of water. After the cessation of their activities, serious problems and difficulties have been generated in the process of agricultural production and water use management. The government tried to create and rehabilitate those organizations by promoting rural cooperatives, agricultural companies (limited), and production cooperatives. But these organizations did not succeed due to different reasons.

In recent years and during the First and Second Development Plans (1989-98), the government has paid attention to the participation of water users.

After a multilateral agreement between the Ministries of Power and Agriculture and the Planning Organization, operation companies were established, but this practice also failed to attract water users and farmers. They did not pay any attention to participate in irrigation management.

In 1993, the mode management in operation companies was brought up and discussed at the Ministry of Power and it was decided to leave operation and maintenance of irrigation schemes to community organizations. After this important decision, the Ghazvin Operation Company established the first management unit of farmers. The most important management feature in the Ghazvin Irrigation Scheme was that there existed planned and organized agriculture. Moreover, there was proper coordination between water and agriculture sectors. Such characteristics have been important in the successful establishment of farmer organizations. By the end of 1998, 10 more cooperatives were established and the union of 11 cooperatives was formed. This union has been practically responsible in exploiting the irrigation canals within an area of 5,000 ha with people' s participation. These cooperatives were formed in two phases in the Ghazvin Plain as follows:

The First Phase

i) Selection of the sample region.
ii) Determination of water utilization points.
iii) Identification and selection of reliable individuals and explain and justify all aspects in several sessions.
iv) Conducting meetings with water user groups.
v) Conducting a final common meeting and selection of founder members and providing minutes of general assembly to establish the legal structure of the organization.

The Second Phase

The farmers were organized on the basis of the previous studies and incentives were proposed to attract farmers to form cooperatives (Anonymous, 1999).

The New Dez Company

Another active community organization is the New Dez Company, which was established by Ministry of Agriculture in 1996. This company is active in the region of Dez Dam. The Managing Board consists of native farmers while the Director General is one of the experts from the Ministry of Agriculture.

About 1,000 ha of land has been leveled and first and second grade irrigation canals have been constructed by the Ministry. Also the canals have been covered with concrete in an

area of about 1,000 ha with the participation of people. The farmers are responsible to repair and maintain the irrigation system. One representative from each village is introduced to Director General to:

a) Coordinate the related activities and duties of the farmers of his/her village;
b) Collect the current expenses of the company;
c) Provide necessary manpower at time of repairs and maintenance; and
d) Water charge collection (Modarresi, 1999).

The Operation of the Company in the Guilan Irrigation Scheme

This company is much more active than the other companies due to its modern and vast irrigation systems on the land under the service of Safid-Rood Storage Dam. The number of participators is also much higher than that of other companies. This company has five management units, one of which controls the repair and maintenance of installations. The other four units are responsible for water distribution, collection of water charges and to repair minor problems of the irrigation facilities (Ejtemai, Zahedi and Fiaz, 1999).

The formation of *Abbaran* cooperatives in the Province of Eastern Azerbaijan is another example of community participation in irrigation affairs. During recent years, about 50 *Abbaran* cooperatives have been established with the cooperation of Ministries of Power and Cooperation. These cooperatives cover a population of about 7,450 farmers, which are cultivating the land located at the lower parts of the dam.

The representatives of these cooperatives distribute water among the members through the main canals. These cooperatives have received Rl.43 billion from the bank facilities (Anonymous, 2000). However, there are many problems that obstruct the capabilities of participatory irrigation management, which must be sorted out to promote and encourage farmers to take more responsibility. These problems and difficulties are as follows:

1. ***Social Problems***
   - i) Unreliability and distrust of farmers about the organizations due to the failure of similar organization in the past;
   - ii) Distrust of farmers in keeping their ownership if new organizations are established;
   - iii) Uncertainty in land ownership in many regions;
   - iv) Different sorts of land utilization and ownership (owning, rental, forcible detaining, temporary cession of land);
   - v) Lack of land leveling and scattered pieces of land and higher costs of supplying water in case of establishment of any form of organizations;
   - vi) Distrust of people on authorities;
   - vii) Little confidence of farmers on the success of the project;
   - viii) Fear of farmers of getting less water if a organization is established;
   - ix) Weak financial capability of water users;
   - x) Possible ways of breach and infringement of farmers in getting high volume of water, cheap and free water in the absence of such organizations;
   - xi) The possibility of illegal cultivation in the absence of community organizations;
   - xii) Insufficient number of farmers for irrigation;
   - xiii) Disputes between farmers within a village or between water users in neighboring villages;
   - xiv) Unawareness of farmers about the advantages of participation; and
   - xv) High attention to immediate incomes by farmers.

2. ***The Problems of Government Agencies***
   i) Inappropriate management structure of government agencies and associated difficulties in carrying out participatory projects;
   ii) Lack of cooperation and coordination between different sectors of the government agencies;
   iii) Lack of coordination between government organizations;
   iv) Lack of serious punishment of offenders;
   v) Little attention to the knowledge and awareness of water users and weak educational programs;
   vi) Little care and attention to NGOs and little support and supervision; and
   vii) Introduction of cheap services to the villages in the last two decades.
3. ***General Problems***
   i) Lack of effective legislation in water and agriculture affairs;
   ii) Absence of an integrated plan for sustainable development and inadequate attention to the economic, social, cultural and development problems and difficulties in villages;
   iii) Lack of reliable, technical, and legal management systems in villages;
   iv) Lack of directions and approaches to coordinate the work of Ministries to follow up the integrated projects for sustainable development in villages;
   v) Lack of appropriate legislation for establishment and supervising NGOs in the villages;
   vi) Inadequate attention to the rights and principles of ownership in the society;
   vii) Inappropriate systems of financial management and custom affairs;
   viii) Lack of suitable agricultural plan for different regions;
   ix) Lack of a rational relationship between the price of agricultural products and product of other economic sectors and disorder and chaos in marketing of agricultural products;
   x) Low price of water and charging for water on the basis of area (ha) rather than on the basis of volume;
   xi) Unjust water distribution; and
   xii) High costs of water supply installations under the present economic situation.

SUGGESTIONS FOR THE DEVELOPMENT OF PARTICIPATORY IRRIGATION MANAGEMENT

Three management organizations entitled "Watershed Management Cooperatives" were established in three regions of Fars Province. These cooperative societies have been successful in dealing with different problems in the villages by people participation. Although the main objective of these cooperative societies is soil erosion control, however, these companies have tried to become involved in all difficulties such as economical, social, cultural, and development problems simultaneously in order to control soil erosion. Therefore, integrated approach of these cooperative societies was the most important factor for their success.

Finally, the following measures are suggested to improve participatory irrigation management:

i) Creation of a powerful management structure which is elected by rural people;
ii) Carrying out integrated studies (recognition of environment, potentials and capabilities, the socio-economic situation, difficulties and peopleís needs) in all rural regions and on the basis of people participation;

iii) Integrated planning on the basis of comprehensive studies to remove obstacles to socio-economic and cultural development while people participation and environment conservation are guaranteed;
iv) Creating an appropriate management structure in all government organizations to carry out integrated projects to achieve sustainable development by considering people participation and removing executive departments;
v) Preparation and approval of appropriate regulations to support, guide and supervise integrated management schemes and related NGOs;
vi) Development and extension of a culture of hardworking, cooperation, order and regularity, legality, abstinence, providence and comprehensive vision in societies;
vii) Paying special attention to education and extension of scientific principles in all socio-economic and cultural aspects in the rural areas; and
viii) Improvement of socio-economic structure of societies.

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8. PAKISTAN

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INTRODUCTION

Pakistan is an agriculture-based country. Mainly due to rapid growth in population – a growth rate of 2.5 percent per annum, the demand for water for domestic as well as for food production is growing exponentially. The population of Pakistan was estimated at 139 million at the beginning of 1998 and is estimated to grow to 208 million by 2025. Pakistan is constituted of four provinces; Punjab, Sind, Balochistan and North-West Frontier Province (NWFP). This paper attempts to describe the Irrigation administration of the NWFP. The procedures followed in the NWFP are typical of those followed in the other provinces of the country.

With an arid subtropical climate, the natural precipitation in Pakistan is limited. Over half the country receives less then 200 mm of annual rainfall and rainfall in excess of 400 mm occurs only in about 20 percent of the northern areas. Apart from being scanty, the precipitation is distributed quite unevenly over the regions and in a major part of the country this is concentrated in the 3-4 months of the summer monsoon. The water resources available to the country are the natural precipitation, the surface water and the groundwater.

Organization of the Paper

After this introduction, the second section of the paper describes the country's irrigation and its sources. This section also highlights the water resources, the major surface water development, small-scale water development and groundwater development explaining different surface irrigation systems. The remaining water resource potential, i.e. surface water potential and groundwater potential including the outflow to the sea and the potential sources for future development of the water resources of the country are also explained in this section. Third section explains the existing administrative setup of the Irrigation Department of NWFP. Different duties as per assigned post are explained in this section. The program that is currently being implemented to introduce the participatory concept within the country is also mentioned along with its brief functions. In the fourth section, the knowledge gained by participatory approach during the construction of projects within the NWFP and the experiences and problems faced during the introduction and implementation of the concept of participatory irrigation are explained. It also highlights the procedure adopted in making water users' associations and their function in the projects. Fifth section is on the participatory approach in operation and management and highlights the ongoing pilot projects in the provinces of the country.

The final section is on the National Drainage Program (NDP) being the key to the implementation of the participatory irrigation management in the country. The procedures that are being adopted at present and also the future changes to be brought in the Irrigation Department through this program are briefly explained in this section.

IRRIGATION NAD WATER RESOURCES IN PAKISTAN

Irrigation

Pakistan's irrigation is more than a century old. It was originally based on the objective of irrigating the maximum area possible with a view to settling the most number of people. Agriculture is the mainstay of Pakistan economy, employing about 55 percent of the labor force, accounting for 26 percent of GDP and contributing 26 percent of export earning. The dominant consumptive use of water in Pakistan is for irrigated agriculture. The mainstay of irrigated agriculture in Pakistan is the Indus basin. It comprises of River Indus, the eastern tributaries of Jhelum, Chenab, Ravi and Sutlej and northern and western tributaries of Kabul, Swat, Haro and Soan. Figure 1 shows the country map with rivers flowing through different provinces. Figure 2 shows the headworks and barrages on the Indus Basin Irrigation System. A schematic is shown in Figure 3. The inflow to these rivers is mainly derived from snow and glaciers melting and rainfall in the catchment areas of the Himalayan Mountains and the Hidukush. These tributaries of Indus are originating India but flowing in Pakistan. In the Indus Water Treaty 1960, the flow of the three eastern rivers (Sutlej, Beas and Ravi) has been allocated to India whereas Pakistan is entitled to all the western rivers (Indus, Jhelum and Chenab).

Although the surface flows of the Indus River and its tributaries available to Pakistan are quite significant, they are characterized by a great variation. The quality of surface water in the Indus and its tributaries is generally good to excellent from an agricultural perspective.

In addition to the surface water, groundwater is another important source of water supply. Investigations have established the existence of a vast aquifer with an extent of 194,000 km^2 (74,904 $miles^2$) underlying the Indus Plains. This aquifer has been recharged in the geologic times from natural precipitation and river flows and more recently by the seepage from the canal system.

Water Resources

1. ***Major Surface Water Development***

The surface irrigation system, which is now all weirs controlled, covers the world largest contiguous irrigated area. It comprises of three storage reservoirs (Tarbela, Mangla and Chashma) with total original live capacity of 18.80 billion m^3, 16 barrages, 12 inter-river link canals, two syphons, 43 main canals and 134,000 water courses or farm channels.

The irrigation system, which is dependant on the variable flows of the Indus and its tributaries, commands a gross irrigable area of 16.85 million ha of which 14.00 million ha is Cultivable Command Area (CCA) to which water is allocated. The perennial canal supply is available to 8.6 million ha while the remaining area is entitled to irrigation supplies only during the *Kharif* season. The annual canal diversions has increased from 82.65 billion m^3 at the time of independence in 1947 to 130.76 billion m^3 at present.

Figure 1. Country Map

2. ***Small-scale Water Development***

The infrequent flows in the smaller streams have been developed through traditional means such as *Rod Kohi* and more recently attention has been paid to the construction of small dams.

3. ***Groundwater Development***

A massive development of groundwater from the Indus basin aquifer has taken place due to the outcome of the Salinity Control and Reclamation Projects (SCARPs) under which large capacity tube-wells were installed in the public sector in the irrigated area to control water-logging. From 1964 to 1996 the number of private tube-wells in the country has jumped from 27,000 to 469,546 which represents an average growth rate of 9.4 percent. Approximately 80 percent of these tube-wells are driven by diesel engines.

Potential of the Remaining Water Resources

1. ***Surface Water Potential***

The surface water inflows of the Indus and its principal tributaries, the Jhelum and Chenab, the canal diversions and the outflows to the sea, following the completion of the Tarbela Dam are shown in season-wise as Table 1.

The average inflow of 179.34 billion m^3 or 76 percent is diverted annually into the irrigation system and 50.60 billion m^3 flows out to the sea.

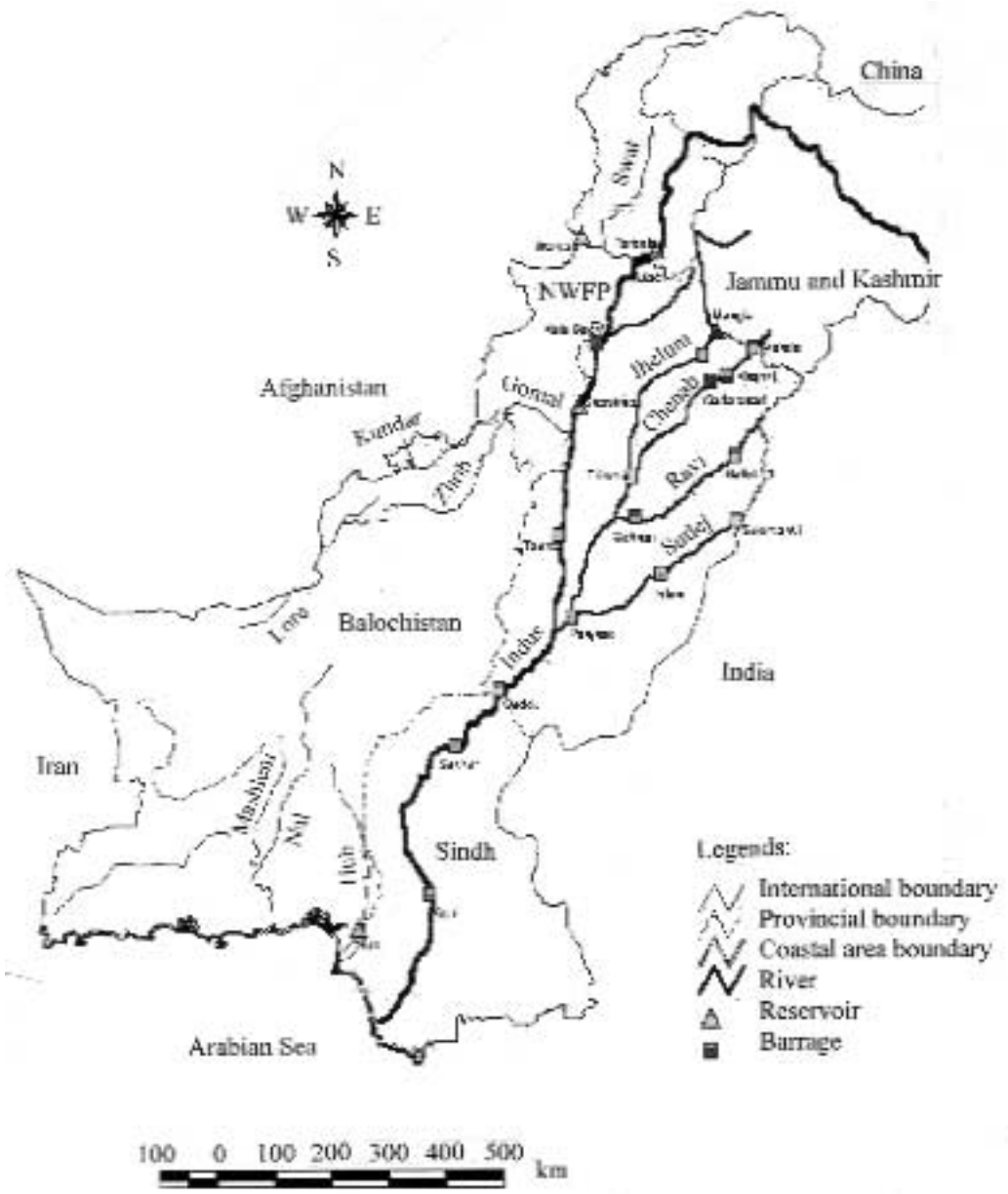

Figure 2. Indus Basin Irrigation System

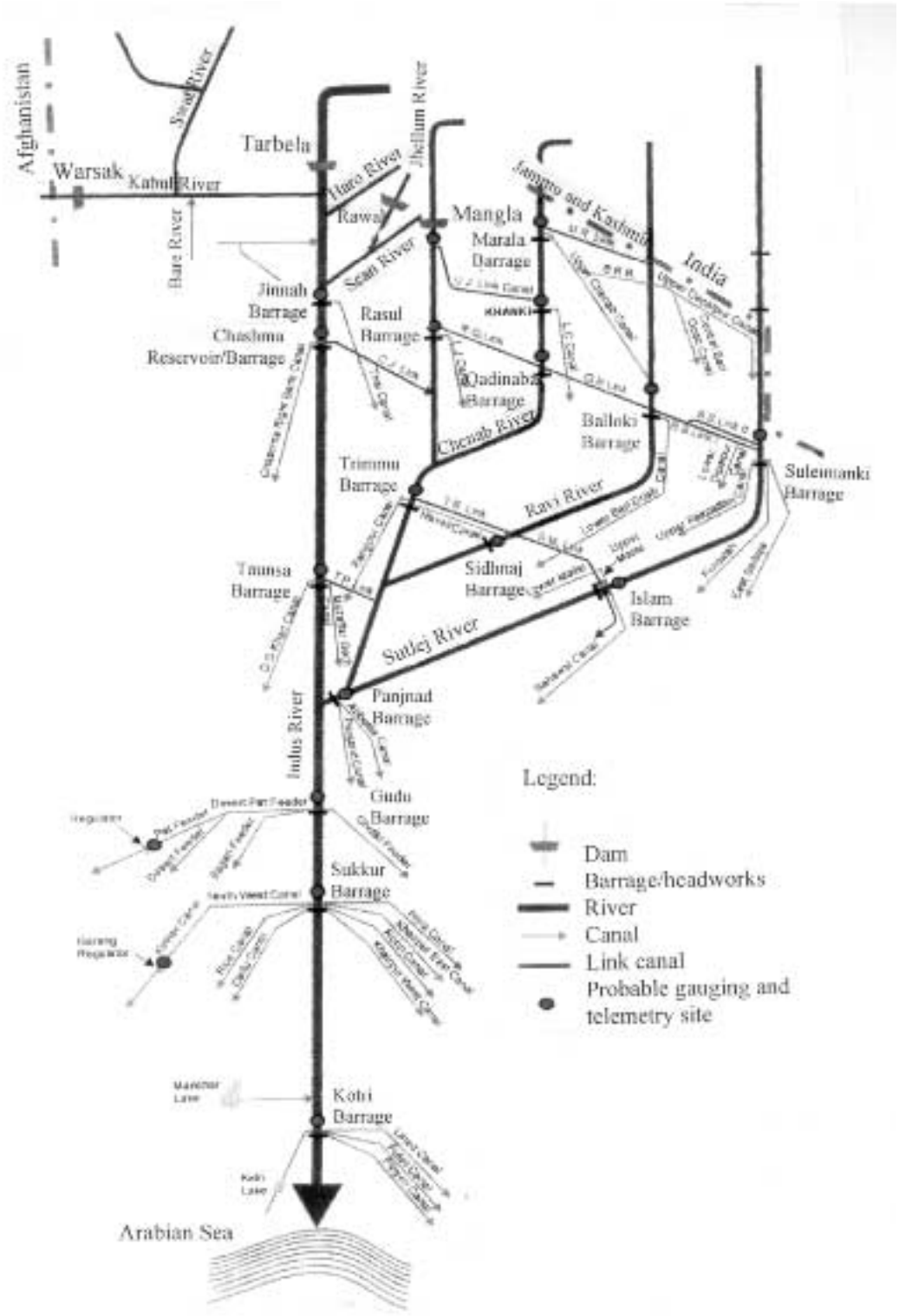

Figure 3. Schematic Diagram Showing Probable Flow Gauging and Telemetry sites for Indus Basin Irrigation System

During *Rabi* (winter) all the natural river flows are captured and the water diverted from rivers are augmented from the storage releases. The outflow to the sea is negligible in *Rabi*. However during *Kharif* (summer) the river flows exceed the diversion by highly variably amounts and end up in the sea. The outflow to the sea of 50.60 billion m^3 is a potential source for future development of water resources.

In addition, large water losses in the irrigation system due to conveyance in the distributary system, evaporation and seepage could be reduced adding to water resources.

2. ***Groundwater Potential***

This resource has been highly exploited. The annual groundwater pumpage exceeds the safe annual yields and the water table is declining. The safe groundwater yield is estimated to be 67.85 billion m^3, whereas the extraction is of the order of 58.21 billion m^3. Thus the remaining groundwater potential is about 8.63 billion m^3, representing possible increase of about 14 percent only.

ADMINISTRATION

In Pakistan, the old administrative and management system established through British Colonial rule is still followed. It is a system of built-in checks and balances that channels decisions up and down in a chain of command. Very little is left to the individualís discretion. Administrative duties currently consume about 80 percent of the staff time. Numerous manuals, rules and guidelines are followed. Legislative acts, ordinances, manuals and other administrative directives are often outdated. There is currently some albeit haphazard attempt to update these through the legislative body of the provinces known as the Provincial Assemblies.

Figure 4 shows the present hierarchy of the Irrigation Department in the NWFP. The NWFP Irrigation Department is headed by the Secretary to the Government of the Province and is supported by a group known collectively as Secretariat Staff. There are two Chief Engineers: the Chief Engineer for Operation and Maintenance (O&M) and the Chief Engineer for Development. More recently a position of Project Coordinator has been added to the hierarchy. This individual is of equal rank to the Chief Engineers and has the sole responsibility of heading the NDP. The latter is an important reformation project and is discussed at some length later in this paper. The Provincial Irrigation Department (PID) employs about 7,000 people in total.

The Chief Engineer for O&M is the administrative and professional head of the O&M Wing of the Irrigation Department. This Chief Engineer is also the responsible professional advisor to the government in all matter relating to his wing. For operational purposes, the O&M Wing is further divided into four circles each of which is managed by a Superintending Engineer, who in turn are assisted by a team of Executive Engineers. Each Executive Engineer heads a Division. In turn, within each Division there are number of Sub-Divisional Officers and also staff in each Division responsible for assessing water charges ñ colloquially known as Revenue Staff. There is further apportionment of Sub-Divisions into Sections and so-on-and-so forth with various designations managing each level in the hierarchy. The Canal Collector heads the revenue activities of the Irrigation Department and works directly under the Chief Engineer for O&M. The Chief Engineer for Development is the head of the Development Wing of the Irrigation Department. He is the administrative and professional head of the developmental wing of the Department and is responsible for execution of large

projects in particular those that are donor-funded, and mostly foreign-aided projects. This wing carries out all the developmental schemes of the PID. The Chief Engineer for Development is also the professional advisor of the government in all matter relating to his charge. The Development Wing is further divided into two circles and a Project Coordination and Management Unit. Each circle is headed by Project Directors who are in turn assisted by Deputy Project Directors in-turn assisted by a number of Assistant Directors, Sub-Engineers etc. for further assistance and are responsible for execution of works.

Table 1. Surface Waters of the Indus and Its Tributaries Inflows, Diversions and Outflows to Sea

(Unit: MAF = 1,233.6 million m^3)

Year	Rim Station Inflows			Diversion			Outflow to Sea[1]		
	Kharif	*Rabi*	Annual	*Kharif*	*Rabi*	Annual	*Kharif*	*Rabi*	Annual
1975-76	116.30	23.22	139.52	64.66	36.76	101.42	37.76	1.48	39.24
1976-77	116.85	18.43	135.28	60.18	39.58	99.76	64.05	5.03	69.08
1977-78	104.36	23.10	127.46	66.29	38.89	105.18	29.00	1.39	30.39
1978-79	137.45	26.03	163.48	61.85	37.28	99.13	75.03	5.57	80.60
1979-80	108.84	23.14	131.98	69.99	37.59	107.58	29.38	0.43	29.81
1980-81	109.81	26.58	136.39	71.19	38.72	109.91	18.74	1.36	20.10
1981-82	117.69	22.93	140.62	68.79	35.58	104.37	33.53	0.26	33.79
1982-83	97.10	25.27	122.37	69.08	36.73	105.81	9.43	0.25	9.68
1983-84	128.20	21.67	149.87	64.13	38.90	103.03	43.81	2.10	45.91
1984-85	115.99	18.93	134.92	67.41	36.19	103.60	28.65	0.90	29.55
1985-86	91.66	26.04	117.70	62.06	36.76	98.82	10.93	0.04	10.97
1986-87	116.38	30.27	146.65	68.91	39.44	108.35	29.72	0.18	29.90
1987-88	111.79	29.28	141.07	71.08	37.99	109.07	17.45	0.08	17.53
1988-89	136.56	24.84	161.40	66.59	38.55	105.14	44.17	8.70	52.87
1989-90	102.01	29.31	131.32	65.27	36.82	102.09	16.85	0.37	17.22
1990-91	130.98	35.14	166.12	69.02	40.75	109.77	38.20	4.14	42.34
1991-92	141.53	30.57	172.10	71.10	38.39	109.49	50.05	3.24	53.29
1992-93	138.62	31.06	169.68	61.59	39.33	100.92	69.19	12.30	81.49
1993-94	104.68	22.80	127.48	71.43	36.16	107.59	28.47	0.64	29.11
1994-95	138.02	27.79	165.81	57.32	37.14	94.46	88.18	3.65	91.83
1995-96	129.80	29.06	158.86	62.80	39.57	102.37	62.50	1.40	63.90
1996-97	137.49	23.77	161.26	72.71	38.40	111.11	28.40	1.50	29.90
1997-98	110.14	32.10	142.24	67.50	35.65	103.15	33.60	4.50	38.10
Average	119.23	26.15	145.38	66.56	37.88	104.44	38.57	2.58	41.02
BCM[2]	147.08	32.26	179.34	82.11	46.63	128.84	47.42	3.18	50.60

Source: Surface Water Hydrology Directorate, WAPDA.

Note [1] At Kotri below; and [2] billion m^3.

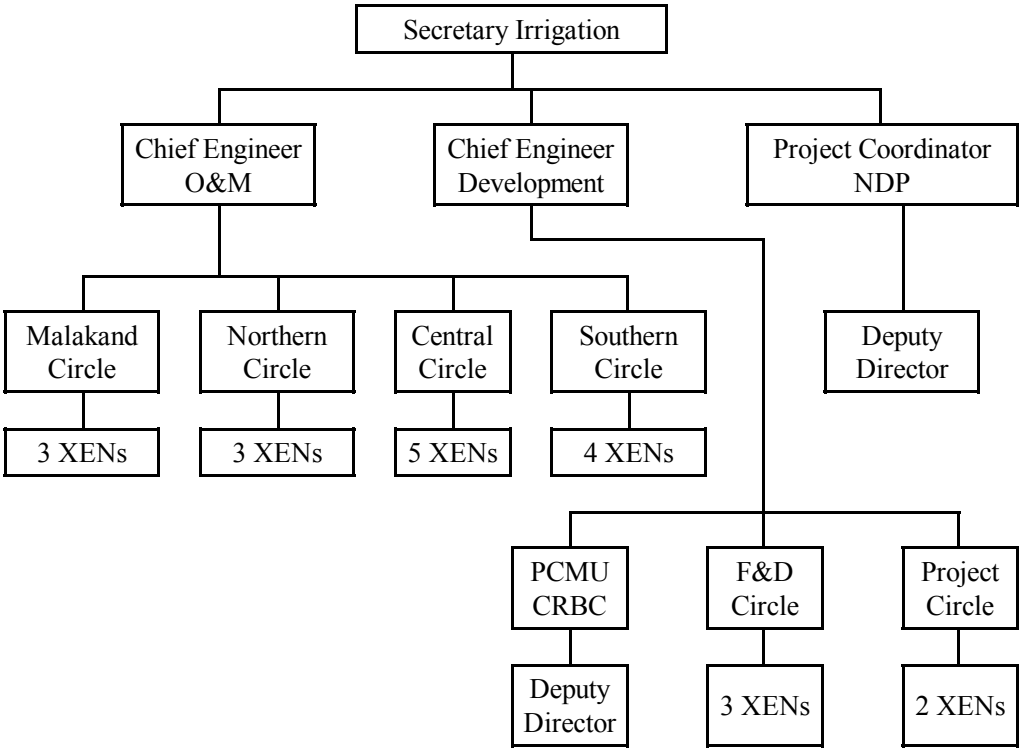

Figure 4. Organogram -- Irrigation Department, NWFP

The Project Coordinator, NDP reports directly to the Secretary of the Irrigation Department. This Project Coordinator is responsible for implementation of the NDP in the province which is involved in reforms such as; decentralization of the irrigation and drainage system. A Deputy Director, an Assistant Director and other support staff assist the Project Coordinator.

Employees of the Irrigation Department are assigned grades in accordance with the scales for all state employees. Employees in junior ranks from 1 to 16 are recruited directly by the Department, whereas employees in grades 17 and above are selected by the Provincial Public Service Commission and then assigned to the Irrigation Department.

PARTICIPATORY APPROACH IN CONSTRUCTION PROJECTS

The Mardan SCARP was probably the first major project within the NWFP where some form of farmer participation was advocated. This was largely on the insistence of the World Bank who funded the project. The project itself included the remodeling of the existing surface drains, installation of sub-surface drains, remodeling of existing minors and conversion of watercourses into minors.

The remodeling activities were carried out and completed albeit with delays. The conversion process in which the concept of making Water Users' Associations never really developed and as a result the minors continued to be used as a water course. The irrigation system rehabilitated under Mardan SCARP was designed to operate on demand system but lack

technical and social understanding resulted in its non-operation and its is still running on the old *warbandi* system i.e. fixed rotation system with time of flow to any field allocated pro-rate with area.

The second project that followed the Mardan Salinity Control and Reclamation Project was the Swabi SCARP. The Asian Development Bank (ADB) funded this project and its main objective was remodeling of Upper Swat Canal System, installation of sub-surface drains, remodeling of existing surface drains and conversion of watercourses into minors etc. The conversion process of watercourses into minors again included formation of water users' associations on each minor which met the particularly criteria for conversion.

The process included the visit of a social organizer along with the Department representative to the area where the conversion process has to be implemented. All the farmers receiving water from the given outlet were gathered in a common place by the social organizer where with the help of charts and plans the whole procedure of conversion of their watercourse into a minor was explained. The CCA under the outlet was then split normally into two tertiary units keeping into considerations the topographic boundaries, levels, technical and social conditions. The farmers where made aware of the whole process and their suggestions were incorporated. The farmers were then told to form a water users' association which will then be responsible to collect money for construction of a parallel water course, clearing trees along the existing water course, providing ample right-of-way for the contractor to execute the work, assisting the Irrigation Department staff in clearing the site and mainly providing land free of cost for construction of a minor along with parallel water courses.

The participatory approach adopted by the project staff initially was unacceptable to the farmers. There was little, if any, cooperation by the farmers and the whole conversion process was delayed. After further efforts by the Agriculture Development Component (ADC) of the Swabi Salinity Control and Reclamation Project, which was responsible for the social organization component, a few watercourses were cleared for conversion into minors. The Irrigation Department was only allowed to physically construct those minors on which the ADC has obtained a Memorandum of Understanding from the farmers in which all the farmers were asked to sign and give their approval of the conversion process. On receipt of the Memorandum of Understanding from the ADC the Irrigation Department moved into physically start the execution of work. The quality and supervision of the work was the responsibility of the Irrigation Department staff and they were directed to encourage the local community to put in their suggestions or reservations on the ongoing works. The farmers and especially the office bearers of the water users' associations were also encouraged to depute their representative at the site of work to keep a check on the quality of work carried out by the contractor.

The construction of parallel watercourses used for supplying water to the fields was the responsibility of the ADC. The policy of construction of these was that 20 percent contribution was to be made by the farmers through their water users' association and 80 percent was to be funded by the ADC. A bank account was to be opened in the name of the office bearer of the water users' association and money was then to be deposited by the ADC into their account.

The water users' associations were then to provide their own labor and contractor whereas pre-cast parabolic segments were to be bought from approved pre-casting yards. This procedure was only successful in a few cases. The very limited success was largely due to small landholdings, ownership problems, non-availability of sufficient finance with a farmer, disinterest of the farmers of the head reach of the outlet as they were to receive the least benefit from the whole conversion process. As a result, this delayed the construction of parallel water

courses along the newly constructed minor for which the Memorandum of Understanding had already been signed by the farmers and on which basis the minor has been constructed by the Irrigation Department.

In turn, this delay resulted in continued use of the minor as a watercourse and direct withdrawal of water from the newly constructed minor canal since the farmers needed water for their fields. The minor was broken at different locations for this purpose and the farmers used to block the flow of water.

In view of these problems the ADB along with the Irrigation Department and the ADC of the project decided to construct the parallel watercourses free of contribution from the farmer' s community so as to implement the whole infrastructure of water distribution up to the field level. This incentive worked and the farmers would give land free of cost, cut down the trees and help the contractors in getting right of way for execution purpose. The water users' associations then worked efficiently and any problem occurring during execution like stoppages by a certain farmer were referred to the water users' association who would in most of the cases resolved the issues.

This participatory approach resulted in conversion of 192 watercourses into minors out of the total of 218. The remainder is still under the process of finding a source of funding as the project funded was terminated on the 30 June 2000.

Another project namely the Pehur High Level Canal Project is under construction and the experienced gained during the Swabi SCARP project is being incorporated in Pehur Project resulting in participatory irrigation.

PARTICIPATORY APPROACH IN OPERATION AND MANAGEMENT

In the Punjab Province, a distributory has been selected by International Irrigation Management Institute (IIMI) as a pilot project and farmers' organizations have been formed. They are now operating and maintaining the distributory, minors and watercourses through the respective farmers' organizations. The same practices also been followed on a pilot project in the Province of Sindh.

In the NWFP a pilot project for Swat River Canals, which includes two canal systems namely Upper Swat Canal and Lower Swat Canal Systems has been made as a pilot project for the Area Water Board (AWB) Swat River System. The process of establishing farmers' organizations is expected to be completed in this pilot area as soon as the consultancy for institutional reforms is awarded by the Government of NWFP in the near future.

THE NATIONAL DRAINAGE PROGRAM

Augmenting the quantum of useable water resources is a pressing need for Pakistan in the face of the raining population, which by conservative estimates, would increase by 48 percent between 2000 and 2005. To augment the water supply to meet the growing demands, consideration would therefore be required to:

- The harnessing of additional surface and groundwater to the extent feasible;
- Minimizing of irretrievable water losses; and
- Demand management.

The indiscriminate use of marginal to hazardous quality groundwater for irrigated agriculture is causing serious secondary soil salinity and particularly soil solidity problem in large areas of the Indus Basin.

A 25-year NDP has been launched to alleviate the problem of water-logging and salinity. The NDP is to be implemented in three phases: Phase I is to be implemented from 1995 to 2003; Phase II, from 2003 to 2010; and Phase III, from 2010 to 2020. The goal of NDP is to minimize saline drainable surplus and facilitate the eventual evacuation of all of saline drainable surplus from Indus Basin to Arabian Sea and thereby restore environmentally-sound irrigated agriculture in Pakistan.

The first phase of NDP, which is under implementation, is estimated to cost of US$785 million. The objectives of the project are to improve the efficiency of irrigation and drainage system in Pakistan and ensure its sustainability, through:

Establishing an appropriate policy environment and institutional framework and strengthen capacity of sector institutions (i.e. carry out the first phase of policy and institutional reforms in the water sector);
Improving sector policies and planning;
Strengthening the technical foundation and knowledge base on irrigation and drainage; and
Improving the irrigation and drainage infrastructure network.

All the four provinces of Pakistan has embarked on major reform improving involving decentralization of its irrigation and drainage system on a same pattern under the NDP. The NWFP is taken as an example. Irrigation in the NWFP covers an area of about 1.4 million acres and includes four canal commands. The system is presently managed by the PID of the Government of NWFP under the rules and regulations applicable to all Department of the Provincial Government.

Expenditures are paid out of general government finances from the treasury and revenues go directly to the treasury. The reforms involve management transfer of the irrigation and drainage system from the PID to a multi-tier system of autonomous institutions with clearly defined rules and responsibilities within the system. Under the proposed reforms:

a. The Irrigation Department would be transformed to an autonomous NWFP Irrigation and Drainage Authority (NWFPIDA) which will manage the irrigating and drainage system from barrage to canal headworks, and from main drains that cross canal commands and major drainage basins to inter-provincial drains;
b. Decentralization of management of NWFPIDA to AWB for each canal command. The AWB would have responsibility for management of irrigation and drainage system from canal headworks to distributaries/minors operated by farmers organizations and from the branch drains operated by farmers' organizations to main drains operated by NWFPIDA. Figure 5 shows the proposed organizational setup of NWFPIDA;
c. The management of the system at the minor/distributary level would be progressively transferred to farmers' organizations, which would be owned and controlled by farmers. Farmers' organizations would be owned and controlled by farmers and are expected to be farmer-owned and -controlled entities. The membership of farmers' organizations

would largely be confined to water users' associations which would be formed at the water course level; and

d. A system of regulation and adjudication for the decentralized irrigation and drainage sub-sector would also be established.

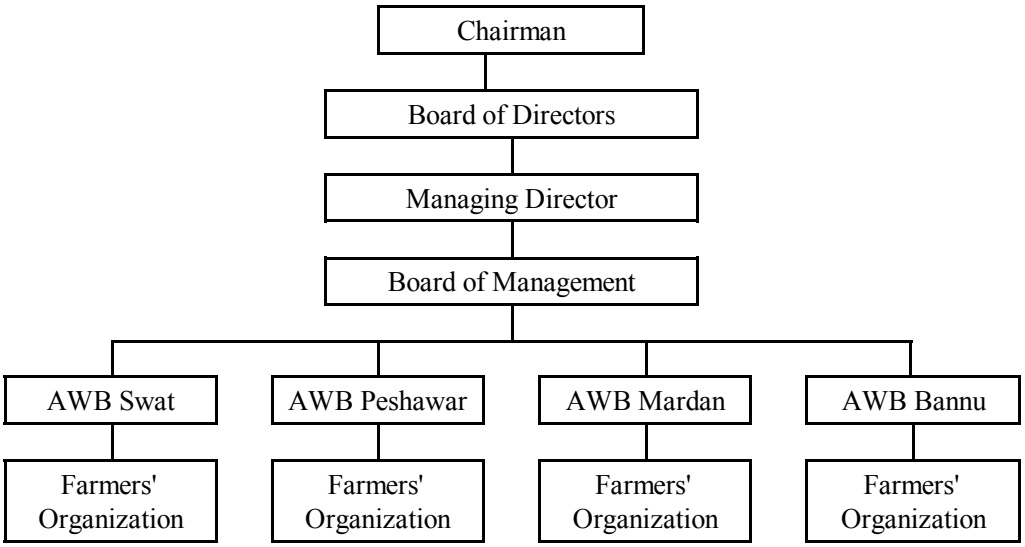

Figure 5. Organogram of the NWFPIDA

The NDP is supporting these reforms. The International Development Association (IDA), the ADB and the Overseas Economic Cooperation Fund of Japan (OECF), in addition to the Government of Pakistan, all provincial governments, finance the NDP.

For the purpose of these institutional reforms consultants are being hired who will assist the Government of NWFP in implementation of institutional reform program. The selection for NWFP is under process whereas in the Punjab and the Sindh provinces, the IIMI has been selected as the consultants responsible for these institutional reforms in the respective province.

The consultants are to be appointed shortly in the NWFP will assist the Government of NWFP and specifically the various entities (NWFPIDA, AWB, farmers' organizations) in a range of activities required in the institutional reform process. This will include the following aspects:

i. Organizational vision and strategy;
ii. Business planning;
iii. Legal framework;
iv. Business policies;
v. Internal polices and procedures;
vi. Organization structure and staffing;
vii. Human resource development;
viii. Improving operational efficiency;
ix. Information systems;
x. Finance and accounting;

xi. Policy and regulation;
xii. Technical and engineering aspects;
xiii. Transfiguring (establishment of AWBs and farmers' organizations);
xiv. Change management; and
xv. Monitoring and evaluation of the reform program.

The NDP is the key to the introduction of participatory irrigation management in operation of irrigation systems in Pakistan.

CONCLUSION

The concept of participatory irrigation is not new in Pakistan. There are canals namely civil canal being operated and maintained by the beneficiaries. These canals were historically constructed by the beneficiaries themselves and enjoy historical water rights. The distribution of the water is governed by a legal document called *Kuliyet-i-Abpashi* (Regulation of Irrigation). The civil canals in NWFP command an area of 0.8 million acres throughout the province whereas the government canals maintained and operated by the state agency measures 1.3 million acres. The operation and distribution of the canals according to their allocated shares are managed through Irrigation Committee represented by the beneficiaries of the different areas to ensure that equitable distribution of water according to the historically allocated shares as per established regulations. Any dispute arising out of the distribution in case the committee fails in deciding upon is referred to the District Collector for arbitration and decisions.

Field interviews taken on different pilot projects within the country clearly indicates that the water users are keen to undertake the responsibility for effective water distribution within the distributory and minor.

In such a context the water users should share responsibility with the government, and does not mean total independence from the government but in the context of participation. An important responsibility that should accompany participatory irrigation management is the accountability that is associated with this concept.

9. PHILIPPINES

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CURRENT SITUATION OF IRRIGATION DEVELOPMENT

Irrigated Area

The total irrigable area in the Philippines is 3,126,340 ha. Out of this area, which is defined as the area under 0-3 percent slope, only 1,373,825 ha or 43.94 percent have been provided with irrigation facilities and structures. The remaining area to be developed is 1,752,515 ha or 56.06 percent. Of the developed area, 50.15 percent (689,010 ha), 37.17 percent (510,615 ha) and 12.68 percent (174,200 ha) are within the National Irrigation Systems (NIS), Communal Irrigation Systems (CIS) and Private Irrigation Systems (PIS), respectively. There are 190 NISs, which are owned and operated by the National Irrigation Administration (NIA). NISs fall into three categories:

a) Run-of-the river gravity systems;
b) Reservoir systems; and
c) Pump systems.

Most NISs have service areas larger than 1,000 ha. CISs are farmer-owned and operated community irrigation systems and usually cover service areas of less than 1,000 ha. NIA has constructed most of these systems and recovers the system's capital costs through annual amortization paid by Irrigation Associations (IAs)/farmers. The payback period for the capital costs of CISs is 50 years without interest. PISs are owned and operated by individuals, groups or organizations. On the regional basis, Cordillera Administrative Region CAR) is the most developed area (73.01 percent) while Autonomous Region of Muslim Mindanao (ARMM) is the least developed area (9.04 percent).

Generated and Rehabilitated Area

The annual generated (new) and rehabilitated areas from 1987 to 1999 (12 years) are presented in Table 1. The generated area was 236,282 ha or an annual average of 18,175 ha. The generated area in CIS (136,528 ha) is higher than the NIS (99,754 ha).

Table 1. Generated and Rehabilitated Area, 1987-99

Year	Generated Area			Rehabilitated Area		
	NIS	CIS	Total	NIS	CIS	Total
1987	14,983	4,291	19,274	5,280	21,294	26,574
1988	14,428	11,520	25,948	1,016	40,875	41,891
1989	16,225	11,305	27,530	1,584	21,722	23,306
1990	5,883	18,595	24,478	2,946	26,054	29,000
1991	4,585	9,661	14,246	300	9,240	9,540
1992	1,037	9,629	10,666	-	5,489	5,489
1993	1,314	6,408	7,722	5,380	5,396	10,776
1994	2,526	4,210	6,736	3,592	3,220	6,812
1995	2,130	7,162	9,292	3,507	8,491	11,998
1996	2,311	7,829	10,140	30,481	8,945	39,426
1997	20,291	20,749	41,040	123,003	27,929	150,932
1998	11,335	16,322	27,657	83,077	50,655	133,732
1999	2,706	8,847	11,553	119,429	32,968	152,397
Total	99,754	136,528	236,282	379,595	262,278	641,873
Average	7,673	10,502	18,176	29,200	20,175	49,375

Higher generated areas were recorded in 1997 (41,040 ha), 1998 (27,657 ha), 1989 (27,530 ha), 1988 (25,948 ha) and 1990 (24,478 ha). On the other hand, the total rehabilitated area for the same period was 641,873 ha, representing 379,595 (59.14 percent) and 262,278 (40.86 percent) ha in NIS and CIS, respectively or an annual average of 49,375 ha. Wider areas were rehabilitated from 1997 to 1999 while the least area was recorded in 1992 (5,489 ha).

Approved Budget and Releases

The approved budget and actual releases (and utilization) for irrigation development from 1975 to 2000 (25 years) are presented in Table 2. Out of an approved budget of ₱80,033 million, ₱68,463 million (85.54 percent) or an annual average of ₱2,739 million were released and utilized. It can be noted that there was a significant increase in the releases starting in 1995 to the present. For all years, the sources of funds are the General Appropriation (approved by the House of Representatives and Senate), loan proceeds, local funds for CIPs, NIA Corporate Funds and interagency projects.

Impact of Irrigation on Farm Productivity

Water is an input to crop production. Yield is affected by the service provided by the irrigation system, cultural practices adopted by the farmers and climate and environmental conditions prevailing in the area.

The annual yield performance in 105 NIS from 1995-1999 is presented in Table 3. Only Region 1 and 5 recorded more than 4 mt/ha while the lowest yield of 3.09 mt/ha was obtained in Region 12. Aside from the regional yield data, Table 4 presents the average yield for wet and dry seasons of the surveyed IAs which included CISs. Not all the IAs were monitored, as

there are inadequate number of field staff to undertake the survey. There is no significant difference in the yields attained for both seasons.

Table 2. Approved Budget and Actual Releases, 1975-2000

(Unit: ₱ million)

Fiscal Year	Approved Budget	Actual Releases and Utilization	Percent
1975-76	1,286.05	1,159.58	90.17
1977	1,120.81	889.09	79.33
1978	1,743.42	932.29	53.47
1979	2,185.02	2,307.58	105.61
1980	2,240.95	2,142.68	95.61
1981	2,740.31	2,262.28	82.56
1982	2,864.13	2,348.37	81.99
1983	2,807.40	1,957.70	69.73
1984	2,210.00	1,787.20	80.87
1985	1,909.92	1,670.51	87.46
1986	1,682.51	1,779.80	105.78
1987	2,303.41	1,601.32	69.52
1988	2,747.78	2,117.17	77.05
1989	2,630.74	1,892.34	71.93
1990	4,064.98	3,058.85	75.25
1991	3,276.90	2,550.50	77.83
1992	2,412.59	1,807.34	74.91
1993	2,852.54	2,442.13	85.61
1994	2,694.60	2,583.58	95.88
1995	4,398.54	4,215.01	95.83
1996	6,321.82	5,981.62	94.62
1997	5,444.37	5,076.89	93.25
1998	6,549.94	5,305.87	81.01
1999	5,580.37	5,553.97	99.53
2000	5,964.15	5,039.15	84.49
Total	80,033.25	68,462.82	85.54
Average	3,201.33	2,738.51	85.54

Sources: Equity/Government of the Philippines, Foreign Exchange, Appropriation for Communal Irrigation Projects, Corporate Funds and others.

Table 3. Yield, National Irrigation Systems, 1995-99

Region	No. of NIS	Service Area (ha)	Average Yield (mt and cav.*/ha)
1	8	55,872	4.48 (89.6)
2	14	48,422	n.a.
3	9	66,803	3.83 (76.6)
4	16	52,706	3.70 (74.0)
5	7	20,496	4.12 (82.4)
6	9	52,216	3.58 (71.6)
7 and 8	8	21,243	3.97 (79.4)
9	3	15,162	3.45 (69.0)
10	3	20,696	3.92 (78.4)
11	7	52,486	3.97 (79.4)
12	7	45,199	3.09 (61.8)
13	6	18,412	3.24 (64.8)
MRIIS	4	88,370	3.93 (78.6)
UPRIIS	4	102,532	3.70 (74.0)
Total	105	660,615	

Note: * 1 cavan = 50 kg of paddy at 14 percent moisture content.

Table 4. Average Yield, 1994-98

Year		Wet Season			Dry Season		
		No. of IAs	Irrigated Areas (ha)	Yield (mt or cav./ha)	No. of IAs	Irrigated Areas (ha)	Yield (mt or cav./ha)
1994	NIS	1,136	272,054	4.05 (81)	1,241	287,046	4.00 (80)
	CIS	777	73,084	3.65 (73)	1,519	102,174	3.55 (71)
1995	NIS	573	146,514	3.70 (74)	946	230,546	3.50 (70)
	CIS	477	38,659	3.80 (76)	1,303	91,205	3.70 (74)
1996	NIS	1,399	332,965	3.60 (72)	720	165,442	4.10 (82)
	CIS	1,368	99,430	3.35 (67)	1,003	75,059	3.50 (70)
1997	NIS	1,027	258,348	3.75 (75)	1,084	258,348	3.80 (76)
	CIS	2,027	160,873	3.60 (72)	1,440	113,542	3.55 (71)
1998	NIS	793	119,361	3.60 (72)	346	219,459	3.55 (71)
	CIS	1,127	79,439	3.50 (70)	1,442	80,980	3.15 (63)

Changes in Irrigation Policy

Agricultural development and food security has always been the primary focus of the government and irrigation water is recognized as one of its important inputs. Republic Act (RA) No. 3601 established the NIA in June 1964. As a government and controlled corporation, NIA was mandated to develop, improve and maintain irrigation systems throughout the country. Primary responsibility of NIA is to develop water resources for irrigation purposes. It is responsible for planning, constructing, operating and maintaining all NISs and also empowered to plan, construct, rehabilitate, temporarily administer and periodically repair all CISs and pump irrigation systems. RA 3601 was amended by

Presidential Decree (PD) No. 552 in 1974, which increased NIA's capitalization from ₱300 million to ₱2 billion. In 18 July 1980, Presidential Decree No. 1702 set the authorized capital stock of NIA to ₱10 billion.

RA No. 8435, the Agriculture and Fisheries Modernization Act of 1997 (AFMA), provided ₱6 billion per year for irrigation development for a period of six years.

PRESENT ORGANIZATIONAL SETUP OF NIA

The NIA organizational structure is presented in Figure 1. At present, NIA is attached to the Department of Agriculture (DA). In 1964, it was under the Office of the President. In 1972, NIA was transferred to the Department of Public Works, Transportation and Communications and Highways (DPWTCH). In 1987, it was attached jointly to the Department of Public Works and Highways and DA. In 1992, NIA was transferred wholly to the DA with a greater emphasis on NIA's role in agricultural development and food security.

The NIA Board of Directors is the policy-making body of the agency, with the DA Secretary as Chairman and NIA Administrator as Vice-Chairman. The members of the Board are representatives of National Power Corporation (NPC), National Economic Development Authority (NEDA), Department of Public Works and Highways (DPWH) and private sector.

Four Assistant Administrators assist the Administrator and the Deputy Administrator in managing the agency. The President of the Philippines appoints all of them. The Project Development and Implementation Sector undertakes project identification, feasibility study, design and specification, hydraulic research and dam safety, construction planning and scheduling, project monitoring and evaluation (M&E) and contract administration. The Systems Operation and Equipment Management Sector handles (M&E) of irrigation system management, organization and development of irrigators association (IA) and equipment management.

The Finance and Management Sector is responsible for funds generation, utilization, accounting and financial transactions, budget preparation, internal control and management information system.

DEVELOPMENTS IN PROMOTING PARTICIPATORY IRRIGATION MANAGEMENT (PIM)

Legal Base

NIA's charter empowers it to transfer full or partial authority and responsibility for management of NIS to duly organized IAs. The recent AFMA renews this mandate, which requires that NIA gradually "turn over" the secondary and tertiary irrigation canal systems to IAs while retaining operation and maintenance (O&M) of the main system. It also mandated NIA to devolve to the Local Government Units (LGUs) the implementation and management of locally-funded communal irrigation systems. Earlier PD 552 of 1974 mandated NIA to delegate the partial or full management of NIS to duly organized and registered IAs or cooperatives.

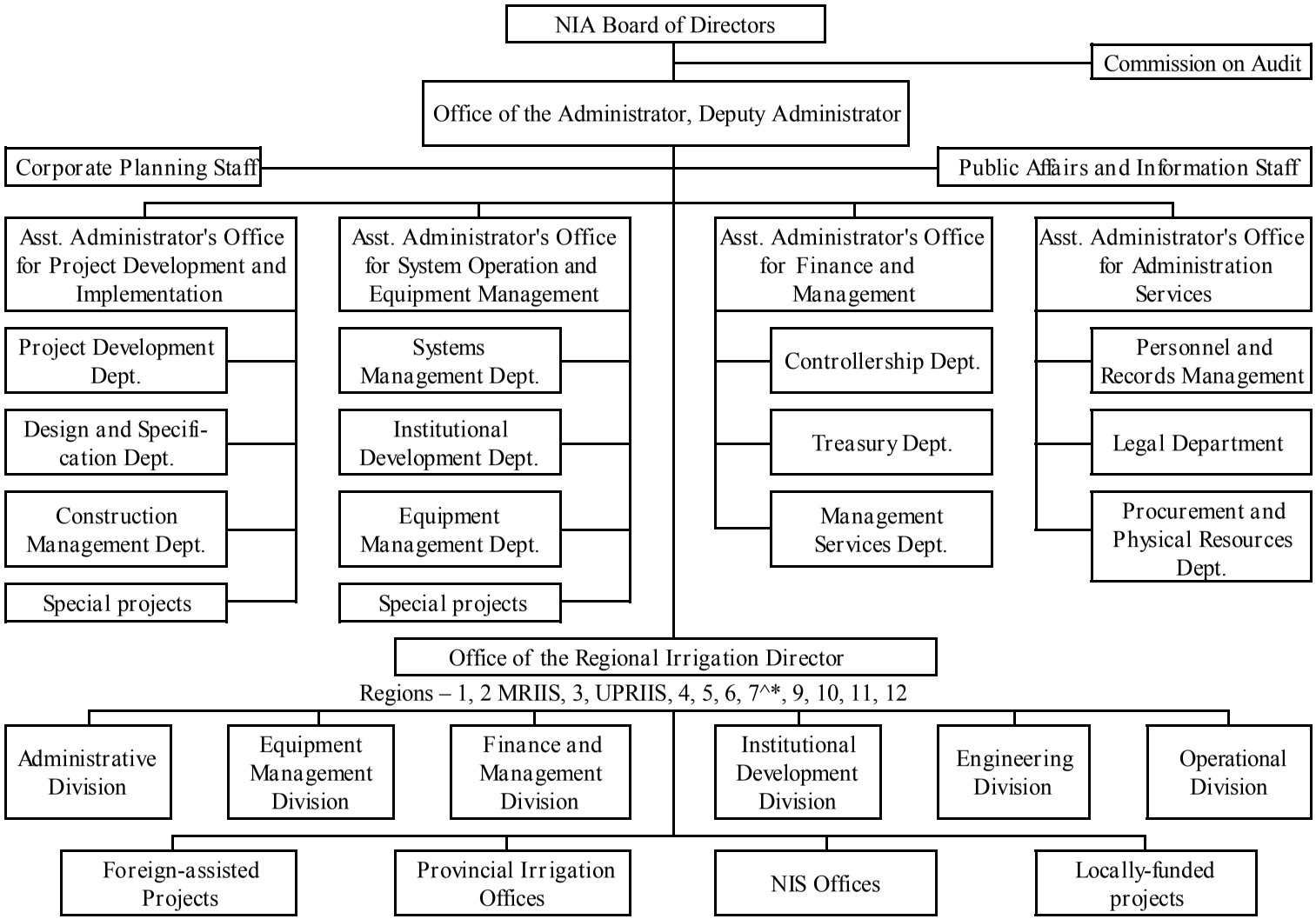

Figure 1. Existing Organizational Chart, NIA

Earlier Organizing and PIM Efforts of NIA

The historical background of NIA's organizing efforts and Irrigation Management Transfer (IMT) development in NIS is summarized in Table 5. Organization of farmers in the late 1960s and the 1970s was primarily for better water management and increase crop production.

Table 5. Historical Background of NIA's Organizing Farmers and IMT Development in NISs

Inclusive Years	Milestones	Features	Lessons on IA Participation
1968-71	NIA implemented the ADB-assisted water management project in 8 NISs in 8 RIOs	• Organization of farmers at rotational units (farm level) for improved crop production (compact farming) and rotational irrigation	• Water management and improvement production is better if farmers are organized. For better irrigation and dissemination of farming technologies, farmers must be organized and trained.
1971-80	NIA implemented under FAO-assisted projects (New NISs) the component farmers' training and organization	• ***Extension Approach***: Program was used as medium for improved farming technology to better realize the benefits of irrigation projects. • Organization of FIGs and FIAs at portions of laterals.	• Organization and training raised the consciousness and skills of farmers on irrigation and crop production. • From smaller groupings farmers should be organized at higher level for better coordination of water. • In the absence of policies, guidelines and incentives, organized beneficiaries tend to depend on projects, hence, lack of ownership and sustainability.
1980-86	NIA pilot tested the organization of IAs in 30 marginal NISs (26,000 ha) under NISIP-ICOP Expansion of the ICOP to FIOP MRIIS (or MRMP) started the Lateral Turnover Program (LTOP) Parallel to these NIA's regional ACDs implemented organizing and training programs in few NISs	• ***Community Organization Approach***: Under MTP participation in rehab was used as strategy and thereafter, assumption of O&M of NISs or part thereof based on negotiated contract. • Introduction of shared management. • Scheme • LTOP was initiated to provide some incentives to participating IAs in complementation with the program under FAPs.	• Strategy of farmers participa-tion in rehab installs ownership of project. • Bottom-up organizing approach combined with strategies for socio-technical coordination and incentives (ISF share), is effective in building cohesive and functional IAs and their participation in O&M. • The program implication of manpower displacement served as threat for NIA personnel. In the case of LTOP in MRIIS, the program caused redundancy of some personnel, hence, higher O&M costs. • While the MTP motivated IAs, the program met some resistance due to displacement issue.

... To be continued

Continuation

Inclusive Years	Milestones	Features	Lessons on IA Participation
1987-92	NIA reinforced the program on farmers/ IA participation through the (World Bank-assisted) First Irrigation Operation Support Project (IOSP I) and AAPP	• Sustained the MTP. • IAs participated in minor rehab. • Modification of contract provisions to suit non-marginal systems. IAs participated in project preparation for IOSP II (1992)	• System rehab is better sustained with participation of functional and cohesive IAs. • Nominal allocation for rehab is not enough to meet improvement needs and hence, de-motivates IAs which have grown consciousness. • For sustainability, IAs should participate in project identification implementation and sustenance. • Policies, procedures and guidelines for improvement O&M with farmers/IA participation must be in place. • O&M responsibilities of IAs must be increased.
1993 to date	NIA, under IOSP II pilots the process of IMT which integrates social technical and O&M aspects of irrigation management.	• Holistic and participatory situation analysis and planning prior to system improvement. • Delegation of O&M based on hydrologic con-siderations (at least, per lateral). • Adoption of the scheme of participatory project preparation under Water Resources Development Project (WRDP) (1995).	• Transfer of O&M responsibilities to IAs based on hydrologic control point would improve O&M and give more empowerment. • However, transfer would be more sustainable with co-ordinated implementation of physical, social and O&M aspects of improvement. • Incentives for both IAs and affected personnel should be in place. • While IMT looks promising, the existing policy on affected personnel is dependent on attention law with the pilot IMT in NDC-5, IMT becomes a snowball and NIA is not yet prepared.
1995 to date	NIA under WRDP replicates IMT.		

The delegation of the partial or full management of NIS to IAs or shared management started in 1984 to improve O&M and irrigation service through the participation of farmers/ IAs.

The shared management is manifested in the O&M contract (Stage I, II and III) entered into between the IA and NIA normally renewed every year. These contracts were later changed into Type I, Type II and Type III in 1987. The IA undertakes routine maintenance work (canal

clearing) in Type I and being remunerated for their efforts. Under Type II, the IA performs responsibilities in systems operations and collects irrigation service fee from the farmers and is entitled for incentives. The incentive for current account is from 2 percent to 15 percent depending on the collection efficiency; 2 percent for new back accounts and 25 percent for old back accounts. Type III, is full turnover of the whole or part of the irrigation system. The IA will pay the direct cost of the system through annual amortization. To date, 88 percent of NIS service area are turned over to IAs under the scheme of shared management or the Management Turnover Program (MTP). From this scheme and the previous efforts of the Agency, the IMT evolved in 1993.

THE IRRIGATION MANAGEMENT TRANSFER

The IMT in the NIA context is explained as the transfer of O&M responsibilities over the NIS or parts thereof to duly organized, ready and willing organization of beneficiaries under mutually agreed terms and conditions embodied in a contract. The O&M responsibilities include operation, maintenance, collection and conflict resolution/ management.

Benefits, Implications and Requirements of IMT

The benefits and implications for major stakeholders are presented in Table 6. While benefits outweigh the implications for both NIA and IAs, the requirements for successful transfer enumerated below are conditions that should be met to ensure attainment of benefits.

Table 6. Benefits and Implications of IMT

Group	Incentives, Benefits and Rights	Cost and Responsibilities
NIA (as agency)	• Streamlined organization. • Decreased expenditures. • Increased revenue: – Revenue base – Collection efficiency	• Capital investment. • Displacement of staff.
NIA (as employees)	• Early retirement benefits. • Other employment opportunities. • Business opportunities.	• Loss of regular income.
IA	• Equity of water distribution. • Increased area and CI. • Water rights. • Rights to specification improvement needs. • Improved management capability. • Rights to employ and sanction its personnel. • Improved financial viability. • Option to own NIS.	• Share/contribution. • O&M.
IA members	• Early retirement benefits. • Other employment opportunities. • Business opportunities.	• Time • Effort • Resource contribution.
Women	• Higher household budget (income). • Opportunity for livelihood ventures.	• Reduction of effective time of partner in the household.

1. Operational irrigation system.
2. Willing and capable IA.
3. Willing NIA as irrigation system owner.
4. Willing and facilitating NIA employees:
   A. Displaced employees provided with compensation package or training; and
   B. Retained employees provided with training program for new directions.
5. Acceptable transfer policy on:
   A. Financial arrangement between IA and NIA.
   B. Technical arrangement between IA and NIA on:
      a. Operation – planning, implementing and controlling water deliveries.
      b. Maintenance – routine maintenance and major repairs.
   C. Compensation package for displaced NIA personnel.
6. Tested IMT process.

While substantial areas have been previously turned over to IAs under joint O&M contracts, IMT is envisioned to: a) increase the level of IA responsibility from part of the laterals to the whole of the lateral, that is, covering one hydrologic control point; b) with the approach under a), it is envisioned that there will be better coordination of water, and hence, equitability that would lead to better sharing of benefits; and c) better empowerment for beneficiaries in the field of agricultural production.

The IMT Process

The objectives of the program are envisioned to be attained in three stages: 1) development of the IAs to build up capacity to manage NIS; 2) transfer of the management of the NIS to IAs; and 3) sustenance of improvement under IMT contract. The first stage, itself, has five important development phases, which is coordinated with the technical aspect of development. The phases are pre-mobilization, mobilization, participatory planning, implementation and M&E/sustenance, which are presented in Table 7.

The IMT program is implemented in the World Bank-assisted Second Irrigation Operation Support Project (IOSP II) and Water Resources Development Project (WRDP). The IMT process aims to improve the performance of the NIS and reduce the O&M costs to NIA.

The transfer learning process parallels that of the management cycle where implementers and participants go through similar processes. The IMT process is really a never-ending cycle of mobilization, planning and implementation. One important component is the training of both NIA staff and IA officers and members. The training focus of IMT shifts from the IA leaders to the IA members. This change is essential innovation in the IMT process in recognition of the need to strengthen the mass base of the IA and broaden the support of farmers on IA activities. All training activities are anchored on the experiential learning process which provide opportunities to the target groups to actively participate and discover new concepts, learn new skills and values that lead to stronger individual commitments to the IMT. The training is built in with activity itself and the participants learn on-the-job as they actually do the activity. Hence, the training develops not only the individual participants, but also the organization as a team towards group empowerment for IMT activities.

Table 7. The Irrigation Management Transfer Process

Phase/Activity	IA Development Activity	Technical Activity
Pre-mobilization Participatory situation analysis NIA staff development consultations on modality of operations and other aspects	• Strengthening of base organizations. • Small group consultations. • IA strengthening.	• Inventory of structures, facilities. • Update of irrigation parameters. • Formulation of improved modality of operations. • Preliminary design.
Mobilization Phase Design consultations IMT consultations	• Organization of federation. • Leadership trainings.	• Design finalization. • POW preparation.
Participatory Planning IMT negotiations Planning for POW Implementation (modality of operations)	• Internal consultations.	• Preparations for POW implementation.
Implementation POW implementation	• Internal M&E. • Installation of internal procedures.	• Technical supervision and evaluation.
M&E/Sustenance IMT sustenance and M&E	• Implementation of internal procedures and rules. • Assumptions of IMT responsibilities.	• Technical evaluation. Performance M&E.

Status of IMT

A total of 59,559 ha is now under IMT which is 31.53 percent of the target area of 188,866 ha covered by three foreign-assisted projects (IOSP II, WRDP and ISIP II) or 8.74 percent of the NIS area (681,255 ha) (Table 8)

Among the issues identified in the IMT pilot areas are:

i) The need for fund support for retirement of affected personnel and other measures pertaining to affected personnel.
ii) Sustainability of the improved irrigation facilities and structures.
iii) Provision of assistance programs to farmers like post-harvest facilities, marketing, credit, etc., which are beyond the mandate of NIA.

The main constraint besetting IMT is the issue of personnel displacement resulting from its implementation. There are so many NIA field staff who are to be displaced by the program. NIA is addressing the concern by way of securing funds for retirement of affected staff or possible reassignment to other units. About 300 staff in the assessed 29 NIS signified their willingness to retire requiring about ₱143 million.

Table 8. Profile and Status of IMT as of 31 August 2000

a. IOSP II Project

Region	NIS	Service Area		Area with IMT Contract	No. of Associations with Contract
		Before Project	After Project		
I	1. Bonga 1	298	298	298	1
	2. Bonga 2	655	674	674	1
	3. Bonga 3	201	202	202	1
	4. Cura	431	431	431	4
II	5. Baggao	2,067	2,067	731	1
	6. IAAPIS	2,306	2,306		
	7. MRIIS Dist. 1	21,797	24,054	14,422	8*
	8. MRIIS Dist. 3	23,442	24,260	8,614	5*
	9. MRIIS Dist. 4	19,890	24,087	13,735	9*
IV	10. Agos	1,119	1,435		
	11. Sta. Maria-Mayor	1,173	1,173		
	12. Cantingas	256	310	310	3
V	13. Barit	2,260	2,260		
	14. Matogdon	307	530	530	1
VII	15. Pongso	800	865	850	5
VIII	16. Maranding	4,927	5,300		
	17. Malasila	4,006	4,006	4,006	4
Sub-total		85,935	94,258	44,803	21

b. WRDP

Region	NIS	Service Area		Area with IMT Contract	No. of Associations with Contract
		Before Project	After Project		
II	1. San Pablo Cabagan	1,273	1,432		
	2. Tumauini	3,615	4,621		
	3. Magapit PIS	10,914	10,914		
	4. Solana PIS	2,777	2,777		
	5. Lower Chico	1,856	1,856		
	6. Baua	2,419	2,419		
	7. MAIIS District II	23,241	24,260	7,799	5
III	8. Camiling	8,580	8,738		
IV	9. Baco-Bucayao	6,327	6,527		
IV	10. Balanac	1,056	1,278		
	11. Pagbahan	1,005	1,551		
VI	12. Jalaur Proper	11,479	11,479		
V	13. Sibalom-Tigbauan	2,020	2,346		
IX	14. Dipolo	1,600	1,600		
X	15. Roxas-Kuya	823	1,063		
XII	16. Mílang	2,981	1,860		
XIII	17. Tago	3,716	3,716		
	18. Andanan	5,000	5,711		
Sub-total		90,682	94,148	7,799	5

c. ISIP II

Region	NIS	Service Area		Area with IMT Contract	No. of Associations with Contract
		Before Project	After Project		
VII/VIII	1. Bao	1,917	2,103	2,103	2
	2. Mainit	1,384	1,422	1,422	5
	3. Tibak	1,630	1,788		
	4. Binahaan North	1,801	1,891		
	5. Binahaan South	1,410	2,021	2,021	3
	6. Lower Binahaan	1,200	1,260		
	7. Guinarona	646	646		
	8. Daguitan	850	916		
	9. Bito	1,411	1,411	1,411	11
Sub-total		12,249	13,458	6,957	21

Note: Federation of IAs at lateral level called Confederation of Irrigators Associations (CIA).

An important activity undertaken at present is the review of the IMT contract provisions particularly on major repair works, Irrigation Service Fee (ISF) sharing and O&M funds. There is a need to clarify the cost of major repair and other concerns related to it.

The ISF sharing should consider cost recovery and payment by farmers of a fixed amount denominated in cavans per hectare or by volume of water supplied by NIA. There should be a built-in mechanism or assurance that the laterals will be maintained at all times and not left as a voluntary activity to be performed by the IAs.

Future of IMT

The prospect of IMT is very bright especially if the concerns and problems encountered now could be appropriately addressed with. In fact, NIA is planning to replicate countrywide the IMT model developed under IOSP II and has already submitted to NEDA a proposal for a National System Performance Optimization Project covering all NIS which have not benefitted from the World Bank- or ADB-assisted projects.

The following are succeeding actions necessary for the pursuance of IMT.

(a) Completion of IMT in ongoing foreign assisted projects.
(b) Sustenance of IMT in these areas through proper M&E capacity development and inter-agency coordination.
(c) Replication/expansion in remaining NISs. However, a basic input for successful IMT is restoring/improving the operating capacity of NISs.

The IMT to be implemented successfully requires strong political will of the NIA hierarchy starting from the Administrator, Regional Irrigation Manager, Irrigation Superintendent and field staff in addressing the concerns, issues and problems during implementation and providing the necessary management, technical, skill and financial support of front-line implementers in working with the IAs/farmers.

10. SRI LANKA (1)

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INTRODUCTION

Geographical Background

Sri Lanka is an island state with an extent of approximately 6,580,000 ha, situated in the center of the Indian Ocean and on the southern tip of India. It lies between 6-10º North of equator and has a tropical climate. The central hill country reaches a height of around 2,500 m and the coastal plains are mostly flat and sometimes undulating. There are a large number of perennial rivers, starting from the hill country and flowing to the sea, right round the country.

The southwestern plains and a larger part of the hill country, receiving around 2,400 mm of annual rainfall is called the Wet Zone and the rest of the country, encompassing about two-thirds of the land area, mostly plains, receive around 1,450 mm of rain and is called the Dry Zone, where rain is confined mostly to the period November to January, when northwestern monsoon is active. he Intermediate Zone lies in-between.

Historical Background

History records Sri Lanka as a hydraulic civilization, which extended from around 500 BC to around 12 AD in the Dry Zone, supported by a very sophisticated system of irrigation, tapping large perennial rivers, starting from wet hill country. But for a number of reasons, this civilization collapsed and the people gradually moved to the Wet Zone. With the arrival of European colonial powers, who were ruling the country from 16th century to mid 20th century, an export oriented plantation economy emerged and the Wet Zone was fully developed with tea, rubber and coconut and rice.

In Sri Lanka, during recent times, land settlement under irrigation as a developmental strategy, dates back to the early decades of the 20th century. Among its objectives, achieving self-sufficiency in food and relieving population pressure in the Wet Zone had been the foremost. The recognition of the peasantry as an institution in a changing political context and the need for their upliftment also influenced the land settlement policy. The promulgation of the Land Development Ordinance in 1935 provided the framework for the development of major irrigation settlement schemes.

Socio-economic Situation and Settlement Pattern

In Sri Lanka, historically as well as in the present times, land development has been intimately associated with the development of water resources. Hence, the limiting factor in developing agriculture is the availability of water and not land.

Sri Lanka's population at present is approximately 19 million, resulting in an unfavorable man/land ratio. This, coupled with a concern for equity has resulted in deciding

on a modal of very smallholding size, under irrigation settlement schemes in the Dry Zone. Almost all the lands, which were utilized for these schemes, belonged to the state. With socio-economic problems of a developing country, such as low standards of living, unemployment on one side and the rising expectations of a newly independent State with a stagnant economy with little avenues in developing industries and other non-agricultural economic activities, the government's main trust was an all out program of settlements, under irrigation in the Dry Zone, with a view to meeting the society's socio- economic needs.

The prime objective was the alleviation of land hunger of the poorest segments of the society and to help to create a contented rural peasant farming community, resulting in the continuation of traditional peasant agriculture, with its attendant problems of low productivity that did not enable the generation of a surplus, above the producers needs, as against an attempt to create an economically dynamic and self-sustaining society (*Land Commission Report*, 1987)

GROWTH IN IRRIGATED AREA AND POTENTIAL FOR FURTHER EXPANSION

By late 1970s a large number of major irrigation projects were built, damming perennial rivers in the Dry Zone in addition to building a large number of medium-scale irrigation projects and village tanks, in a cascade formation, along river basins. In late 1970s the most ambitious program of the time – the Accelerated Mahaweli Development Program to utilize waters of the biggest river in the island commenced by building a large number of storage reservoirs, diversion tunnels and trans-basin canals mainly for irrigation and power generation.

It is estimated that there is approximately 6,000 km^2 under irrigation systems in Sri Lanka, at present. The Department of Irrigation maintains infrastructure facilities in systems covering nearly 250,000 ha of gravity irrigation schemes, 2,300 ha of lift irrigation and 34,000 ha of drainage/flood protection schemes of the country. 266 of the gravity irrigation schemes are major irrigation schemes.

Further, under the accelerated Mahaweli Development Program (1978-98) an extent of 349,926 ha have been developed out of which an extent of 130,000 ha is under irrigation (8,145 km of canal networks). 121,394 farmer families have been settled in the areas opened up under seven major schemes, which are called systems. Over Rs.69 billion (at current prices) has been spend on Mahaweli Program. The bulk of (53 percent) of this substantial investment was directed towards the completion of four large reservoirs with powerhouses along with trans-basin irrigation diversion systems and their operation and management structures. The balance 47 percent was utilized for the establishment of associated downstream human settlements. Prior to this period, from 1960 to 1980, the State had been spending a large portion of its capital expenditure of major irrigation development which can be seen in the Public Investment Program pertaining to that period, when State to State foreign funding both through multilateral and bilateral sources, used to flow liberally on soft loan and outright grant basis, which has now come down to a mere trickle.

Potential for Further Expansion

A large number of rivers in the Dry Zone have already being tapped by damming to create large reservoirs for irrigation. However, there are two more storage reservoirs identified as feasible namely Moragahakanda and Kalu Ganga to be built in one of its tributaries, which

would improve the water availability in Mahaweli Systems. Although, earlier there were plans to divert water from the upper reaches of a large number of rivers in the Wet Zone, with a view to augment water requirements of Dry Zone basins and also to protect the Wet Zone lowland areas from flooding, some of these have been abandoned or are to be re-designed by downsizing such projects as the water requirement of the growing population in the Wet Zone itself are projected to rise rapidly with the rising standard of living of the people and industrialization. Further, minimum water levels required for environmental sustainability have to be maintained in those rivers.

In recent times, irrigation wells and tube-wells have been built in large numbers for agricultural purposes. However, studies have indicated that this could have adverse impacts environmentally such as lowering of the water table. Hence, in future the construction of those have to be done after adequate surveys to ascertain the actual quantities, which could be extracted without adverse environmental impacts.

Hence, the potential for further expansion of irrigation facilities both surface and groundwater is limited and now the emphasis is on rehabilitation and re-modeling of existing degraded and neglected projects for higher irrigation efficiency and increased farm productivity. Focus also has changed from merely irrigation system management to total river basin management for environmental reasons and with a view to manage natural resources, mainly water resources, within a river basin, on environmentally sustainable basis.

THE PRESENT ORGANIZATIONAL SET-P OF THE IRRIGATION ADMINISTRATION IN THE COUNTRY

In terms of the size and the scale of irrigation works, those could be divided mainly into four categories.

i. Small-scale village tanks;
ii. Medium-scale irrigation schemes;
iii. Major irrigation schemes (which have a command area of above 80 ha; and
iv. Major irrigation systems under the Mahaweli Authority of Sri Lanka (MASL).

The small-scale village tanks come under the purview of the Department of Agrarian Services. The medium- and large-scale irrigation works are the responsibility of the Irrigation Department (other than the irrigation systems coming under the purview of MASL). The Irrigation Department has a number of programs for its major irrigation projects, where concerted efforts are made to have farmer participation in the management of those schemes.

The MASL has its own regional officers through which Mahaweli systems are overseen and has recently been involved in a number of new innovations and experimentation in developing a suitable model for farmer participation. While the Agrarian Services Department falls under the Ministry of Lands and Agriculture, the Irrigation Department comes under the purview of the Ministry of Irrigation and Power, and the MASL comes under the purview of the Ministry of Mahaweli Development. Although these organizations have their own management structures, there are effective coordinating mechanisms which create opportunities to discuss common issues pertaining to policy and programs and share experiences, which could be mutually beneficial to the organizations coming under the purview of those three Ministries.

However, overall policy decisions, pertaining to the irrigation sector and decisions on macro level water utilization among major uses, such as irrigation, power, domestic and recreational, are taken at the Cabinet level, on the advice and guidance from these three Ministries and the Ministry of Finance and Planning. They get together, under various statutorily constituted committees. Further there is a Cabinet Sub-committee to look into sector policy and future programs.

The Proposed Changes at the Top

However, based on the recommendations made to the Cabinet recently a 'New Integrated Water Resources Management Organization' is being established. Under this new organization, a 'Water Resources Council' (WRC) and a 'Water Resources Secretariat' (WRS) have been established as apex bodies to oversee the country's water policy and the distribution of water resources at macro level among major users and irrigation, power, industrial, domestic use and recreational requirements.

These two bodies have been entrusted with the responsibility of providing guidance and direction for the implementation of the following components of the action plan, under the above project:

- Development of a national water resources policy and legislation;
- Development of recommendations for an independent agency for water resources management;
- Carrying out studies for comprehensive planning of water resources in selected river basins; and
- Establishment of an improved system to provide data and information in the water sector.

These developments in the overall water resources management in the country would no doubt have a favorable impact on the irrigation administration, as due recognition of the irrigation sector would be accorded and issues relating to present and future water allocation among major uses would be adequately looked after.

PARTICIPATORY MANAGEMENT APPROACH

In late 1970s, the State realized that the top-down highly bureaucratic approach with little consultations or involvement with main stakeholders – the settlers and the local communities – who were the main beneficiaries of these high cost state programs could create major problems in the long run.

Efficient use of irrigation water was not a serious concern in irrigation schemes and high permissive water use was characteristic of these schemes which led to "head end–tail end" problems, low cropping intensities and income inequalities among farmers. The poor operation and maintenance (O&M) practices at the systems level had compounded the problems of excessive water use. These conditions led to the shortening of lifetime of irrigation projects, needing costly rehabilitation. The World Bank and the other donor agencies insisted that proper O&M and the involvement of beneficiaries in the management of these schemes was essential for the sustainability of these projects. They, too, pointed out that at least a part of the O&M cost should be met by the beneficiaries. There was realization that farmers cannot

remain as passive recipients of capital inputs and that active participation of farmers was needed for proper functioning of these irrigation systems as well as to increase farm productivity.

Several special projects were started to achieve better coordination and provision of new input technology. These projects registered some success but lost momentum, as those did not incorporate proper institutional building strategies, at the grassroots to mobilize farmer participation, in water management and other activities. Subsequently, suitable participatory models were evolved, involving user associations and farmers organizations (FOs) through pilot projects. Most of such efforts have been linked with the rehabilitation of physical structures. Some of these irrigation rehabilitation projects were also focusing on productivity and equity issues, relating to water use. A conscious effort was made to train farmer leaders in new settlement schemes to facilitate settler incorporation into the joint management process. Further re-training and re-orientation of official cadres that interact with the farming community were undertaken under these new programs.

FARMER ORGANIZATIONS UNDER DIFFERENT MINISTRIES AND DEPARTMENTS

The Agrarian Services Department

As mentioned earlier, the small-scale village tanks numbering about 30,000 (1,500,000 acres) comes under the purview of the Department of Agrarian Services and at present the FOs formed under these village tanks have been entrusted with responsibilities in managing water distribution, O&M and even rehabilitation of tanks and irrigation canal system. The costs involved are small and systems are technically not complex. The Department provides technical guidance and other support services. Traditionally to the villagers had been looking after these functions, fairly satisfactorily in the past. The FO now undertakes rehabilitation contracts and meets 20 percent of the costs involved.

Irrigation Department

The Irrigation Department has the largest extent under irrigation schemes, especially those, which are medium and large in size. The Irrigation Department manages major irrigation systems numbering over 266 and covering an extent of approximately 250,000 ha. The larger inter-provincial irrigation systems, which cover 37 schemes, with a total extent of 157,000 ha are under the Integrated Management of Settlement Program (INMAS) of the Ministry, which produce 30 percent of the paddy in the country. FOs (over 1,175) at distributory canal level, federated to 30 main system level organizations engage in participatory system management. Improved efficiency, reduced costs with improved officer/ farmer relationships have resulted from these developments. Amendments to the Irrigation Ordinance in 1994 gave legal backing to these institutional arrangements.

The prime objective of this participatory management program under INMAS is the improvement of productivity of irrigation systems and uplifting of the economic conditions of the farming community. The main features of this policy are the formations of farmers' associations, strengthening them and transfer part of management responsibility. A time-bound action plan has been prepared for transferring the management functions to farmers. In addition to above programs, there are 671 FOs to cover medium-scale irrigation projects. In

addition to handing over of O&M duties of irrigation systems the following functions are also performed under these programs:

- Capacity building for joint management, including formation and strengthening of FOs;
- Adopting improved and scientific operation and management practices including installation of measuring devices and calibration. Preparation of O&M manuals;
- Facilitating seasonal water distribution and production planning;
- Programs for adoption of new irrigation and agricultural technology;
- Environmental activities for long-term sustainability, including activities for prevention of soil erosion, siltation of tanks, water-logging and salinity; and
- Training of staff and farmers.

Other functions include assisting and facilitation of input supply and coordination, post-harvest processing and marketing and programs for increased off-farm incomes.

Mahaweli Authority of Sri Lanka

MASL is a very centralized organization, which has all the required specialization for the management and operation of the irrigation and settlement project, located under seven systems widely scattered, geographically. The system's administration is headed by a Resident Project Manager, under whom, *inter alia*, has cadres of Irrigation Engineers, Institutional Development Officers, Block Officers and Unit Officers, who are directly involved with operation and management of the irrigation systems and institutional development. These officers have close links with the Water Management Division, Planning and Monitoring Division and the Human Resources Development Division at the Head Office in Colombo, headed by respective directors.

From initial stages there was more concern in planning and designing of irrigable areas and human settlements in providing a good layout for O&M of irrigated lands, a higher levels of economic and social infrastructure for the new settlers under Mahaweli than in the past. The institutional development division took interest in promoting FOs in all the systems. There was a time when farmers were paying a percentage of the costs of O&M, but subsequently abandoned due to socio-political reasons.

The Need to Have More Active Participation of FOs in Management

Some selected reasons for promoting farmer participation in management are listed below:

i. To ensure sustainability of the irrigation systems so as to reduce the need for costly rehabilitation of such systems periodically.
ii. With active participation of farmer beneficiaries, irrigation systems could be managed more efficiently ensuring timely availability of water for timely cultivation which ensures higher productivity and less crop failures.
iii. Strong FOs managing their systems could be utilized for other economic activities such as animal husbandry, inland fisheries, agro-processing, input supply and marketing for better returns economically and socially.
iv. Globally, at meetings on environment and water resources, it has been highlighted that there would be severe shortfalls in water requirements, especially in large number of

developing countries where increase in population and increasing domestic and industrial use of water would no doubt reduce the water availability in irrigation projects. Further, it has been realized that certain minimum water levels have to be maintained in river basins for environmental considerations and for biodiversity, which could further reduce the water availability in irrigation schemes. There is also tendency to use water in the upper catchments for crop production and for other uses, which also would contribute to lesser water availability in downstream irrigation projects. Hence the need to optimally use the limited water resources in irrigation systems and strong farmer participation could be very helpful to face this challenge, especially in systems, where multitude of smallholdings are operating.

v. The general trend is that the government sector is contracting in size and that the government would have fewer resources to have a large bureaucracy, as in the past. Hence government would gradually withdraw with a thinner bureaucracy, where farmers have to play a bigger role, in managing irrigation systems by themselves.

NEW DEVELOPMENTS AND EXPERIENCES IN PARTICIPATORY IRRIGATION MANAGEMENT UNDER MASL

This section presents some efforts in involving the beneficiaries and other stakeholders on various stages of the project development from identification to O&M of the facility, through water users associations:

i. The new experiences and experimentation with Participatory Irrigation Management (PIM) under the World Bank-assisted Mahaweli Restructuring and Rehabilitation Project (MRRP). One of the main objectives of this project, *inter alia*, is a rehabilitation of the irrigation network in system H and to ensure sustainability of the system with farmer participation.
ii. Project component on development of sustainable FOs under the Mahaweli Consolidation Project funded by the European Union covering Systems G and C of Mahaweli systems.
iii. The newly formed farmer companies in Mahaweli systems with a view to manage their agricultural activities on a commercial basis.
iv. Project component of the World Bank-assisted in System C for the training of villagers and other stakeholders including officers of all relevant agencies working at village level to empower village communities – village self-help learning Initiative Pilot Project.

New Experimentation with PIM under the MRRP

Under the above World Bank-assisted project, *inter alia*, one main objective was the rehabilitation of irrigation network in System H, by handing over of Distributory and Field (D&F) canals to the FOs for O&M and increasing farmer productivity. System H was first built in 1974-80 (31,500 ha of irrigated land extent, with 30,000 farmer families during a short period of 18 years had deteriorated to such a level that needed rehabilitation. All the 250 Distributory Canal Farmer Organizations (DCFOs) in System H have been strengthened for effective participation in the rehabilitation program. An action plan has been prepared and

implemented to ensure farmer participation at pre-construction, construction and post-construction stages.

The assessment of the DCFOs using 15 performance indicators has shown that nearly half of them are functioning satisfactorily. The engagement of an NGO of proven capability and consultants with experience in FOs is helping to strengthen the FOs speedily. Action is also being taken to strengthen the FOs financially through the collection of an O&M fee amounting to Rs.250/ha/season from farmers, and the setting up of Block Development Councils under the new Agrarian Services Act. There is encouraging evidence at present of farmer acceptance of payment of the O&M fee. Under this MRRP project, in order to increase the farm income, a production plan has been prepared for the DCFOs where rehabilitation works have been completed. The plan has set targets for the production of major crops, incorporating livestock development and inland fisheries and includes farmer training and extension programs. A research report on 'Need for Institutional Impact Assessment in Planning Irrigation System Modernization' by D. J. Bandaragoda (1999) explains that it is very important to involve the beneficiaries as well as all the other stakeholders from the designing stage in new irrigation schemes or in rehabilitation schemes.

The following strategies were adopted to achieve farmer participation at planning, designing and operation stages.

i. Coordinating committees at levels of the canal system hierarchy (unit, block and project levels) to facilitate conflicts, resolution and decision-making in respect of seasonal agricultural planning scheduling, O&M, water distribution, extension, and marketing and to help implementation and monitoring of those activities.
ii. In order to follow the participatory rehabilitation planning process within limited time available for the task, eight multidisciplinary survey teams were formed and assigned to each management block supported by 3-4 Engineering Assistants and two Institutional Development Officers with support staff. Each team was assigned with the task of consulting farmers, by holding Participatory Rural Appraisal (PRA) sessions. Each team was assigned to hold ratification meetings to get the concurrence of the farmers for final solutions/proposals.
iii. A carefully planned institutional development program was launched to build up farmers by changing their attitude, to be volunteered to accept O&M responsibility of rehabilitation canals.

Development of Sustainable FOs under the Mahaweli Consolidation Project, (funded by EU in Systems G and C)

This project to be implemented during the period 1998-2003, has as its main objective the transformation of farmer communities into viable and self-sustainable private smallholder commercial farmers. The Mahaweli Consolidation Project (MCP) has been conceived as an integrated intervention with the FOs as the focal point. This is encapsulated in the project description of the EU Project Appraisal Mission (PAM) Report of 1993 as follows:

> "*The wider objectives of the project are to support and consolidate the investment and development initiated in the Mahaweli area, to create and support viable self-sustaining farmer communities based on commercial agriculture, where irrigation infrastructures and irrigation water are seen as*

assets which have to be maintained; to create a commercial environment with improved access to credit, business facilities and skills training which can provide alternative job opportunities for the second and third generation; and to safeguard the environmental equilibrium of the area."

The present situation in the settlements is that farmers are caught in a cycle of unsatisfactory maintenance of the distribution system and an unreliable supply of water that is imperative for embarking upon crop diversification, cultivation of high-value crops and commercial farming in the Dry Zone. It is therefore imperative that the farmers, as beneficiaries of these investments, take over the management and O&M of the irrigation infrastructure, which should be treated as a productive asset, PAM report further stated. Although there are six major components as stated below the project heavily depends on development of FOs to take on the responsibilities of managing the irrigation water, agricultural development and other economic activities.

i) Farmer Organization (FO) Component
ii) Rehabilitation and Improvement (RI)
iii) Agricultural Production and Extension (AE) Component
iv) Credit Support (CS) Component
v) Enterprise Development and Marketing (EM) Component
vi) Forestry and Environment (FE).

FO component will be responsible for the institutional development of the FOs to enable them to take on O&M responsibilities of the tertiary irrigation system. An expatriate Institutional Specialist (IS) and a local counterpart will supervise this component. The inputs comprise supervision and technical training. The implementation of the FO component will be done through the IDO/MASL staff including the Govi Niyamake (Agriculture Department).

1. ***Establishment of Farmer Companies Under the MASL***

In 1998, Mahaweli Authority started a pilot project at Chandrikawewa in Udawalawe system with a view to organize farmers not only to manage the respective irrigation turn out areas but to undertake agriculture on a commercial basis by jointly organizing input supplies such as seed paddy, fertilizer, and insecticides and marketing as well. These farmers also have been encouraged to undertake contract growing for specific market segments, linking with the private sector.

As the farming community in irrigation projects essentially have small plots of land for farming and living at subsistence level without producing a surplus would have a breakthrough only if they are assisted to make use of new technology, better economic organization and undertake farming for the market. This model was developed with some earlier experiences in Huruluwewa under the Shared Control of Natural Resources Management Project (SCOR), implemented by the International Water Management Institute (IWMI).

2. ***Experimentation in Farmer Community Empowerment Through Village Self-help Learning Initiative on a Pilot Project Basis***

Under the World Bank-assisted MRRP project an additional project component was added by including this pilot project with a view to empower a very backward and remote farming community in System C. By working closely with this community and all the State

sector organizations including Mahaweli Officers in irrigation, institutional development, agricultural extension as well as banks and local level officers of government line departments, this intervention intends to help and guide these backward villagers to manage their own affairs such as their domestic water supply, housing, agricultural production, non-farming activities etc. NGOs and agencies with experience and competence in institutional building are entrusted with this exercise and the FOs has been given a certain amount of funds to manage on their own affairs with the view to change the attitude of the community and thereby develop them, on a self-help basis.

PROBLEMS/CONSTRAINTS BEING ENCOUNTERED

The following can be identified as some of the constraints, which had hindered the satisfactory development of farmer participation in management of irrigation systems on a sustainable basis.

1. ***Provision of Irrigation Water Free of Charge***

From the inception, the State has not charged for irrigation water which have been provided to the farmers to recover either a percentage of the initial capital outlay or the O&M charges or periodical rehabilitation charges resulting from fast deteriorating of systems due to low levels or lack of O&M. If efforts were made at initial stages in charging a nominal amount for the irrigation water from the beneficiaries, it would have not only inculcated the value of expensive irrigation water in the minds of the farmers but also provided and opportunity to collect O&M charges from them. However, for political reasons, successive governments have abandoned this effort. Hence the users of water do not realize the actual value of water and the cost of provision of irrigation water to the government, which is ultimately borne by the whole society. Now an effort is being made to issue water rights (entitlements) to farmers to overcome this problem and make optimum use of irrigation water.

2. ***Socio-political Background of the Country***

Although the democracy has been practiced for the last 50 years and people have been provided with avenues to express their views and needs and exert pressure on the government through their representatives people tend to seek political patronage not as a group to solve their common problems, but on an individual selfish basis leading to partisan politics which discourages the villages at grassroots to work together to meet their common goals. Even farmer leaders sometimes have a tendency to be subservient to the politicians for their personal gain, sacrificing the common objectives of FOs.

3. ***Financial Constraints of a State***

The financial constraints of a developing State also has had an adverse impact on evolving strong FOs in its inability to provide small-scale farmers with loans, agricultural extension, better seeds, better infrastructure etc. The channeling of large sums of money for the civil war in the North has also contributed to this situation in Sri Lanka.

4. ***Holding Size and Selection Criteria***

Small holding size and the adoption of poor criteria in selecting farmer families have resulted in their remaining at poverty levels, reducing the capacity and capability required for active farmer participation. A more flexible policy on holding size to cater to different capacities of farmers coupled with the selection of farmers with the required experience and training in agriculture, with correct aptitude and attitudes would have led to the farming

community deriving full potential of the irrigated farmlands and the other facilities and extension services available within a much shorter time. It would also have helped in operation of the irrigation system on a sustainable basis, with stronger and willing participation of better off farmers.

THE FUTURE PROSPECTS OF PIM

The writer through his experience in the sector is of the view that the following factors may have to be considered to build more efficiently managed organizational change for improved PIM in Sri Lanka:

i. The past experience amply show that dedication of officers in charge of the projects, on one hand, an honest and active leadership provided by farmer leaders on the other has played a crucial role in building up highly successful FOs and sustaining those. Few experiences in 1980s in Gal Oya and Minipe projects have demonstrated, like in many other countries, that the dependency syndrome has been caused by a situation, where smallholder farmers, living at subsistence level, prefer to depend on the bureaucracy to carry out their activities maintaining the same state than develop their initiative to manage their own affairs.

ii. Although Sri Lanka has been experiencing a democratic form of government for over 50 years and equal rights were given both gender, the women in rural areas have not played an active role in farming although in political and professional arena women play a significant role. Still in the rural sector, traditional values seem to hold good and gender dominance of males can be seen which has discouraged participation of women or their taking leadership in farm organizations, in a significant way. However women play a prominent and a very beneficial role in agricultural activities and in managing the family farm, in addition to household and domestic affairs and should be encouraged to take up a prominent role in FOs.

iii. It is seen that political influence also has blunted the development of strong FOs. Hence it is important to insulate farmers and officers, working in these irrigation schemes from political interference. However, this should not be mixed up with the type leadership the local politicians could provide to these rural societies, which could be of immense help, if not colored with partisan politics.

iv. Strong Human Resource Development (HRD) capabilities and tailor made programs at empowering farmer communities by experienced and knowledgeable staff could play a vital role in developing an independent, self-reliant farming community. The staff handling these programs should possess not only the technical capabilities but also should have the attitudinal and behavioral attributes and the patience to facilitate FOs to overcome farmer dependency on the State. Sensitization, familiarization and training of officials and there intensive interaction with settlers is essential for achievement of this end (Samaranayaka, 1998).

v. It is very important that the empowerment programs of farmers should be timed at the commencement of the new irrigation projects or at the beginning of a rehabilitation and remodeling of irrigation projects, so as the farmers could get involved in the interaction from the initial phases of designing planning and construction. This would benefit the designers of the new projects as the local conditions are known best to the

farmers who had been the operators of the earlier degraded system who would sometimes have more practical knowledge on what went wrong earlier. The farmer involvement also would give a sense of ownership to the farmers at the time of operation of the system. Further a badly neglected and degraded irrigation system would not create the necessary enthusiasm the farmer community would need to start managing their own affairs. Hence the availability of an adequately efficient delivery system, with appropriate measuring devices to ensure equity considerations would be helpful at the commencement of an empowerment program.

vi. A proper legal framework, too, is needed to ensure that FOs have adequate safeguards and authority to carry out their functions without any legal hitches and that such legal framework also should ensure that the assets and resources belonging to the company members are safe and would not be swindled by the company directors. Lengthy legal procedures and protracted legal cases in courts too have discouraged the FOs from taking irrigation offences to courts. Hence, the creation of a special tribunal for the agriculture and irrigation sector could be useful.

vii. It is very essential that assured and fair farm-gate prices are available at least within a farming season as fluctuating prices could be a disaster in building up the confidence of the farmers in taking to commercial farming.

viii. There is a need for land tenure improvements as lands in Sri Lanka settlements specially those of Mahaweli were influenced by a number of factors not directly related to agricultural productivity and on selecting efficient farmers. For example, a fairly large percentage of lands have been given to non-farming people whose lands were submerged by reservoirs. The attitude of the government in looking after the farming community by insulating them from market forces made them to include certain restrictions on transferring of lands. These restrictions have prevented those wanting to enter the farming and move out of farming, which would ultimately assist in higher productivity of farmlands.

ix. Although many management functions in irrigation systems at lower levels would be transferred to FOs to manage on their own, the presence of the State on a very strong basis should be in place not only to monitor and evaluate the water management functions but to ensure that regulations pertaining to the maintenance of the irrigation system as well as the natural resource endowment surrounding the area to be managed on a environmentally sustainable basis. But the basis of their involvement would be of a facilitator's role and of an overall watchman to see where and how FOs are proceeding and take corrective action in policy areas and effecting organizational adjustments when and where necessary.

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11. SRI LANKA (2)

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INTRODUCTION

Sri Lanka is an island with a gross land area of about 65,000 km^2. It is situated between 6º-10º north of the equator. The country is broadly divided into two climate zones, which determine the characteristics of agricultural production. The Wet Zone to the southwest quadrant of the island gets an average annual rainfall in excess of 1,900 mm from both seasons. The Dry Zone which consists of over 65 percent of the total land area in the other three quadrants has an average rainfall ranging from 900 mm to 1,900 mm, much of which comes during the north-east monsoon (*Maha* season) from October to March. The south-west monsoon (*Yala* season) brings very little rain to the Dry Zone.

The population of Sri Lanka is approximately 19 million. Three-fourths of the population is concentrated in the Wet Zone, which is only a third of the country. The rural population is about 70 percent of the total population.

Historical Background

From early historic times until the 13th century the Dry Zone was the local of Sri Lanka's social political and economic activities. In 1815 the country was brought under the control of the British until independence was granted in 1948. During the early period of British rule, attempts had been made by the Colonial Government to establish large-scale commercial plantations through cultivation of tree crops, in the Wet Zone, where the lands hitherto enjoyed by the rural peasantry.

In 1972, Land Commissioner's interim report mentioned that preservation of the peasantry, as a social group should govern the formulation of the land policy. The crystallization of this policy in to a conceptual and legal framework is clearly seen in the land development. Ordinance of 1935 displays its bias towards peasant welfare. In the early years, attempts by the British Government to open up new lands on the Dry Zone did not meet with much success until the physical and economic environment was ripe enough to attract people who were ready to venture in to Dry Zone cultivation. The unequal competition between the plantation economy and the paddy farming still persisted. Productivity in paddy farming in the country was about the lowest in Asia and the prospects of attracting large private investment like in the plantations sector were very low. Thus, it was left to the government to take the initiate to develop the Dry Zone in which the most favorable conditions for paddy cultivation were found.

During the initial stages, the involvement of the Colonial Government in providing irrigation facilities were largely confined to the repair of minor and medium-scale irrigation works mainly on account of the colonial policy of that time with regard to the type of investments favored by them. It is therefore seen that the British thought that the more practical approach was to harness local initiative, customs and traditions for the upkeep and operation of irrigation works.

In 1856, legislation was enacted to remedy the non-observance of ancient irrigation customs and practices, which were considered highly beneficial for irrigated agriculture. This was called the Paddy Land Irrigation Ordinance (No. 9) of 1856 that intended to facilitate the revival and enforcement of ancient customs regarding irrigation and the cultivation of paddy.

Formulation of Law and Irrigation Policy

The establishment of a separate Department of Irrigation in 1900 further accentuated the interest in irrigation. Prior to that, a Division in the Public Works Department handled matters connected to irrigation.

For over a period of two decades, the Department of Irrigation developed its constitutional reforms under the Donoughmore constitution, which bestowed certain powers that enabled the Executive Committee to deal with agriculture and land use priorities to effect the development of land and water resources in the Dry Zone. The Chairman of the Executive Committee on land and agriculture at that time was Hon. D. S. Senanayake who is considered the father of irrigation development in modern Sri Lanka. He formulated a national program to transfer people from the highly connected Wet Zone to sparsely populated Dry Zone and re-enacted the glory of ancient Sri Lanka.

THE PARTICIPATORY IRRIGATION SYSTEM MANAGEMENT POLICY

Prior to 1978, all "major" and "medium" irrigation schemes in Sri Lanka had been managed by the government with little official involvement of farmers. In 1988, after a decade of experiments, the government formally adopted a Cabinet Paper defining the "participatory irrigation system management policy". This policy attempts to increase farmer involvement in the management of major and medium irrigation systems. The goals of the policy are twofold:

1) Improvement of the productivity of the irrigation schemes through improved ability to manage the system to serve crop needs.
2) Increasing the share of Operation and Maintenance (O&M) expenditure borne by the farmers by transferring a large portion of the O&M responsibilities to them. This would help relieve pressure on the government budget.

The participatory irrigation management policy is considered a key element of the future development of irrigated agriculture in Sri Lanka (Irrigation Management Policy Support Activity [IMPSA], 1991). This paper reports the results of a study conducted to evaluate the progress and impacts of the participatory irrigation system management policy.

Irrigation System Management before Participatory Management

Prior to adoption of participatory management, major and medium irrigation schemes were managed as follows:

1. ***Government Agencies Responsible for Managing Irrigation Schemes***

Major schemes are generally divided into two classes; major schemes whose command areas are larger than 800 ha and medium schemes with command areas between 80 ha and 800 ha. Management of both these types of schemes is the responsibility of the Irrigation Department. However, there are exceptions and not all major schemes are managed by the Irrigation Department. Since before independence, Sri Lanka has been developing new irrigation and settlement schemes. Starting at independence, the integrated development agency approach modeled on the Tennessee Valley Authority has been used to the large schemes. The Mahaweli Project is the latest development scheme and is managed by the Mahaweli Authority of Sri Lanka (MASL). The Mahaweli Economic Agency (MEA) is the specific organization within the MASL that manages Mahaweli schemes.

2. ***Seasonal Planning***

Seasonal planning includes deciding upon the crops to be grown in different areas of the scheme and the allocation of available water to those areas. In addition, seasonal decisions define when irrigation will start, how long irrigation for land preparation will continue and how long irrigation for the crop growth will continue. The Irrigation Ordinance of 1968 specified that, for major schemes, seasonal plans were to be made by the farmers prior to the season at a *Kanna* (seasonal) meeting. *Kanna* meetings were called and chaired by the government agent of the district or by his delegate. The idea was to get farmer participation in making the decisions. Because the Irrigation Ordinance applied to all major systems, *Kanna* meetings were held for Mahaweli schemes as well as for Irrigation Department schemes. However, they were called and chaired by MEA personnel rather than by the government agent.

3. ***Operations***

Both the Irrigation Department and the MEA claimed to deliver water to the farmer's outlet. In Irrigation Department's case, gate operations on main, branch, and distributory canals, down to the gate at the head of each field channel were carried out by Irrigators (*Jala Palakas*) under the supervision of Work Supervisors and Technical Assistants. In case of MEA, irrigators carry out gate operations under the supervision of the department rather than from farmers. Farmers supposedly had no role to play in setting gates. In fact, however, farmers could and did interfere with gate operations whenever they felt it necessary. Because of lower level of funding, Irrigation Department irrigators were fewer and Irrigation Department systems thus were more subject to interference by farmers than were MEA Irrigators. It is said that a farmer caught interfering with water distribution could be punished. However, no special powers were given to Irrigation Department or MEA officers to punish farmers, instead, they had to rely on the police and the courts. In fact, in reality, little could be done.

4. ***Maintenance***

Maintenance of all channels and structures other than field channels was the sole responsibility of the Irrigation Department and MEA, respectively, in the two cases. In Irrigation Department schemes, "Patrol Laborers" or irrigators generally carried out the work under the supervision of the Work Supervisor. The irrigators or special laborers did the work on Mahaweli Schemes under the supervision of the Technical Officer.

Farmers were considered responsible for cleaning field channels each season. This work was to be carried out under the supervision of the *Yaya Palaka*, a farmer appointed by the Agrarian Services Department. The normal practice was to assign each farmer a stretch of canal. A date would be set at each *Kanna* meeting by which each farmer was supposed to have cleaned his section of the field channel. In theory, the courts could punish farmers if they did not clean their sections. In fact, it was very difficult to enforce the cleaning.

5. ***Resource Mobilization***

Virtually all costs of O&M were to be borne by the Irrigation Department and MEA. The Irrigation Ordinance of 1968 authorized the government agency in each district to levy a fee on farmers for maintenance. However, before 1984, no fees were charged. An irrigation service fee was introduced in 1984 along with the promise of improvements to the services. Although many farmers paid at the beginning, service did not improve significantly. Also, political disturbances affected both the ability of the government agencies to deliver services and the ability to collect the fee. Recovery rates dropped from almost 85 percent for 1984 to less than 10 percent by 1988.

Participatory Irrigation System Management

The basic idea of participatory irrigation system management is that farmers work together with the government irrigation agencies to take responsibility for system management. As developed since 1978 through various experiments, participatory irrigation system management in Sri Lanka includes the following basic elements:

1. ***Farmer Organizations***

A key element is the development of hydrologically-based farmer organizations (FOs) whose basic functions are to deal with irrigation matters. FOs, however, need not be limited to irrigation matters. Most FOs consist of informal Field Channel Groups (FCGs), each of which selects a Farmer Representative (FR) who sits on the committee that governs the Distributory Channel Organization (DCO). The DCO that is considered the legal farmer organization. In some schemes, farmers have created higher-level organizations, including System Level Farmer Organizations (SLFOs) by federating DCOs.

2. ***Joint Management Committees***

Each irrigation scheme/system has a structure of joint management committees (JMCs) comprising of both FRs and officers from the relevant agencies. Minimally, every scheme has a top-level committee, generally called a Project Management Committee (PMC). The PMC is responsible for preparation of the seasonal plan, including allocating water to different part of the system according to the crop plan, and deciding upon an overall schedule of operations. In addition, the PMC attempts to coordinate efforts among agencies, improve communication and resolve problems between farmers and agencies, and resolve disputes among DCOs. Larger schemes have lower level JMCs, generally called Sub-Project Committees (SPCs) to deal with irrigation and other problems of sub-areas within the scheme. One accepted principle is that FRs must outnumber the agency officers on each JMC.

3. ***Turnover***

Once FOs and JMCs are established and considered capable of handling the responsibilities, the irrigation agency formally assigns ('hands over') the responsibilities for O&M on the distributory channels and field channels to DCOs. The agency retains responsibility for O&M of headworks, main channels and branch channels.

Figure 1 shows the current organizational model for participatory management. This model was first developed for the Integrated Management of Major Irrigation Schemes (INMAS) program and can be called the INMAS model. The idea behind the INMAS model is that FOs and joint management committees will improve communications with between farmers and the agencies, thus improving the agency response to farmer needs.

Better coordination in the turnover of O&M responsibilities will lead to improved operations and management. Better O&M and better agency services will lead to increased crop production and this, in turn, should lead to increased income from irrigated agriculture. At the same time, turnover will enable the government to reduce staff and materials costs thus reducing government expenditures on O&M. Figure 2 shows the participatory management process and Figure 3 shows the relations among variables affecting joint management committees.

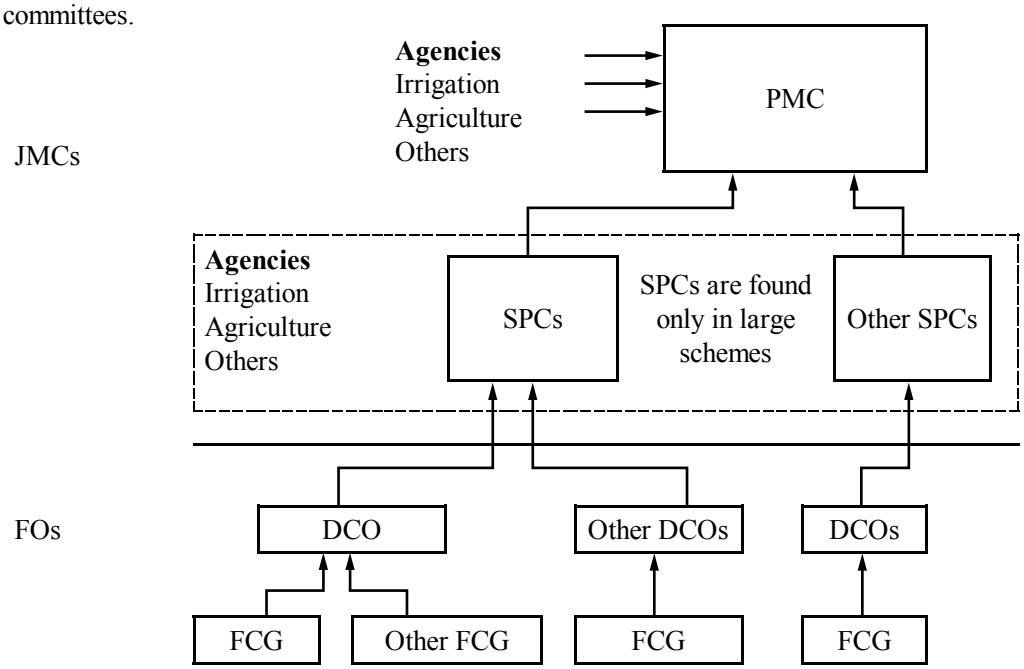

Figure 1. The INMAS Organization Model

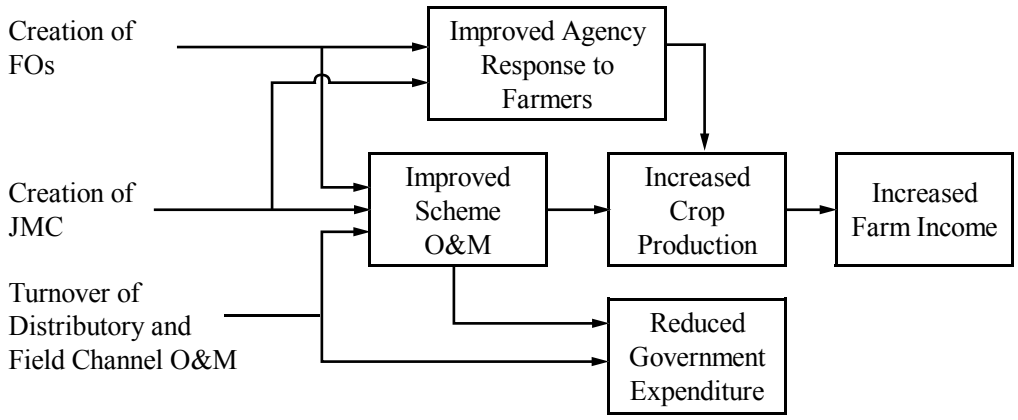

Figure 2. Participatory Management Process

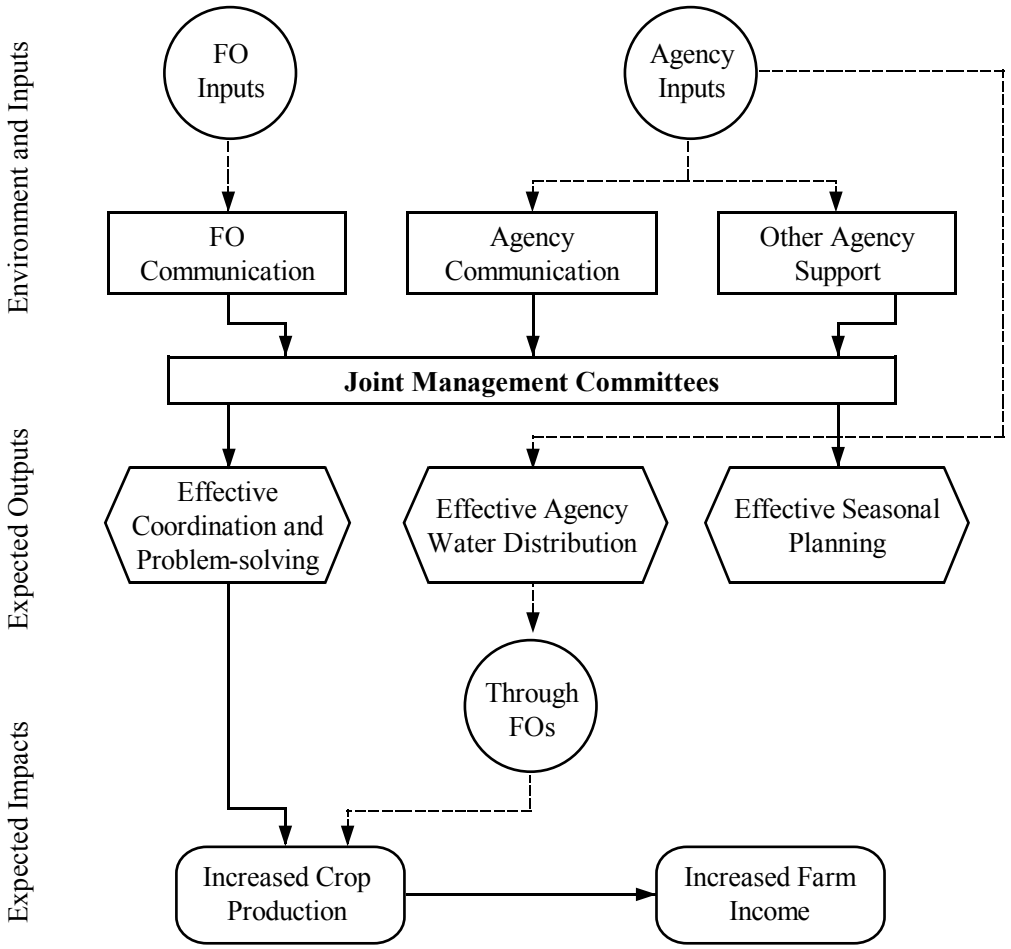

Figure 3. Relations Among Variables Affecting JMCs

Source: Brewer, 1994.

The major activities starting from the pre-participatory management situation Include following:

1. ***Seasonal Planning***

Seasonal planning is to be carried out by the JMCs instead of *Kanna* meetings. The basic idea is that, by using representatives of the farmers, instead of farmers themselves, the number can be made manageable so that farmers can have effective participation in seasonal planning decisions.

2. ***Operations Planning***

Under participatory management, operations planning is still carried out primarily by Irrigation Department or MEA engineers. However, the JMCs can discuss operations plans and set out basic parameters for the plans.

3. ***Operations***

Under participatory management, operations on field channels are the responsibility of FOs. Where turnover has occurred, operations on distributory channel are also the responsibility of FOs. The agencies retain responsibility for headworks and main system operations.

4. ***Maintenance***

Under participatory management, unless there has been turnover, the maintenance of all channels and structures other than field channels remains the sole responsibility of the Irrigation Department and MEA. FOs are responsible for maintaining field channels each season. Turnover implies that the FOs also take responsibility for maintenance of distributory channels.

5. ***Resource Mobilization***

With turnover, farmers are still supposed to pay the irrigation service fee, in addition to taking responsibility for operations on the field channels. The 1988 Cabinet Paper on the participatory management policy proposes turning over O&M responsibility, including responsibility for resource mobilization, for field and distributory channels to FOs. In return, the farmers would be exempted from their obligation to pay the irrigation service fee. The Cabinet Paper clearly was a response to the difficulty in collecting the service fee.

Table 1 contrasts the management responsibilities that prevailed before participatory management with the assignment of management responsibilities under participatory management.

Table 1. Comparison of Pre-participatory Management and Participatory Management Systems

Management Function	Pre-participatory Management	Participatory Management
1) Seasonal planning	Done by agencies and ratified at *Kanna* meetings.	Done by PMCs.
2) Operations planning	Done by agencies, basic plans ratified by *Kanna* meetings.	Done by agencies, basic plans ratified by PMCs.
3) Distributory channel operations	Carried out by irrigation agencies.	Carried out by FOs after turnover.
4) Field channel operations	Carried out by irrigation agencies.	Carried out by FOs.
5) Headworks, main channel, branch channel maintenance	Planned and carried out by irrigation agencies.	Carried out by irrigation agencies in priority order determined by PMCs.
6) Distributory channel maintenance	Planned and carried out by irrigation agencies.	Planned and carried out by FOs after turnover.
7) Field channel maintenance	Done by individual farmers under direction of the *Yaya Palakas* of the Agrarian Services Department.	Done by FOs.

RECENT DEVELOPMENTS IN PARTICIPATORY MANAGEMENT POLICY

Until recently there was no legal basis for the FOs and JMCs to take on any specific irrigation management functions in major irrigation schemes. FCGs and DCOs had no legal rights to stop abuses of water distribution. Similarly, PMCs had no legal right to make seasonal plans. Because of this last point, *Kanna* meetings continued as a legally required means of ratifying seasonal plans made by PMCs. In May 1994, the Irrigation Ordinance was amended to recognize the rights of FOs to operate and maintain distributory and field channels, to collect fees from the farmers to cover O&M costs and to fine farmers who take more than their share of water or who fail to contribute their share of maintenance labor.

The government has continued to develop the participatory management policy. Beginning in 1989, efforts were carried out to define the responsibilities to be turned over and the mechanisms for turnover, including development of formal agreements between the Irrigation Department and FOs. Between 1990 and 1992, the USAID-financed IMPSA developed numerous policy papers on various aspects of the irrigation system management based on the participatory management policy (IMPSA, 1992). More work on the policy, particularly on the responsibilities to be turned over to FOs are in progress.

PROGRAMS FOR ACHIEVING PARTICIPATORY MANAGEMENT

The INMAS, Management of Irrigation Schemes Program (MANIS), and Mahaweli programs are the governmentís main means for implementing participatory management and achieving its goals.

The Integrated Management of Major Irrigation Schemes Program

The INMAS program was begun in 1984 and was based on earlier experiments in improving irrigation management (Brewer, 1994).

At the same time, the Irrigation Management Division (IMD) was created to implement the INMAS program. As defined in the 1984 documents, the INMAS program has the following objectives:

1. ***Short-term Objectives***
    - Increase agricultural production per unit of irrigation water;
    - Increase agricultural production per unit of land;
    - Distribute irrigation water to farmers adequately and equitably;
    - Arrange for timely supply of agricultural inputs and sale of products;
    - Recover O&M costs from farmers in major irrigation schemes;
    - Maintain irrigation systems at optimum level of performance; and
    - Identify major systems needing urgent rehabilitation.
2. ***Long-term Objectives***
    - Integrated development of the farms to commercial holdings;
    - Crop diversification and rotation;
    - Social and economic development of the farming community;
    - Improved marketing of agricultural produce and by-products;
    - Local processing of agricultural produce to semi-finished or finished products; and
    - Handing over to farmer organizations some management and operational functions of the systems.

Under INMAS, an Institutional Development Officer (IDO), specifically charged with creating and strengthening the farmer organizations generally assists a Project Manager. In some INMAS systems, the IMD has appointed Institutional Organizers (IO) to act as catalyst agents to create and strengthen FOs. IOs have generally been provided only to schemes undergoing rehabilitation through a donor-funded project. IMD expects that the IOs can be withdrawn once the FOs develop.

At least two levels of hydrologically-based FOs exist in INMAS schemes; FCGs and DCOs. Recently the INMAS program has begun organizing system level FOs in many of the INMAS schemes.

Since adoption of the participatory management policy, formal turnover of the O&M of distributory channels to FOs has been a goal of INMAS. Many FOs have now formally taken responsibility for the distributory channel O&M. In most cases, the Irrigation Department is still providing funds and other assistance to the FOs. However, in February 1992, under the Irrigation Systems Management Project, 33 FOs signed agreements with the government renouncing this assistance.

The Management of Irrigation Schemes Program

In 1986, the Irrigation Department created the Management of Irrigation Schemes (MANIS) program to bring the benefits of the INMAS approach to the schemes not falling under INMAS. The objectives of MANIS are identical with those of INMAS and the scheme level organization is similar. MANIS is managed directly by the Irrigation Department.

Each MANIS scheme has a (part-time) Project Manager, generally the Technical Assistant assigned to the scheme by the Irrigation Department. Irrigation Department field-level staff, including Work Supervisors and others, assists the Project Manager. So far, the special inputs have been few. The most important has been training given to the Project Managers. Until very recently, MANIS Project Managers have not had specialized help such as IDOs or IOs. Project Managers attend to their functions on a part-time basis since they have their technical duties to perform as well. Recently some MANIS programs have been taken for rehabilitation under the World Bank-funded National Irrigation Rehabilitation Project. Under these projects, IOs, like those used in INMAS schemes are provided to these schemes.

Like INMAS, each MANIS program is supposed to have hydrologically-based FOs and the equivalent of a PMC. As in INMAS schemes, formal turnover of distributory channel management functions is a goal of MANIS. In addition, it has been recommended (IMPSA, 1991) to turn over the medium schemes with command areas of 400 ha or less to FOs.

Mahaweli Participatory Management Program

Most of the Mahaweli schemes are new settlement schemes based on irrigation systems that derive some or all their water from the Mahaweli River. The MEA, a unit of the MASL, manages the Mahaweli schemes. MEA attempts to provide fully integrated services to the settlers, including irrigation, agricultural, health and other services. In non-Mahaweli schemes, these services are provided by a variety of specialized agencies or by the private sector.

There are six hydrologically distinct Mahaweli irrigation schemes: System H, System C, System B, System L, Bakamuna, and Uda Walawe. Bakamuna was formerly called System G. It has recently been amalgamated administratively with System B; System L is still under construction and is not further considered here. In effect then, there are four Mahaweli

schemes discussed here: System H, System C, System B (including Bakamuna) and Uda Walawe.

A Resident Project Manager is in charge of each scheme. Deputies for agriculture, lands, irrigation, marketing, community development, and institutional development help the Resident Project Manager. Each Mahaweli scheme is divided into Block Managers who are assisted by deputies for the five subject areas. Each Block is divided into Units headed by Unit Managers assisted by Technical Officers and Field Assistants in irrigation and agriculture, respectively.

Of the 270 major and medium schemes, 199 have been included in the three programs and the remainder is located in high-security areas. Of these included schemes, 160 schemes are under MANIS. The Irrigation Department divides MANIS schemes into three classes based on the amount of effort expended to date. MANIS Class C schemes have had very little effort. Table 2 gives the distribution of major schemes among the three programs.

Table 2. Irrigation Schemes under the Three Programs

Program	Number of Schemes/Systems	Total Command Area (000 ha)	Average Command Area per Irrigation Scheme/System (ha)
Mahaweli	4	121	30,250
INMAS	35	197	5,629
MANIS	160	59	369
Total	199	377	

MAJOR FINDINGS AND FUTURE PROSPECTS

This section summarizes the major findings of the comparative analysis of participatory irrigation management and examines the future prospects.

- There has been good progress in establishing farmer organizations. FOs have been established in almost all parts of all of the INMAS and Mahaweli schemes. FOs also exist in most MANIS schemes. Overall, 85 percent of schemes in the three programs have FOs.
- The organizational strength of the FOs varies greatly among the schemes. FO strength in INMAS schemes is reasonably high; most farmers are members and most have the necessary management systems in place. FO strength in Mahaweli schemes is less successful but is improving with assistance from the MEA. FO strength in MANIS schemes varies greatly but the majority are rather weak. There has been less progress in establishing JMCs. JMCs exist in all INMAS and Mahaweli schemes but in only a minority of MANIS schemes. Overall, JMCs have been established in about 51 percent of the schemes in the three programs.

- The performance of FOs in water distribution, in general, is efficient. Similarly, JMCs have helped improve seasonal planning. It is widely acknowledged that participatory management has improved water distribution. Overall, farmers have shown themselves quite willing to take water distribution responsibilities.
- The performance of FOs and JMCs in maintenance is controversial. The work done by FOs, in general, is of high standard. It is quite probable that without FO involvement in clearing and desilting of the distributory canals, the quality of work would have been significantly worse because of the decreased maintenance budgets of the irrigation agencies.
- JMCs have relatively little direct involvement in maintenance, except in Mahaweli schemes. In Mahaweli schemes, JMCs are directly involved in maintenance planning at various levels, including prioritizing needs and allocating funds. In the other programs, JMCs serve mainly as a place for farmers to bring problems to the attention of the Irrigation Department.
- The strength and performance of FOs are affected strongly by some key factors. These include water availability, physical condition of the system and land tenure. Ethnicity and caste appear to have little effect. Outside interventions, occasionally have created problems.
- All three programs are using the INMAS model of FO as the basic form to be achieved. This is appropriate in INMAS and Mahaweli schemes. However, the physical structure, land tenure, and other factors in some MANIS schemes are such that the INMAS organizational model is not appropriate.
- The performance of JMCs in solving irrigation problems varies greatly among schemes and is dependent mostly on agency involvement. In INMAS and Mahaweli schemes, irrigation agency officers attend meetings regularly and respond reasonably positively to farmer initiatives at JMC meetings. The result is that JMCs in INMAS and Mahaweli schemes are effective in solving irrigation problems. In MANIS schemes, however, failure to hold meetings and less responsiveness of Irrigation Department officers makes JMCs less effective.
- JMCs are less effective in solving other types of problems. In INMAS and MANIS schemes, officers from agencies do not regularly attend meetings, and often do not pay attention to the farmer concerns expressed at meetings. Some agencies, such as the Department of Agrarian Services, have policies that hinder the ability to work with farmers through the JMC. In Mahaweli schemes, officers from other divisions of MEA attend the JMC meetings because it is the MEA policy. So far, however, MEA officers have not fully adapted to dealing with farmers through JMCs. Thus, in future, Mahaweli JMCs are likely to effective in solving many kinds of problems.
- A major organizational weakness that affects both FOs and JMCs is poor communication between FRs and their constituents. Another major problem for many FOs is weakness in managing money.
- Turnover comes in several forms. To date, several O&M activities have been taken over by FOs whether or not turnover is recognized. These activities include water distribution among and on field channels and the jungle clearing of distributory channels. On the other hand, recognized turnover, whether formally written into an agreement or not, has not proceeded very far; only in INMAS schemes has turnover been recognized by the government for a significant number of FOs.

- There is general confusion and controversy about turnover. First, except in Mahaweli schemes, there is no well-defined process for turnover, although a generally accepted set of stages can be discerned in practice. Second, there is strong disagreement about turnover of maintenance responsibilities. A vocal group of Irrigation Department officers, with support from many farmers, is opposing full turnover of responsibility for maintenance of distributory channels to FOs on the grounds that the farmers cannot afford it. No one seriously opposes turnover of operational responsibilities.
- Agency support for participatory management includes actions directed towards helping FOs and JMCs, such as providing catalyst agents and training. Where such direct support has been provided, it has proved useful and generally effective. The strength of FOs and JMCs is highly correlated with the direct support provided. However, support has not been provided equally to all schemes. INMAS schemes have had at least some direct support over 10 years; many have had a lot of support. Mahaweli schemes have hand strong direct support but only since reorganization in 1992-93. Most MANIS schemes have had little or no direct support.
- Agency support also includes working cooperatively with the FOs and JMCs and responding positively to their initiatives. Irrigation Department officers in INMAS schemes have gradually become more cooperative over time so that now they work well with FOs and JMCs. However, the officers of other agencies, except the IMD, do not yet work well with FOs and JMCs. MEA officers are now learning to work with FOs and JMCs. Overall, more progress is needed.

CONCLUSIONS – IMPACT OF PARTICIPATORY MANAGEMENT

Conclusions on the impacts of participatory management are the following:

- Most farmers perceived that they have benefitted from the participatory management, including improved relations with agency officials and improved water distribution as the main ones.
- The impact of participatory management on crop production appears to be marginal or nonexistent. However, improved water distribution brought about by participatory management may reduce the risks of cultivation, even in encroached areas. The value of this risk reduction cannot be easily estimated. However, over the long run, participatory management should help raise the average productivity.
- Overall, participatory management has had little discernible impact on farm income. There has been no increase in either yields or area cultivated; hence there has been no increase in salable production. Although participatory management has enabled many FOs to venture into agriculture-related businesses that have reduced costs of inputs and services to the farmer, the benefits have been limited to specific areas, and overall have not had a large impact. Diversification to more remunerative crops appears to be unrelated to participatory management.
- While government expenditure on O&M has, except for Mahaweli systems, generally decreased over time in real terms, participatory management does not directly cause this. Participatory management has reduced the workload of irrigation officials as well as

costs. The savings and the officialsí time may have been transferred to the O&M of main systems. In the long run, more attention to the main systems may increase the period between rehabilitations, thus reducing the overall cost of rehabilitation or the long-term costs of maintenance. More importantly, water distribution has improved and maintenance has at least remained at the same level, generally decreasing the real expenditures on O&M.

Findings indicate that adequate funding for O&M of distributory channels costs farmers less than 10 percent of the net farm income for a single season in most cases. Further, farmers would be able to make more efficient use of the resources and therefore accomplish the same amount of work for less funds than the agency. However, the farmers may not be willing to take over the additional burden of O&M. If profits from farming and particularly paddy farming declines, the conclusion reached that farmers can afford to take over O&M, may no longer be valid.

Overall, it is believed that the participatory management policy is moving in the right direction. Water distribution has improved and the maintenance has also improved. Despite the failure in achieving certain expected impacts, the benefits of participatory management in water distribution and potential to increase sustainability are sufficient reasons to continue the policy. However, there is a need to reconsider certain aspects of the organization and policy support.

12. THAILAND

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INTRODUCTION

Thailand is a tropical country located in the center of Indo-China Peninsula. It is bounded on the north by Laos, on the east by Vietnam and Cambodia, on the south by Gulf of Thailand and Malaysia, and on the west by Myanmar. The total land area is about 513,000 km^2, which consists of 25 river basins. Annual rainfall of the whole country ranges from 1,200 mm to 2,700 mm, with an average of 1,700 mm. The average annual runoff is 200 billion cubic meters (BCM), but only 38 million cubic meters (MCM) or 19 percent can be stored in reservoirs.

The population of Thailand, at present, is about 65 m inhabitants, and they create a demand of 53 BCM of water per year. The water is also used for industrial use, salinity control, including navigation etc. The demand for water in the next 10 years is estimated to be 70 BCM per year.

Within Thailand, there is a considerable variation in natural resources across the six major regions; the North, the Northeast, the East, the Central Plain, the West and the South. The topographic features of the country represent four main types of landform, i.e. highlands/ mountain ranges, undulating plateau, alluvial/flood plains, and coastal plains. There are many steams and rivers scattered throughout the country, the rivers being classified into 25 major river basins as shown in Table 1.

National development efforts in the past have been concentrated in the agriculture sector, because agriculture is the highest single source of income accounting for 25 percent of total income. In addition, employment and agriculture exports constitute 60 percent of the total foreign exchange earning of the country.

WATER RESOURCES IN THAILAND

The water resources of Thailand can be classified into two categories, surface water and groundwater.

Surface Water Resources

The total volume of water from the rainfall is estimated at 800 BCM, of which 75 percent or around 600 BCM is lost through evaporation, evapotranspiration and infiltration. The remaining 25 percent or 200 BCM constitute the runoff that flows in the various rivers and streams as shown in Table 2.

Table 1. Major River Basins in Thailand

(Unit: Km^2)

Region	River Basin	Total Area	Upper Watershed Area	Average Annual Water Volume
N	Salween	17,920	14,873	8,156
N	Mekong	57,422	10,514	15,800
N	Kos	7,895	4,452	5,119
N-E	Chi	49,477	6,531	8,035
N-E	Mun	69,700	2,300	21,767
N	Ping	33,898	17,762	8,116
N	Wang	10,791	39	1,429
N	Yom	23,616	7,557	1,430
N	Nan	34,330	13,354	9,581
C	Chao Phraya	20,125	403	4,925
C	Sakae Krang	5,191	841	519
C	Pa Sak	16,292	3,486	2,708
C	Tha Chin	13,682	944	2,815
W	Mae Klong	30,837	16,405	12,943
E	Petchaburi	10,481	1,362	4,502
E	Bang Pakong	7,978	631	4,900
E	Tonelesap	4,150	228	1,193
E	Eastern Coast	13,830	2,060	25,960
W	Petchaburi	5,603	2,740	1,410
W	Western Coast	6,745	803	1,013
S	Southeastern Coast	26,353	5,007	35,614
S	Tapee	12,225	2,543	17,380
S	Songkla Lake	8,495	2,013	7,301
S	Pattani	3,858	826	3,024
S	Southwestern Coast	21,172	10,057	9,981
Total		512,066	127,731	215,621

Sources: Royal Irrigation Department (RID), 1985 and 1993.

Table 2. Rainfall and Runoff in Different Regions

Region in Thailand	Catchment Area (km^2)	Average Annual Rainfall (mm/year)	Amount of Rainfall (MCM)	Amount of Runoff (MCM)
Northern	169,640	1,280	117,140	65,140
Central	30,130	1,270	38,270	7,650
Northeastern	168,840	1,460	246,500	36,680
Eastern	34,280	2,140	73,360	22,000
Western	39,840	1,520	60,560	18,170
Southern	70,140	2,340	164,130	49,240
Total	512,870	-	699,960	198,880

Groundwater Resources

Rainfall and seepage from the rivers mainly recharge groundwater system in Thailand. Previous hydrological balance studies had estimated that about 12.5-18 percent of rainfall infiltrates the soils and about 8.75 percent of rainfall reach the aquifers. However, this estimate is valid only for the basins under favorable geologic conditions such as those in the Northern Highlands, the Upper Central Plain and along the Gulf Coastal Plain.

In basins under unfavorable geologic conditions such as in the Lower Central Plain where Bangkok is situated, about half of the area is covered by thick marine clay, and in the Khorat Plateau where its central part is covered by impervious shale. It is estimated that only 5-6 percent of rainfall reaches the aquifer.

The first systematic government program for groundwater investigation and development began in 1955 in the Northeastern region where water shortages are critical for 6-8 months a year. The program objectives were to provide potable groundwater for rural water supply and to evaluate essential information required for proper development of the groundwater sources. Similar programs were later conducted in other regions throughout the country. The Department of Mineral Resources has long been involved in groundwater investigation. The Department has conducted studies and involved in groundwater development. Systematic investigations leading to the aquifer system analysis have been initiated recently, except for the Bangkok Metropolitan Areas where a program of detailed groundwater investigation and simulations have been made together with the monitoring of groundwater levels and land subsidence.

Groundwater is an important source of water supply in Thailand. Public water supplies for one-fifth of the nation's 220 towns and cities and for half of the 700 Sanitary Districts are derived from groundwater. It is estimated that 75 percent of domestic water is obtained from groundwater sources.

WATER RESOURCES DEVELOPMENT IN THE PAST

Systematic water sources development in Thailand was initiated in 1902 during the reign of King Rama V, starting with the construction of the diversion dam on the Chao Phraya River at Chainat and the canal system in the central plain. Subsequently, the construction of the Rama VI barrage with irrigation system on the Pasak tributary started in 1915, for irrigation and flood prevention. It should be pointed out that the dredging of the canal system in Chao Phraya delta helped improve the drainage of flood water in the central region, especially in Bangkok and other urban areas.

A milestone in the history of water resources development in Thailand was established with the construction of the Bhumibol reservoir as a multipurpose project on the Chao Phraya River in 1952. This multipurpose project designed for hydropower, irrigation, flood control and navigation improvement, has a total storage capacity of 13 BCM. This milestone marked the beginning of a major trend to build up storage capacity in continuing efforts of the national program to regulate the flow regime of major rivers of the country to maximize the benefits of the large flow fluctuation and minimize their adverse effects, particularly floods. During the period, several large- and small-scale water resources projects were constructed throughout the country, particularly on the major river basins, for power generation, irrigation and flood alleviation. In fact, water resources development was recognized as a major area of public investment in all the first seven Five-Year Development Plans (First through Seventh National

Economic and Social Development Plans, 1961-66). As a result of these national efforts, the storage capacity was built up in all the six regions as summarized in Table 3.

Table 3. Water Storage Capacity in the Regions

Region	Active Storage Capacity (MCM)	Percent of Annual Runoff	Remarks
Northern	13,960	21	(1) The percentage is expressed in terms of annual runoff locally generated.
Central	250	3	
Northeastern	7,780	21	
Eastern	470	2	(2) Storage capacity does not include those completed recently.
Western	11,090	61	
Southern	4,190	9	

Three categories of water resources development projects were implemented: large-, medium- and small-scale, throughout the country (Table 4).

Table 4. Characteristics of Water Resources Development Projects

Size of Project	Investment Cost (฿ million)	Storage Capacity (MCM)	Water Surface Area (km^2)	Irrigation Area (ha)	No. of Project
Large-scale	>200	>100	>15	>12,800	90
Medium-scale	<200	<100	<15	<12,800	825
Small-scale	>4	-	-	-	8,550

Recent Efforts in Water Resources Development

During the past 10 years, there was a major shift in the approach to water resources development and the focus was on the construction of small-scale projects instead of large- and medium-scale projects. This change was necessary because of the rapidly increasing requirements to minimize adverse environmental impacts and also of the difficulties in finding appropriate construction sites for large-scale projects that would make investment attractive and viable. Thus, large number of small reservoirs, weirs and ponds, up to about 17,600 projects, were constructed throughout the country with a total storage capacity of around 1,700 MCM.

In addition, storage capacity was further enhanced with works on river training and management such as channel improvements and modifications of natural water bodies, which had become shallow over the years. In this line of action, more than 4,000 projects have been undertaken for water storage and flow retardation, with a total storage capacity of 240 MCM.

In fact, the above-mentioned measures represented a new conceptual approach towards integrated water resources management in Thailand. Within this integrated framework, complementary measures for integrated river basin management undertaken by the government including the following:

– Protect and conserve upstream forest areas so that the forest will help increase deep percolation of water and retard runoff from storm waters.

- Improve hydraulic management of upper catchment areas by constructing cheeked dams to reduce and soil erosion as well as to increase the soil moisture.
- Improve land-use control in the catchment and slope areas to prevent soil erosion by building terraces and cultivating vetiver grass to impede the water flow and reduce sedimentation problems which would normally lead to silting up river channels in the downstream areas resulting in flooding.

WATER RESOURCES MANAGEMENT AND PROBLEMS

In the past, Thailand did not pay much attention to water resources management because water had been abundant and one could have easily obtained almost any amount of water from the rivers, lakes, canals and rainfalls. Most of water programs were then dedicated to water resources development. Such a trend continued even when the population had rapidly increased over the past few decades and economic activities had significantly expanded. This resulted in a lack of sound water resources management practices. Although many water resources development programs have been implemented continuously for more than 80 years, water demand generated for all purposes exceeds supply because of rapid rural development, industrialization, expansion of tourism, and deteriorating water quality due to excessive use of fertilizer and pesticides, urban sewage etc. Water supply to the industries also confronted with problems of availability and adequacy.

Water resources planning, development and management is critical to sustain future economic growth in Thailand. Water resources play – and will continue to play – a fundamental role in meeting the growing demand for domestic water consumption, agricultural and industrial production, hydropower and in the tourism sector.

During the critical periods such as flood and drought in river basins, the Cabinet usually set up an *ad hoc* committee to manage the water resources for the benefit of all users in the basins. The National Water Resources Committee (NWRC) is the secretariat office, which has the responsibility of coordinating with other agencies concerned. Planning and allocation of water or the management procedures are discussed below.

Agencies Involved

There are 32 agencies involved in water resources development and management. However, the major responsibility is shared among the following 10 agencies that deal with water resource development and utilization, as well as related scientific activities: the Office of National Water Resources Committee (ONWRC), RID, Electricity Generating Authority of Thailand (EGAT), Bangkok Metropolitan Administration (BMA). Public Works Department (PWD), Department of Local Administration (DOLA), Thai Meteorological Department (MD), Harbor Department (HD), Port Authority of Thailand (PAT), and Ministry of Science, Technology and Environment (MOSTE).

The organizational structure of irrigation administration in Thailand is illustrated in Figure 1.

Concept of Water Management

In the past, water resource development was primarily for irrigation purposes and the project staff did water management. Water management was governed, not only by the design criteria, but also by the fluctuation of climatic conditions. The activity was not so complicated and was concentrated mainly in the wet season, especially in the irrigation projects, which have been operated by the staff of the RID. Each project depended on its water availability, therefore in the dry season, most of the project activity was shut down, according to the available water. Hence, the control of water allocation was not quite necessary.

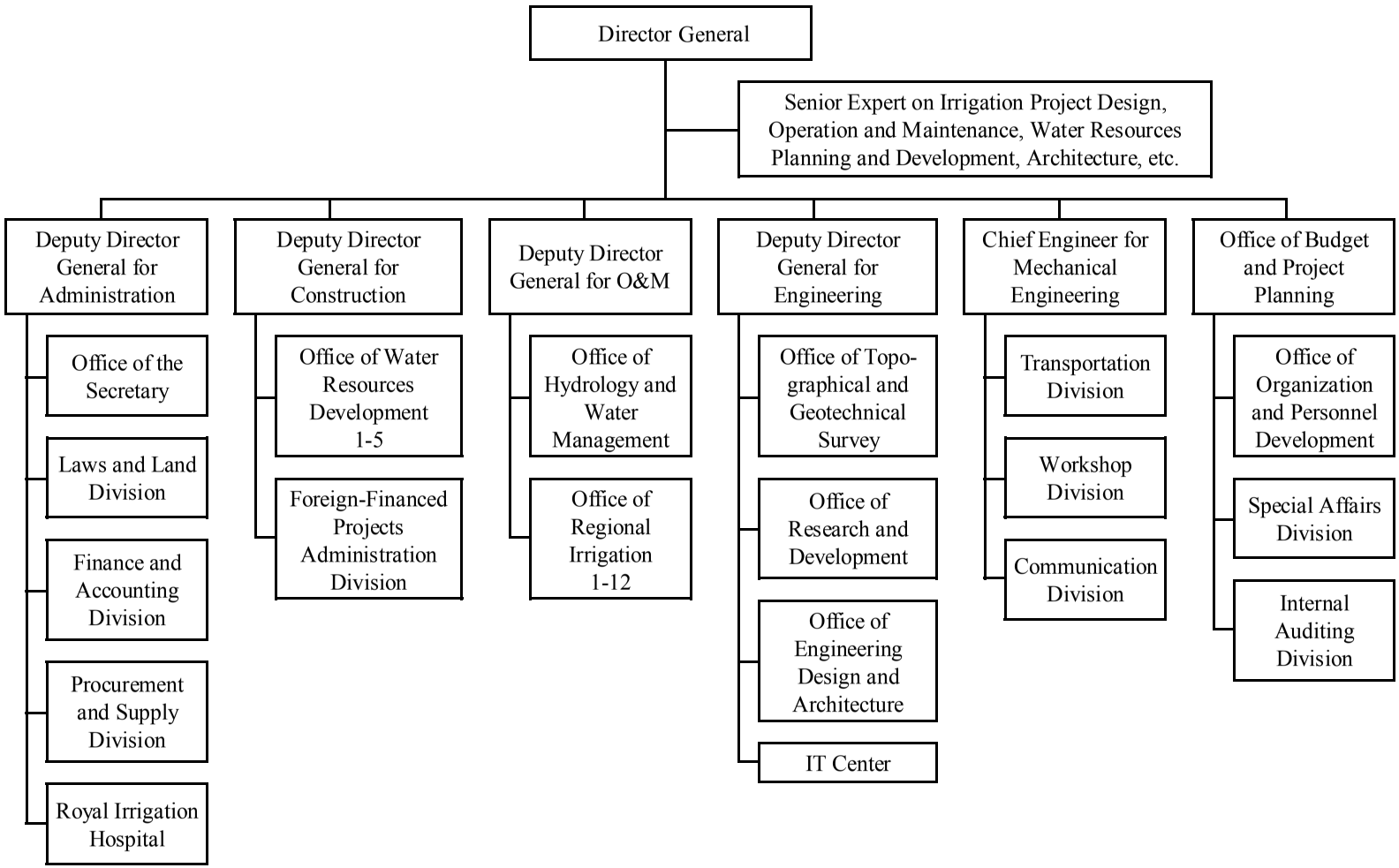

Figure 1. Present Organizational Setup of Irrigation Administration in Thailand

To carry out activities on water management, the RID has now divided its personnel to work at two levels:

1. ***River Basin Level***

Water allocation has become a complex activity, especially after the completion of: i) the largest and the most complicated irrigation system of the country i.e., the Greater Chao Phraya Irrigation Project, in the central plain in 1957 (which covers the Chao Phraya River Basin); ii) the first and the largest storage work, Bhumipol Dam (1964); and iii) the second storage work, Sirikit Dam (1971) in the upper reach of the basin. This was because the water allocation for each project for multipurpose utilization is a difficult task. Consequently, the Water Operation Center was established in 1967, in order to implement the national policy decision on water crisis as well as for the routine water allocation serving multipurpose requirement. The Center collects, processes and analyzes real-time data and information on climate, hydrology, crop condition etc., and formulates the water allocation schedules on weekly, monthly and seasonal basis for execution, both in normal and critical conditions. The performance has been found satisfactorily, especially under the critical conditions i.e., during floods and droughts.

2. ***Field Level***

In Thailand, there are 12 regional irrigation offices and each Regional Irrigation Director supervises a number of projects. A project engineer who is assisted by one or more water-masters manages each irrigation project. A water-master is in charge of an area of 16,000 ha and supervises a number of zone-men and gate tenders. Zone-men supervise irrigation in a zone of approximately 160 ha and gate tenders are in charge of a structure, e.g. a headwork, cross-regulator or an offtake regulator. Besides the zone-men and gate tenders, there are administrative and maintenance personnel. Special mention should be made of the hydrographer, a clerk in charge of the inventorying and processing of hydrological data. The regional engineer, the project engineer, water-masters and clerical staff of a project are stationed at the project headquarters located near a headwork. Zone-men and gate tenders are housed near the zone of the structure, for example the gate under their command.

Problems of Water Resources Management

1. ***Government Policy***

Government policy did not have sufficiently clear guidelines on water sector management and practices to be adopted. Emphasis had always been placed only on the development of water resources and the provision of water. There were no master plans for water resources management in river basins.

2. ***Institutional Problems and Constraints***

Problem of fragmentation prevails in water sector management. There are more than 30 executing agencies in 11 ministries working in water resources development and furthermore, seven national committees involved in this field. This makes things complicated and even confusing. Even there are too many executing agencies dealing with water resources, there is no river basin organization to work out water resources development and integrated water management of the basin.

3. ***Budgeting***

The annual budget is allocated to each agency, based on individual requests by respective agencies. Such a process is not oriented towards problem-solving in those areas and

does not address water resources management issues in a holistic manner. Moreover, it usually leads to inefficiencies in implementation.

4. ***Legal Framework***

There are several acts concerning water resources but not even one directly relates to water resources management. In order to properly address the increasing problems of more complex requirements of national development, it is necessary to draft a law on water resources management.

5. ***Availability of Information***

Because of the relative large number of implementing agencies, information on water resources development scatters all around. This fact makes it difficult to establish plans for efficient water resources development and management. Similarly, it is also difficult to formulate good new projects under such circumstances.

ENVIRONMENTAL CONSIDERATION

Water quality is one of the most important parameters indicating the environmental situation in the country. In order to compare the level of degradation, the overall water quality in the 25 basins was surveyed in 1993-94. The survey examined the criteria adopted for measurement, the differences of the measured results of various agencies etc. Altogether 45 physical and chemical parameters, 25 pesticide/insecticide/herbicide parameters, two biological parameters and 12 heavy metal parameters were measured. The results were interpreted and compared with the standard values of the National Environmental Board of Thailand in order to classify water quality in various natural waterways. However, the number of parameters measured and the timing of measurement varied depending on the agencies that performed the measurement. The overall results indicated that urbanized areas have major impact on water quality in the natural rivers. In Bangkok itself, more than 70 percent of the present water pollution is due to domestic discharge. Among the 25 basins, the study showed that six major river basins namely: Mae Klong, Chao Phraya, Tapi, Songkhla, Chi and Mae Khong river basins, with large command areas of irrigation and with large number of population, were poorly degraded.

The study on water quality in the Chao Phraya river basin covering one quarter of the area of the country was the most extensive task so far done in the country. Thirty-two sampling stations were located over 380 km from the river mouth. The results indicated a significantly poor water quality due to 2,300 industrial sites located downstream of the region of river mouth. Salinity values were found to be less that 2 ppt., as a result of wastewater being discharged from Bangkok dwellers into the Chao Phaya River and pushed back the salinity wedge.

The study also showed insufficiency of number of water quality parameters measured in the major river whereas the redundancy of measured parameters were observed in the smaller rivers and of lesser importance. This helps the environmental agencies to prioritize the basins in terms of quality degradation and the water quality protection required. The knowledge on water quality can assist the planners and the operators to manage water resources in each basin in a better way. The government, presently, provides a budget for central water treatment plants for every province in the country. Also, the control of water quality in the drainage canals before releasing into the natural waterways is more emphasized. Furthermore, the study recommended the systematic basin wide planning of water quality stations in coordination with hydrological gauging stations as to obtain meaningful and correlated data of both water quality and quantity as well as to reduce the cost and manpower

required. The coordination among concerned agencies in terms of parameters measured, location and timing of measurement is very important in order to arrive at meaningful and useful results.

PARTICIPATORY IRRIGATION MANAGEMENT

There are several factors, which point to the need for farmers to participate more in the management and cost-sharing of irrigation systems in Thailand. These are:

- Government budgetary constrains;
- Recurring deferred maintenance;
- Rising competition for water and agricultural land;
- The need to increase profitability of irrigated agriculture; and
- The need for more efficient and demand – responsive water delivery.

International experience indicates that in order to be effective and sustainable, participatory irrigation management (PIM) must include true empowerment of water users organizations (WUOs). It also requires the reorientation of the irrigation agency toward a new partnership with its clients, the water users. This normally involves a shift by government away from direct implementation of O&M toward provision of technical support services and incentives to build organizational capacity of water users. PIM also can better enable farmers to diversify agricultural production, develop cooperative marketing and increase the profitability of irrigated agriculture.

PIM should be designed so that farmers, government, and the private sector will all be mutually motivated to invest in the productivity and sustainability of irrigation systems. And new patterns of investment in irrigation will need to be more cost-effective than government-dominated strategies of the past. Because of the critical importance of adequate farmer incentives, PIM should be comprehensive. This will probably require changes in the following seven areas:

a. Governance of irrigation systems;
b. Provision of O&M services;
c. Cost-sharing for irrigation;
d. Maintenance and rehabilitation of infrastructure;
e. Water and land use rights;
f. Means for making agriculture more profitable to farmers; and
g. Capacity of farmers to develop cooperative agribusinesses.

Previous Experiences with PIM in Thailand

Over the last two decades several pilot experiments have been implemented in Thailand. Community Organizers (COs) were recruited to work directly with farmers to establish and strengthen water users associations and promote their participation in the O&M of tertiary units of medium- and large-scale irrigation systems or entire small-scale irrigation schemes.

Essentially all of these pilot experiences of using COs to create and strengthen water users associations have failed to produce sustainable, self-reliant WUOs. Pilot PIM interventions have sometimes succeeded for a time but farmer organizations and artificial government "partnerships" with them have all collapsed after the end of the projects. Like government construction projects, pilot interventions for PIM have also been over-designed.

They typically adopt approaches, which are too intensive, costly and impractical for replication on a national scale. An example of this is the recruitment of university-trained COs to work intensively in only one or two tertiary units, or a single small-scale scheme, for 18 months to two years.

The following is a summary of reasons for the failure of previous efforts aimed at promoting PIM and WUOs:

- WUOs were never empowered with legal status or the authority to define what services they would get or to decide who would provide it.
- WUOs did not federate to have a voice in main system management.
- COs were only deployed temporarily and did not reach a structurally strong position.
- COs could only be deployed in a few locations.
- Many Turnout Groups (TOGs) were created in an "*ad hoc*" manner and did not develop into strong organizations.
- Lack of training for water user leaders.
- The government paid the full cost of main system O&M and rehabilitation.
- RID maintained a top-down, command-oriented approach toward farmers.
- RID was not involved in strengthening, training, and supporting WUOs as a normal function of their program.
- There were no organizational incentives for RID staff to work with farmers.
- RID continued to deliver water to TOGs whether or not they cleaned field ditches prior to the irrigation season.

Figure 2 summarizes the suggested roles and relationships between different actors involved in PIM, from national to farmer levels. Table 5 summarizes the activities and responsibilities to be performed during each of four stages of implementation of PIM. The fifth would be "post-transfer, support and consolidation stage".

CONCLUSIONS

The recurrent drought situation which occurred in Thailand in the last few years, together with the chronic problem of inadequate coordination among water resources development agencies had stirred the government to prepare a plan for the future to cope with the similar problems and to optimize the use of national water resources. Studies revealed that demand for agricultural use was 92 percent in 1993 and it would become 88 percent in 2006. There will be other competing demands. Among the 25 basins, the studies showed that six major river basins with large command areas of irrigation and large number of populations were poorly degraded. Critical basins were identified and prioritization of project plans was also made.

Base on such studies, the RID prepared her own master plan by involving participation of local staff in identifying local needs and thus re-prioritizes projects in the potential development plan. Based on this experience, it is suggested that PIM should be designed to motivate all the actors, namely, farmers, government, and the private sector, to invest to enhance the productivity and sustainability of irrigation systems. And, new patterns of investment in irrigation will need to be more cost-effective than government-dominated strategies of the past.

Environmental profile survey in Thailand indicated major problems include deforestation, water pollution, solid waste disposal, air pollution, social problems, etc. In order to respond to national policy on sustainable development, these problems require delicate countermeasures.

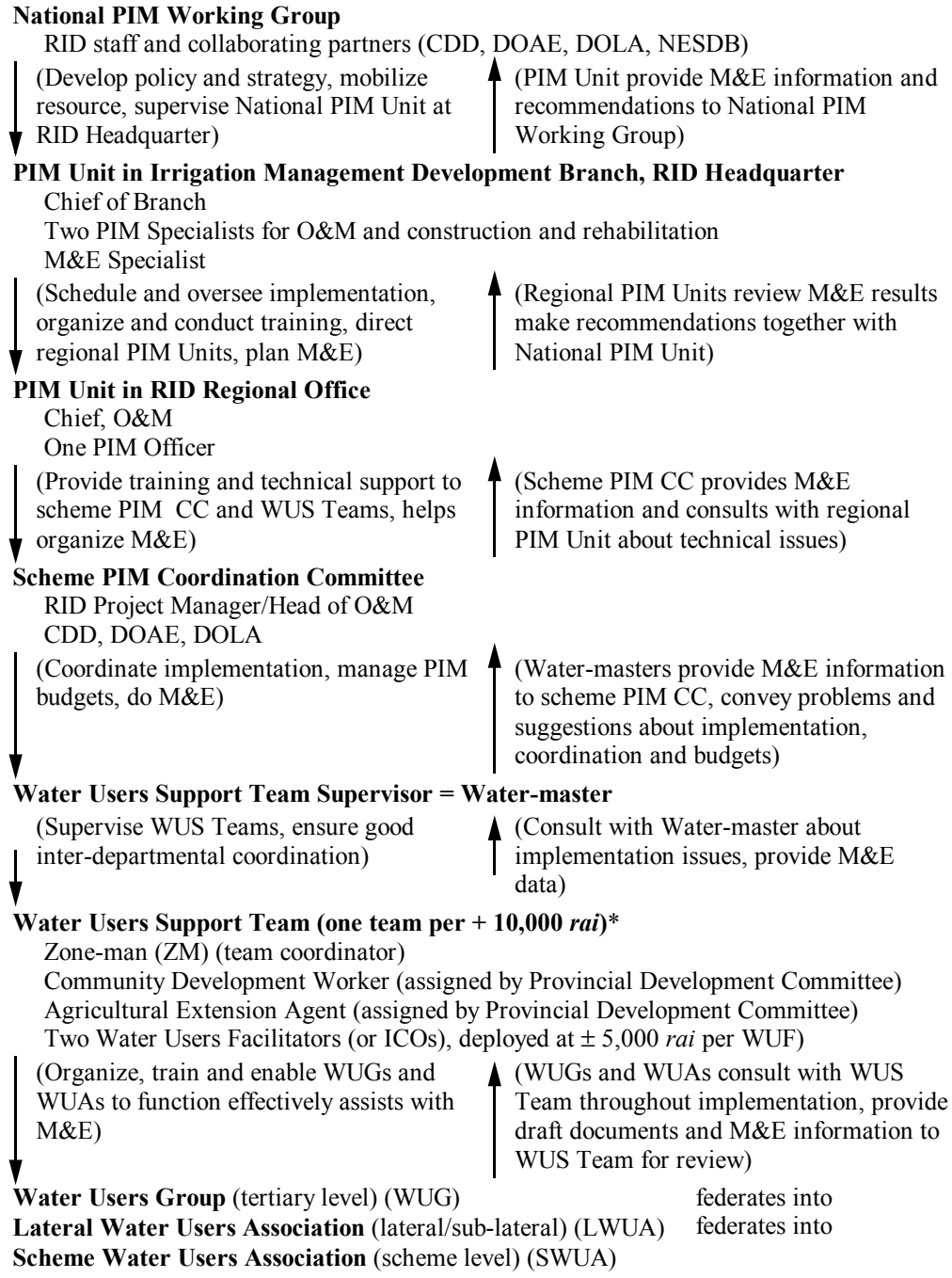

Figure 2. Proposed Structure for Implementing PIM

Note: * 1 ha = 6.25 *rai*.
CDD = Community Development Department; DOAE = Department of Agricultural Extension; NESDB = National Economic and Social Development Board; M&E = Monitoring and Evaluation; and CC = Coordination Committee.

Table 5. Proposed Plan for Implementing PIM

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Stage	Orientation and training	Organize WUGs and LWUAs	Joint management of lateral canals	Joint mgt. of scheme	Reinforce SWUA
Duration	Six months	One year	Two years	Two years	Two years
Period	9/2000-2/2001	3/2001-2/2002	3/2002-2/2004	3/2004-2/2006	3/2006-2/2008
WUG		Organize	Build capacity	Build capacity	WUG initiative.
LWUA		Organize	Lateral Mgt. Board Joint Mgt. and transfer	Build capacity	LWUA takes initiative.
SWUA			Organize	Scheme Mgt. Board. Joint mgt. and transfer. Start capital reserve fund.	Fund capacity new staff/ service provider finance plan.
RID	Orientation and training	Orientation Training	• LWUA transfer agreements. • Gate tenders (GT) -> LWUA. • RID retirees not replaced. • Training for IRIF and audits.	SWUA transfer agreement IRIF and audits IRIF budget allocation GT&ZM -> SWUA RID retirees not replaced.	• Strengthen IRIF and audits. • Declining O&M cost-sharing for main system. • IRIF budget allocation.
Ministry of Agriculture and Cooperatives and DOLA	Orientation and training		• IRIF budget request. • Training for IRIF/audits. • Agricultural development and marketing support.	• IRIF budget allocation. • Start IRIF and audits. • Agricultural development and marketing support.	• IRIF budget allocation. • Strengthen IRIF and audits. • Agricultural development and marketing support.
WUS Team	Training and planning	Organize WUGs and LWUAs	• Support WUG/ LWUA. • Organize SWUA.	• Support SWUA and LWUA.	Support SWUA and LWUA.
Policy and Planning Level	• Plan budget, IRIF, PIM posts, RID restructuring. • Land tax analysis • Set up M&E.	• Legal reform for land tax service levy. • Plan IRIF, PIM posts, RID reform. • M&E.	• Legal reform for land tax. • Allocate IRIF budget. • PIM posts. • RID reform • M&E.	• Allocate IRIF budget. • RID reforms. • M&E.	• Allocate IRIF budget. • M&E.

13. VIETNAM

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INTRODUCTION

Overviews in Vietnam's Water Resources

According to the current statistics, the population of Vietnam is quite large, about 80 million people of which about 70 percent living on agricultural occupation. Main hydraulic works consist of 743 large- and medium-scale reservoirs; 2,000 pumping stations for irrigation and drainage with 10,000 pumps of all kind. Sine early 1990s, Vietnamese Government has specially focused on the development of agricultural production including the water sector. Some existing policies have been amended, some new ones have been promulgated such as Ordinance on hydraulic works protection and utilization, Agriculture Law, in addition, Law on Water Resources has created a legal framework to develop the water sector.

The upgrading and rehabilitation of existing irrigation systems irrigating for nearly six million ha of annually cultivated area have contributed to increase the food output by 33.8 million mt in 1999. Notably, total rice exports for nine years from 1989 to 1997 was 18 million mt, but in 1999 alone, 4.55 million mt have been exported.

According to survey and assessment of the Ministry of Agriculture and Rural Development (MARD), currently irrigation schemes perform only about 60 percent of the designed capacity. Especially, the performance of small-scale irrigation schemes in the mountainous area is less than 50 percent. The major reasons causing low efficiency of irrigation schemes are: a) many of them have been in operation for years, but insufficiently rehabilitated; and b) investment for irrigation schemes has not been properly planned.

Emphasis on Institutional Arrangements in Water Management

At present, it has been affirmed in many conferences that the efficiency and sustainability of irrigation schemes would depend mainly on institutional arrangements. The appropriate management form in water sector would create the potential for saving water, reducing operation and maintenance costs, insuring safety operation and, increasing production and profits. Following this judgment, the scope for effective water management in irrigation schemes has been determined. Functions and duties as well as organizational mechanisms for water management entities also has been developed and documented. For example, such arrangements are spelled out in "the instruction of institutional arrangement of water management", which has been issued recently. The government has concentrated on issuing new policies that encourage the participation of farmers in the management and utilization of hydraulic works. However, it is useful to examine what is actually mean by "participation of

farmers in water management". This paper addresses this issue and illustrates a participatory approach implemented in one of the irrigation schemes in Vietnam.

PARTICIPATORY IRRIGATION MANAGEMENT (PIM) IN VIETNAM

Current Situation of PIM Development

The PIM has been developed in Vietnam since 1980s by some projects funded by NGOs. Especially there were projects of PIM formulated in Nghe An and Thanh Hoa provinces. Models of water management organizations in irrigation schemes are basically formulated on the basis of physical works – type and scale and the command area serviced by the irrigation schemes. Practically, there are many forms of on-farm water management institutions such as water management groups formulated by agricultural cooperatives, water users cooperatives that are responsible for irrigation with the extent from "2 and up" cooperatives, water users associations or water users advisory committee. Since 1995, there have been many water management organizations with the participation of farmers at the farm level, established in some provinces such as Thai Nguyen, Tuyen Quang, Nghe An, and Thua Thien Hue. These institutions have achieved a great success. In early 1999, MARD promulgated a decision to set up PIM office in Vietnam.

In general, participation of farmers in water management in these institutions is relatively similar to each other. Farmers are usually attended in meetings and discuss issues such as operational regulations, water fee as well as electing the Management Board of the new organization. Still, other important issues of the water management organization are stated in its cooperative congress.

In regards to irrigation works supported by funding from international institutions in some localities, besides activities mentioned above, farmers are actually participated in technical and management training courses. Especially, projects supported through external funding for upgrading and rehabilitation of existing irrigation works, has been involved in farmer participation. The performance of these water management organizations is relatively stable and more sustainable.

Currently, in Vietnam there are three models of on-farm water management organizations, namely:

- Those formulated by competent agencies;
- Those formulated and established on the basis of discussion and agreement of farmers; and
- Those developed by the agreement and consensus of farmers and incorporated with competent institutional levels.

At present, the last model has dominated in many area of Vietnam.

Benefits Gained from the On-farm Water Management Model in Vietnam

The major benefits of this model are as follows:

a. To change the negative attitude of farmers and their dependency on outside support;
b. To pave the way for new institutional arrangements in managing irrigation schemes and draw positive experiences for the extension of this model;

c. Improved irrigation works as well as efficient operation and water distribution have contributed to increase crop production and yield, even though irrigated area could be extended as in canal N4 B in Nghe An;
d. To find out in a timely manner repair the damaged physical structures in order to prevent the deteriorated status of these works;
e. To collect water fee timely and sufficiently; and
f. To develop community activities for farmers.

Limitations in the Development of the Model

Despite the fact that MARD has promulgated general policies on the development of the on-farm water management model, there were no specific papers to instruct the formulation of this model. Moreover, there are many constraints for the development of on-farm water management model. Such limitations are listed below:

a. Farmer's awareness about appropriate management transfer is limited.
b. There is lack of the cooperation between existing PIM organizations in Vietnam.
c. There is no adequate support from the government for the formulation of PIM organizations (support for rehabilitation structures before transferring and assisting in crop failure etc.)
d. Education level of the local management officials is low, therefore, they could not successfully outline the action plan and instruct appropriately.

AN EXAMPLE OF PIM IN VIETNAM

This section describes a PIM case in Vietnam. This particular exercise was conducted to establish institutional arrangements to improve water use efficiency in secondary canal N5 in La Khe irrigation system in Hatay province.

La Khe is typical of many pumped irrigation systems the in the Red River Delta. The scheme irrigates an area of approximately 5,600 ha accounting for 46 percent of designed area, and has a population of some 20,000 people. The system has a main canal with a length of nearly 23 km and a pumping station with six pumps (capacity of 2,100 m^3/hour of each). An important problem is uneven and untimely distribution of water throughout the system. Farmers near the main pumping station have ready access to water and tend to waste it. One trial estimated that some of them were taking up to five times more than they needed, while farmers who are far away from the main pumping station often fail to receive sufficient water to meet their crop demands. Part of this problem stems from inadequate management and control arrangements, and part stems from the poor condition of water delivery infrastructure.

Management and control issues include technical and institutional aspects. While the poor condition of system infrastructure, relating to the inability of the irrigation company to raise sufficient revenue to fund an adequate maintenance program, farmers often cannot, or do not pay the fees levied. Moreover, the amount levied is insufficient, as traditionally there has been an expectation that the government would subsidize operations and maintenance.

Traditional Management Structures

The traditional approach has been for the La Khe Irrigation Company to distribute water to each cooperative. Water management groups within cooperatives would assess farmer's

seasonal water requirements and submit these to the La Khe Company. The Company would deliver water to the appropriate secondary canal, and would bill each cooperative for water use according to an area-based formula which incorporates a differential fee schedule according to the ability to deliver water to fields by gravity or not. This management arrangement works reasonably well when there is only one cooperative on a secondary canal.

The problem in La Khe is that, in general, there may be up to four cooperatives receiving water from a secondary canal. There has been a tendency for a "first come first serve" rule to operate, so farmers near the head of the secondary canals get most of the water, to the detriment of those downstream. Cooperatives sharing access to the same secondary canals have generally operated independently of one another, in respect of water ordering and in resolving issues of common concern, such as identification of canal maintenance needs.

Institutional Arrangement to Improve Water Use Efficiency

1. ***New Management Structures***

During the implementation of research project, it was agreed that new management arrangements were needed to address problems in water management in secondary canals irrigating for 2 and up cooperatives. An institution called Water Users Associations (WUAs) was established in three secondary canals of the La Khe system: one at the top; one in the middle; and one towards the bottom (Figure 1).

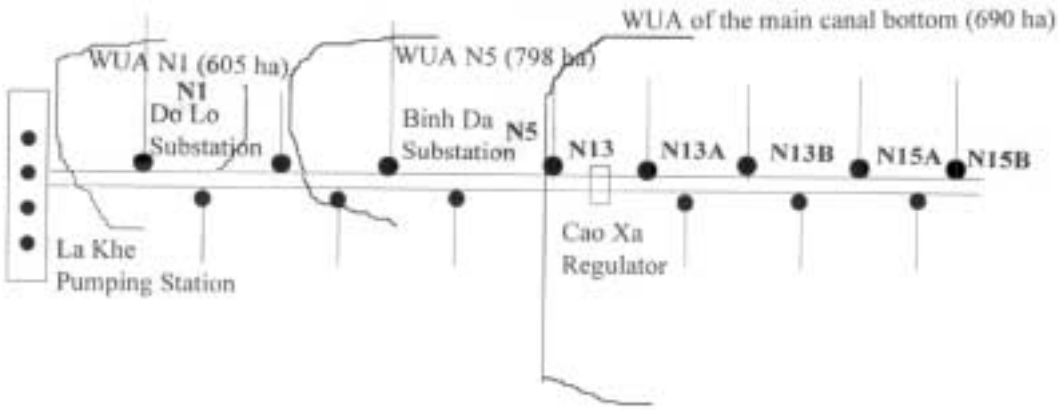

Figure 1. Spatial Distribution of Water Users Associations

At present, there are three pilot forms in La Khe irrigation system:

(i) WUA N1 consists of five water users cooperatives with six representative (one of Do Lo substation);

(ii) WUA N5 consists of six water users cooperatives with seven representative (one of Binh Da Substation); and

(iii) WUA of the main canal-end consists of five water users cooperatives with six representatives (one of Cao Xa Substation).

A charter was developed up for these WUAs, which spelled out their structure and duties. Essentially, the committees comprise members of each cooperative, which draws water

from the same secondary canal, and a representative from the La Khe Company. Their duties are as follows:

(i) To meet periodically to assess the forthcoming water needs of all farmers along the canal and advise the La Khe Company;
(ii) To develop and monitor water distribution arrangements; and
(iii) To assess and advise to La Khe Company on infrastructure repair and maintenance needs.

These duties are discussed and outlined collectively. These WUAs function on the spirit of voluntarism, without formal legal status and budget.

2. ***Effects of WUAs***

(i) Irrigation schedule is outlined before irrigating.
(ii) Put an end to conflicts between cooperatives during irrigation periods.
(iii) Cooperatives located in the bottom of secondary canals also are irrigated as irrigation schedule. Water distribution becomes more favorable and members of water management group of these cooperatives need not go along the canal for monitoring during irrigation (as previously when WUAs were not in existence).
(iv) The understanding between cooperatives and between farmers is established, therefore, water distribution is more favorable and efficient.
(v) Increase gravity-fed area for cooperatives at the bottom of canals.
(vi) Some reaches of canal or structures on canals which were broken or deteriorated were timely upgraded reducing the delay of waiting for approval from higher levels.
(vii) Water fee collection is higher, notably there were some cooperatives which could pay the debt in the past (e.g. Binh Minh and Tam Hung communes).
(viii) In three pilot WUAs in La Khe system, the WUA in canal N5 is appreciated as the most effectively operation one. Members of this WUA have proved their ability in on-farm water management. So far, the management transfer of canal N5 to its WUA has taken place. This means, WUA of this canal has a formal legal status and its own budget for all the activities related to water management.

WUA of Secondary Canal N5

Secondary canal N5 is located in the left bank of main canal, it is about 10 km from La Khe pumping station. Physical structure of this canal was the regulator N5. The length of the canal is about 5,600 m. Canal N5 covers an area of 789 ha, which is mainly under wet rice.

The main objectives of the water management transfer are to improve awareness of farmers on water management, water use efficiency, ensure the equality in water distribution and create an sufficient budget for operation and maintenance of the canals.

1. ***Steps to Transfer the WUA N5***

Steps established and undertaken to transfer management of WUA N5 are given in Table 1. At present, management transfer of WUA N5 has been implemented in four steps. As planed, the transfer would be completed in December 2000. It is expected that, in the spring season of the year 2001, another PIM model would be available and that will be the first model of PIM in the Red River Delta.

Table 1. Steps to Transfer Management of WUAs in Canal N5

Steps	Objectives	Actions Taken
(1) Prepare plan and submit to district and province	– The plan to be accepted by province, district and persons who will support finance. – The plan to be accepted by the farmers who will contribute their money and labor to carry out the plan.	– Discuss these problems with the leaders of district and province, and with La Khe Company. – Discuss with the leaders of villages, cooperatives, members of WUA N5 about the problems. – Prepare and finalize plan. – Present the plan to the leaders of district and province.
(2) Assessment of the real situations of N5	– To know the advantages and disadvantages of N5 management. – Determine the volume of water which to be carried by N5 canal. – Counting water fees for N5 (check the adequacy of funding for paying for repairing, WUA, fees ...)	– Survey group is established. – That group discuss to find out goals and methods. – Training for survey group. – Carry out the survey: • Irrigated areas. • Number of each kind of irrigation structures on N5. • Number of field irrigation structures and field canals. • Water requirement. – Data collection and determine the amount of managing labor on N5. – Data collection and calculate total financial requirement for annual repairing.
(3) Establish a project group	The group has the ability to help the farmers to solve the problems and capable of carrying out water management model.	– Establish a project group (there are about 20 members): province, 1; district, 1; La Khe Company, 2; sub-irrigation, 1; WUA/cooperative, 6; leaders of village, 6; and social group, 3. – Training for project group on: • What is WUA? • Steps to establish WUA. • Define the structure and composition of WUA. • Define the WUA members' standards. • Define irrigation schedule.

... To be continued

Continuation

Steps	Objectives	Actions Taken
(4) Project group and the farmers develop the action plan to establish WUA	– Establish WUA. Select leaders. a) The farmers will be helped to define a suitable mechanism for irrigation system management. b) The farmers will partici-pate to carry out the internal regulation of WUA and they can elect their leaders to WUA. – Irrigation system will be repaired. The farmers contribute labor and materials to repair canal.	– Meetings with each cooperative: a) Discuss with the farmers about kind of WUA and obtain farmers' opinion and their responsibility. Distribute irrigated areas and the farmers who belongs to the areas will elect their representative to come to second meeting. b) Discuss the documents, policies, and regulations of WUA activities. c) To elect WUA manager and irrigation group. d) WUA manager discusses about canal, structure repairing volume and distributes for each farmer group.
(5) Training of WUA's members, irrigation groups and pump workers	All the members of WUA, irrigation groups and pump workers have a good knowledge on irrigation management and that gives the farmers' satisfaction.	Training to be carried out, e.g.: – Scheduling irrigation. – Irrigation management: irrigation and drainage method, plan for water distribution on N5. – Water fees management. – Working order of pump.
(6) To help the farmers to establish a irrigation management model	The farmers can establish a irrigation management model by themselves and determine the amount of water fees.	WUA plan to spend of water fee. Discuss with the farmers about water fee problems.
(7) Farmers enter into a water use contract with WUA	– One hundred percent farming families who used water on N5 canal are contracted with WUA. – One hundred percent farming families willing to pay their water fee.	– WUA members complete concerned documents and prepare for water use contract. – The farmers sign the water use contract with WUA. – WUA members collect water fee in first season. – Draw the balance sheet of water fee. – Communication about water use fee and prepare the plan for next season.

1. LIST OF PARTICIPANTS, RESOURCE SPEAKERS AND SECRETARIAT

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2. PROGRAM OF ACTIVITIES

(23 - 27 October 2000)

Date/Time	Activity
Mon., 23 Oct.	
Forenoon	Opening Session Presentation and Discussion on Topic I: *Recent Developments in Irrigation Management in Asia and the Pacific* by Dr. Randolph Barker
Afternoon	Presentation of Country Papers by Participants
Tues., 24 Oct.	
Forenoon	Presentation and Discussion on Topic II: *Improving the Irrigation Service to Farmers: A Key Issue in Participatory Irrigation Management* by Mr. Thierry Facon Presentation and Discussion on Topic III: *Participatory Irrigation Management in the Philippines: Issues and Constraints* by Mr. Avelino M. Mejia
Afternoon	Continuation of the Presentation of Country Papers by Participants
Wed., 25 Oct.	
Forenoon	Presentation and Discussion on Topic IV: *Role of Water Users Associations for Sustainable Irrigation Management* by Mr. Benjamin U. Bagadion, Sr. Presentation and Discussion on Topic V: *Requisites of Organizational Change for Improved Participatory Irrigation Management* by Dr. C. M. Wijayaratna
Afternoon	Continuation of the Presentation of Country Papers by Participants Workshop: Issues and Recommendation on Participatory Irrigation Management
Thurs., 26 Oct.	
Forenoon	Case Presentation by Engr. Emmanual S. Sunga, Irrigation Superintendent Dialogue with NIA officers/IA members Visit Sta. Maria Mayor River Irrigation System (irrigation site)
Afternoon	Case Presentation by Engr. Romeo R. Anonuevo, Provincial Irrigation Management Officer Dialogue with IA members Visit San Benito Communal Irrigation System (irrigation site)
Fri., 27 Oct.	
Forenoon	Evaluation and Summing-up Session Closing Session